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SATELLITE Markets & Research

Industry Trends, News Analysis, Market Intelligence and Opportunities

Change, Innovation and Flexibility

by Elisabeth Tweedie

The key themes emerging from the three major conferences held in Europe this September, (World Satellite Business Week, IBC and VSAT Global and Next Generation Satellite Applications), were: change, innovation and flexibility. Change is all around. Change for manufacturers as demand shifts from Geostationary Orbit (GEO) to Non Geostationary Orbit (NGSO). Change in the structure of the industry. Lockheed is tracking 975 new space startups. Change in the manufacturing process. Satellites are getting bigger, and smaller. Electric propulsion is now an accepted technology; software defined satellites are moving from concept to reality, although we are still some time away from an in-orbit fully reconfigurable satellite.

Pacome Révillon CEO of Euroconsult, opened Satellite Business Week, by likening HTS for the satellite industry to 5G for the telecoms industry. The first HTS satellites came into operation in 2011-12. Their capacity varied from 70-140 Gbps, ViaSat-3 satellites, due to be launched in the early 2020s will have a capacity of over 1 TB. Euroconsult pointed out that in 2017, HTS capacity leased, increased by 38% whereas leasing of regular satellite capacity only increased by 3%. Going forward, data is the name of the game. Euroconsult is expecting a slight increase in video capacity leased to 2021 but a decline in revenue, from ~US$7 billion today to ~US$6 billion in 2021. Conversely on the data side, both capacity leased and the market value are increasing: from around US$6

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EDITORIAL

Change is the Only Constant

September was a very busy month for trade shows and conferences in the satellite industry. There was the IBC in Amsterdam, VSAT Global in London and the Euroconsult World Satellite Business Week in Paris. Our Associate Editor Elisabeth Tweedie covered all three of these important conferences in our cover story this month. What she found was an industry in a constant state of change with the pace of change accelerating as never before in recent memory.

In times of change, it's important to be one step ahead and not just cope with changes but thrive in them. Having access to the right information which not only provides facts and news of what happened but analysis and insights on where the industry is heading and where the opportunities are is important. That's our commitment to you here at Satellite markets and Research--to give you actionable information and analysis of the changing global satellite industry.

This month, see us at MILCOM 2018 which will be in our home city of Los Angeles from October 29-31.

Virgil Labrador

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Industry Trends, News Analysis, Market Intelligence and Opportunities

EDITORIAL

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COVER STORY

Change, Innovation and Flexibility from page 1

billion to just under US$9 billion. Steve Collar CEO of SES went as far as to say, that whereas right now, two thirds of SES' revenue, comes from broadcast video, he is expecting an equal split between broadcast video and data, in a few years' time.

However, most of the major operators are still very bullish on video. Rupert Belmer, CEO of Eutelsat, stated "we're very strong on video, the number of channels is still growing by 5% per year. What we sell to our customers is not bandwidth, but the position of our orbital slots." Collar, agreed, also stressing the importance of orbital slots. He also pointed out that the technical capabilities that SES offers are also important. The CEOs of SES, Eutelsat, Intelsat and Telesat were all in agreement about the necessity of maintaining presence in the OTT market. As Steve Spengler, CEO of Intelsat said: "As customers do more OTT they are adding more cost to their business. This creates an opportunity for us to help them make their business more efficient."

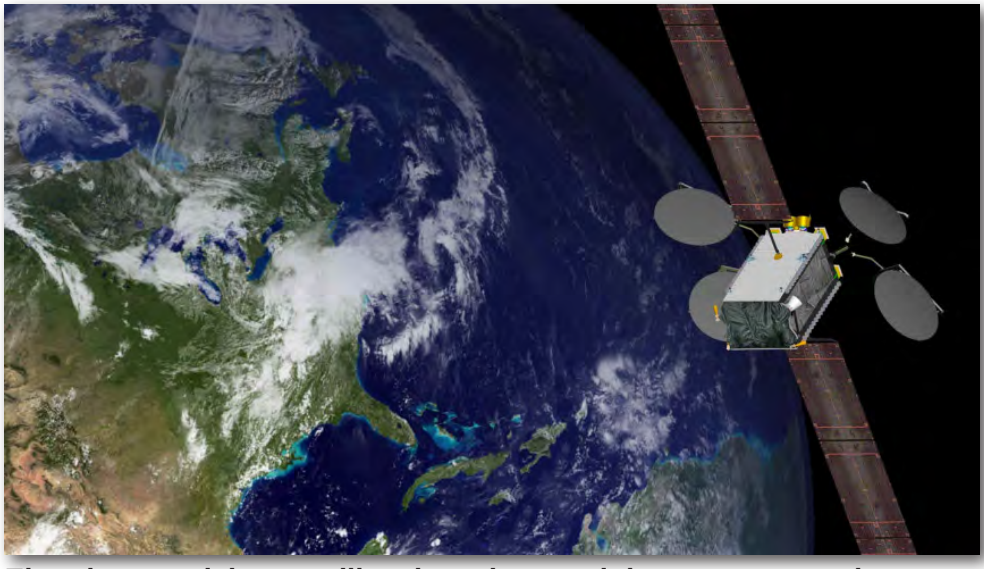
Flexibility is the name of the game, going forward. Linear television has not gone way, but its growth has slowed. Euroconsult are projecting 1-3% per annum over the next few years, meanwhile the demand for OTT continues to grow at an ever increasing pace.

Satellite operators, are not standing idly by, when it comes to OTT and many, if not most are looking for ways to participate in the delivery of these services. Jacques Le Mancq, CEO of Broadpeak, and described by Thomas van den Driessche, CEO Newtec, as "the savior of satellite," pointed out that the issues with OTT, namely latency and buffering, were not caused by inherent problems in the OTT service itself, but by the limitations of broadband. Given that OTT is effectively delivered as a one to one experience, the more successful it becomes the more congested the broadband "pipes" become, causing the aforementioned issues.

The Broadpeak solution, known as nano-CDN uses adaptive bit rate streaming (ABR) over satellite, to transform the unicast OTT video stream to multicast at the headend for delivery over the network. At the home it is transformed back into a unicast stream for viewing on WiFi connected devices. Eutelsat is utilizing nano-CDN in its Cirrus service. Gerry O'Sullivan, EVP, Global TV and Video, Eutelsat, likened OTT and Linear TV to reading books and going to the cinema: people do both.

At Satellite Business Week and VSAT and Future Satellite Applications, there was also considerable interest in emerging economies and the unconnected, who now number nearly four billion. Collar mentioned that with O3B, SES had made partners for life by providing connectivity. "Every time we make a new connection, we fundamentally change the lives of people. Mark Dankberg, Chairman of the Board and CEO, Viasat, went further to say that "the cost of being unconnected is far higher than the cost of being connected." ViaSat-2 has a partnership with Telebras in Brazil. " Telebras have a brief from the government to provide connectivity and by working with them to create Wifi hotspots, we can help fulfil this brief."

At the VSAT 2018 conference in London, during a panel that I moderated on "Connecting the Unconnected," John Mor-



Electric-propulsion satellites have been gaining acceptance in the market. Pictured here is Boeing-built Satmex 7, which uses all-electric propulsion.

Credit: Boeing artist's concept.

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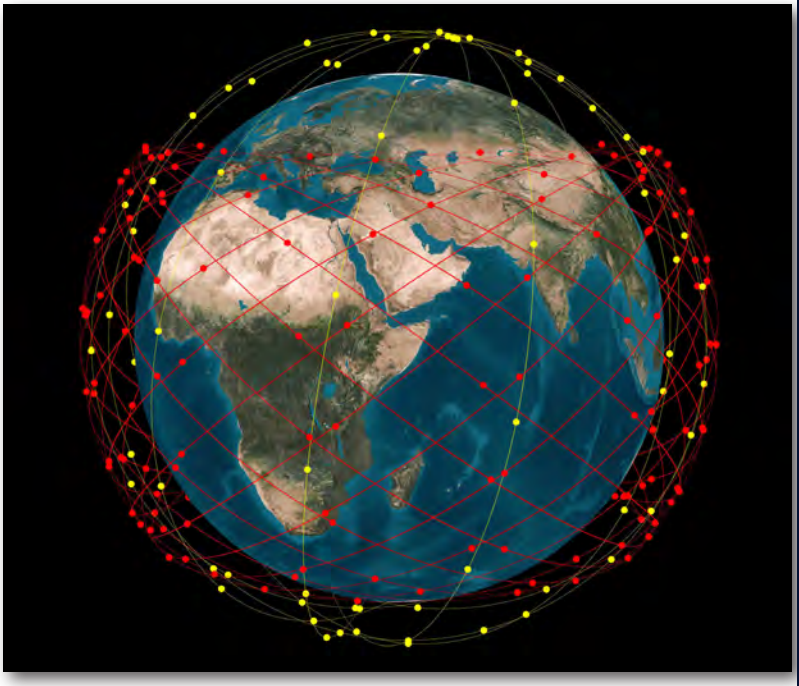
ris, Co-founder and Director of Geeks without Frontiers, talked about one of the initiatives Geeks is working on, in conjunction with Eutelsat, to deliver video and connectivity into a refugee camp in Jordan. Given that the average time spent in a refugee camp is 20 years, one can understand the necessity for this. On the same panel, Stein Skjorshammer, Founder and CEO of SunErgy, talked about the villages in the Cameroon, that SunErgy is supplying with solar power, television and internet, for the equivalent cost of bottle of local beer a day.

Unsurprisingly 5G was also a major talking point at all three conferences. Steve Spengler described it as a "huge game changer. There are multiple ways that we can participate in 5G, not just LEO or GEO, it could be via high altitude platforms (HAPs). It will have a huge impact. It's the first-time satellite is being integrated into the standard." The operators were divided in their attitude and approach. Rupert Pearce, CEO of Inmarsat, stating: "We don't do a good enough job as a community to explain why the mobile industries need us, nor do we do a good enough job of fighting for spectrum." Both Telesat and Eutelsat, stated that their investment in LEO constellations had been driven by 5G. Belmer stating that Eutelsat has a strategy to become "a privileged partner of large telcos, to enable them to provide full services in all geographic areas. The definition of satellite is that we go where telcos can't, that is why we're doing a LEO system." Dan Goldberg, President and CEO, Telesat, echoed this statement: "We won't be able to get involved unless we can match latency, which is why we've been reluctantly driven in that (LEO) direction." Steve Collar was the most enthusiastic. "When you combine 5G with the cloud, artificial intelligence and analytics, it becomes super interesting. If we can do that, our big challenge will be scale. How do we grow quickly enough to put that needed capacity out there?"

There was plenty of talk about the LEO constellations. Eric Béranger, CEO of OneWeb, said that company has raised US$1.7 billion in equity so far, and is still moving forward. Given that the cost of the constellation is now rumored to be closer to US$6 billion, than the original US$3.6 billion, it still has a way to go. Nevertheless, he reported that the first ten satellites should be launched and ready for service soon. OneWeb is focusing on the 5G market and the system has been built around a 3GPP core.

LeoSat's has a totally different strategy. Its customers will be large enterprises and an end-to-end service, totally bypassing the internet will be supplied. The total cost of its system is around US$3.7 billion. So far Hispasat and JSat have both invested an unspecified sum. Mark Rigolle, CEO stated that LeoSat should close its series A (US$100M) by the end of the year. This statement was reiterated by Ronald van der Breggen, COO in London. He pointed to the fact that LeoSat had made a decision to have no strategic investors, as the reason why it was trailing OneWeb in raising funds. He also stated that LeoSat has over US$1 billion in customer commitments.

There were very mixed feelings, particularly on the manufacturing side, when it came to the GEO vs LEO debate. In Paris the manufacturers were asked, if they were concerned about the long-term sustainability of the GEO market, given that last year there were only seven orders for commercial GEOs, and with only six to date, this year isn't looking any better. Chris Johnson, President Boeing Satellite Systems, stating: " We don't expect to return to the old world, but GEO



Telesat is investing in a LEO broadband constellation.
Photo credit: Telesat

is beachfront property – it's here to stay and we're committed to see through this downturn and come out the other side." Lockheed has integrated commercial and government manufacturing and currently has 21 GEOs going through the factory. Lisa Callahan, VP & GM, Commercial Civil Space, Lockheed Martin Space commented: "we see an ebb and flow between commercial and government, that is why we've gone to a common manufacturing base."

SSL, however, appeared considerably more pessimistic than the others. Dario Zamarian, Group President SSL, stated that SSL/Maxar believed that "we have reached a new structural low…..we haven't made any decisions, but strategically we're exploring alternatives for our GEO comsat business.. We have a business built on volume so we need to examine what to do." Since it had already been reported that one of the options under consideration is withdrawal from the GEO market, many of us were hoping for clarification one way or another. But the only thing that was clear, is that as yet, no decision either way has been made. The company says it will make a decision by the end of the year.

Interestingly at the conference in London, I took the opportunity to ask the approximately 200 delegates if they thought the LEO satellites signaled the end of the GEO era. About six hands were raised.

Elisabeth Tweedie has over 20 years experience at the cutting edge of new commmunications entertainment technologies. She is the founder and President of Definitive Direction (www.definitivedirection.com), a consultancy that focuses on researching and evaluating the long-term potential for new ventures, initiating their development, and identifying and developing appropriate alliances. During her 10 years at Hughes Electronics, she worked on every acquisition and new business that the company considered during her time there. She can be reached at etweedie@definitivedirection.com.

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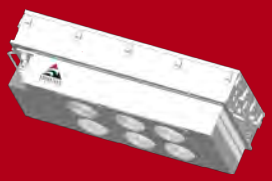

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FEATURE

Executive Roundtable on Maritime and Energy Markets

by Bernardo Schneiderman

The maritime market for the satellite communications industry continue to grow according to a recent report by NSR. NSR forecasts that the maritime atcom market will generate US$36 Billion in cumulative revenues through 2027. Driven by the migration of unconnected vessels to MSS, MSS customers to VSAT, and VSAT vessels to even higher throughputs, revenue growth will approach 7% from 2017 – 2027.

NSR also forecasts the major energy markets (oil and gas) to yield nearly US$1.6 Billion in retail revenues by 2027, up from US$900 million today. Requiring 80 transponders of FSS capacity and 3.5 Gbps of High Throughput Satellite (HTS) capacity spread across nearly 280,000 HTS, Fixed Satellite Service (FSS) and Mobile Satellite Service (MSS) in-service units for the global energy markets, the outlook for energy satcom connectivity is slowly improving.

Although revenue growth remains in the low single-digits over much of the forecast period, by 2027 oil and gas (the largest opportunity by nearly any metric) will nearly double the size of both the mining and utility segments. The bottom line is that market instability is largely behind the energy markets, with a slow return to growth expected over the next ten years.

For the maritime market, there is "an insatiable demand for connectivity driving the market today," said Brad Grady, NSR Senior Analyst and report author. "Broadband connectivity, with extremely high bandwidth demand found in some of the largest ocean-going cruise ships in the world, the impact of newer connectivity options in GEO and Non-GEO are having a profound impact on the market. FSS will still play a significant role in enabling a highly reliable, globally available network – but, the demand for higher throughputs combined with high vessel density in areas like the Caribbean are shifting network designs towards GEO & Non-GEO HTS options. At the lower end, new offerings in the MSS form factors are expanding the bottom of the market – bringing new vessels into service," Grady added.

Offshore oil & gas will bear the brunt of these changing dynamics energy market, since end-user expectations are more throughput, with minimal pricing increases.

Maritime satcom markets will see demand grow to over 670 Gbps of throughput by 2027 – 26% from FSS and HTS GEO, and 74% from Non-GEO. As LEO comes online in the latter half of the forecast and SES's O3b transitions to mPower in MEO, there is a huge amount of capacity coming online pushing prices down and unlocking additional demand in key markets. Merchant, leisure, and fishing markets will largely remain on GEO connectivity, as outside Super Yachts they do not yet have the significant levels of demand and/or budgets for the hundreds of Mbps per site from Non-GEO. Offshore faces stiff competition from terrestrial and ongoing pressures to keep budgets in-check, while the demand for passenger connectivity is ever-constant.

Overall, with another US$ 2.5 Billion in revenue growth between 2017 & 2027 and another 45,000 vessels adopting broadband capability over the next ten years, there is a strong demand for throughput in all orbits, frequencies, and form-factors.

Answering the call for insatiable demand for connectivity: In late 2015, Inmarsat ordered from Airbus Defence and Space a $600 million contract for the construction of two mobile communications satellites for Inmarsat's sixth-generation fleet. The first satellite to be called I-6 F1 will be delivered in 2020.

To give an update on these two key markets segment we invited executives from Service Providers and Antenna Manufacturers for a virtual round table discussion. The participants are: Ronald Spithout, President of Inmarsat Maritime; Paul Comyns, VP Global Marketing, Intellian; Wouter Deknopper, Vice President and General Manager, Maritime Line of Business, Iridium; Richard Elson, Vice President, Global Energy, ITC Global; Tore Morten Olsen, President Maritime, Marlink.

Satellite Markets (SM): What satellite communications services or products are you now offering for the maritime and oil and gas markets?

Inmarsat: Inmarsat was set up in 1979 by the International Maritime Organization (IMO) to enable ships to stay in constant touch with shore or call for help in an emergency but has since evolved into a publicly-listed, multi-sector communications service provider which today offers connectivity via 13 operational geostationary satellites.

Nevertheless, over 40% of Inmarsat's revenues are still derived from the maritime and offshore industries, where it offers the broadest portfolio of mobile voice, data solutions and value-added communications services available. Thousands of vessels rely on its end-to-end service availability and its 99.9% global coverage for operational communications and safety services. Connectivity options include voice calling via handheld satellite phones, broadband internet devices, and specialist terminals and antennas fitted on ships.

Inmarsat services are available directly or via its worldwide network of independent Distribution Partners and Service Providers. The portfolio includes:

— FleetBroadband: Inmarsat's flagship service for the maritime and offshore sectors, which provides always-on voice and broadband data coverage using L-Band for multiple user operational and crew communications.

— Fleet Xpress: Fleet Xpress exploits Ka-band high data speed capability available via new generation Global Xpress satellites, combined with the proven reliability of unlimited L-band back-up via FleetBroadband to enable the digitalization of the maritime and offshore sectors.

— Fleet One: specifically designed to meet the low data usage demands of smaller, occasional or seasonal users when they move out of VHF or GSM coverage areas, Inmarsat offers two Fleet One service plans to put satellite broadband in the reach of any size of vessel.

— FleetPhone: a low-cost, maritime satellite phone service for use when users are beyond the range

of land-based networks.

— Fleet Secure: a suite of cyber security services including a Unified Threat Management (UTM) service, an Endpoint protection service and an Awareness service that helps train seafarers on the dangers of cyber threats at sea.

— Fleet Data: Inmarsat's new Internet of Things (IoT) service to enable ship owners and managers to access and analyse real-time onboard data more efficiently using a ship's onboard Voyage Data Recorder (see below).

— Fleet Safety: Inmarsat's next-generation safety at sea service, which was formally recognised as a new service to support the Global Maritime Distress and Safety System (GMDSS) by the IMO Maritime Safety Committee in May 2018. Delivered over FleetBroadband/Fleet One, Fleet Safety offers free 505 calling service for vessels and incorporates the web-based messaging services for mariners SafetyNET II and RescueNET in one platform.

— Fleet Media: Inmarsat's entertainment service for crew includes Hollywood movies, international films, TV box-sets, and international news and sports, anywhere at sea. The service can be watched via laptop, computer or smartphone on board.

Intellian: The latest product from Intellian that targets the energy sector is the new v240MT, our 2.4m tri-band antenna system. The v240MT can operate on C, Ku, or Ka bands with either GEO or MEO satellite constellations, ensuring future-proof communications for the oil and gas market. This new tri-band antenna system will enable operators to switch networks, frequency bands and constellations depending on where the rig may be deployed. It is a fully flexible solution for any offshore installation.

Iridium: Iridium has many partners and customers within the maritime and oil and gas markets. Specifically, for maritime customers, including oil rigs, we find that many end users rely on Iridium's network for a range of uses, such as preventative vessel maintenance and monitoring, diagnostics, crew communications and internet capabilities. A variety of Iridium products and services can support

Intellian's innovative v240MT enables communication services in three different frequency bands and tracks both geostationary Earth orbit (GEO) satellites, as well as satellites in medium Earth orbit. (MEO).

these needs and markets including (but not limited to) Iridium's maritime broadband terminal, called Iridium Pilot®, Iridium's latest satellite phone, called the Iridium Extreme® and Iridium's Internet of Things (IoT) transceivers, including the Iridium 9603®. While working on oil rigs, we find Iridium's aviation products are popular since helicopters are a primary mode of transportation. Iridium's aviation product line, including the Iridium Certus terminal called FlytLINK developed by Thales, is the only line of satellite solutions that can provide connectivity under a moving rotor blade. All Iridium products are small in form factor, rugged and able to provide reliable satellite connectivity anywhere in the world, including Polar regions.

ITC Global: ITC Global recently rolled out new features to our crew welfare platform, ITC Crew LIVE, adding Video On-Demand to the service. Crew LIVE is an advanced, multi-purpose connectivity and entertainment solution that enables companies to modernize welfare programs for their remote staff and crews while meeting the bottom-line needs of their business.

This platform offers a whole new approach to remote connectivity, with reliable hotel-style wireless internet direct to personal devices for access to top-of-line content, including streaming entertainment services, all types of social and digital media, and more. This is especially necessary in remote environments where limited connection to the outside

world can have a direct impact on crew welfare, causing hardship for remote site personnel and their loved ones. Crew LIVE enables remote staff to stay connected with friends and family and keep up with personal business during off hours while away at work for extended periods of time.

The solution can be delivered on a dedicated satellite antenna, separate from corporate network communications, which ensures that business and personal use are kept entirely separate to eliminate security concerns and competing network priorities. This provides the best user experience for everyone during work and leisure time.

Additionally, ITC Global continues to augment Crew LIVE and its crew welfare offerings for the broader energy and maritime market tailored to meet customers' demands and needs. ITC Global is also working to augment Crew LIVE to provide improved overall system management to ship owners. This will allow for more effective crew welfare management on the customer end, enabling ship operators to manage their crew's data, review and manage data throughputs and address abusers on the network. While many of our Crew LIVE customers prefer to rely on ITC Global for all aspects of their crew welfare platform, some vessel operators are looking for solutions with higher levels of ownership.

Marlink: Our extensive C- and Ku-band network is integrated with L-band Mobile Satellite Services and next generation Ka-band High Throughput Satellite services – Inmarsat FleetXpress and Telenor Satellite's Thor 7 – ensuring highly flexible and reliable services globally. We take a technology-agnostic, multi-band approach to our portfolio, ensuring we are able to meet all customer specifications and operational areas. We provide full global coverage on the widest spread of satellites, including from Inmarsat, Intelsat, Iridium, SES and Telenor Satellite. Through our partnerships with all major satellite network operators, we deliver the bandwidth where and when it is needed, supporting thousands of vessels across all maritime verticals to access digital applications that can help them to operate safer and more efficiently.

In parallel with our extensive satellite services offering, we also provide a wide portfolio of Value Added Services, including our Cyber Guard IT security portfolio which has recently been updated with a unique, advanced maritime Cyber Detection service. The Cyber Guard portfolio enables Marlink customers to protect, detect and resolve any cyber-threat through a holistic combination of network resilience and redundancy, dedicated maritime cyber-security technology and maritime Security Operation Center (SOC) experts. Cyber Detection, the latest addition to Cyber Guard, monitors

Iridium has been collaborating with AWS on the development of Iridium CloudConnect, the first and only satellite cloud-based solution that offers truly global coverage for Internet of Things (IoT) applications.

all outbound and inbound network traffic around the clock and enables customers to view threats affecting their vessels through an intuitive, web-based dashboard.

Our XChange centralised communications management system also brings with it unique opportunities for our customers, such as a new cloud-based file transfer system and a leading range of crew welfare focused technology, such as Bring Your Own Device and a cutting-edge telemedicine solution.

ITC Offshore Platform.

SM: Do you have any plans to use flat antennas in your portfolio of products and services to address this market in the short or long term?

Inmarsat: For commercial vessels of over 500gt, terminals used for maritime applications need to be approved by the International Maritime Organization, so flat panel antennas are still a few years away from adoption in the commercial maritime market.

However, Inmarsat is fully cognizant of developments in flat antennas and has type approved Paradigm's Swarm45 terminal for use with for Inmarsat Global Xpress worldwide across multiple platforms and missions. Inmarsat also entered a strategic technology development agreement with Isotropic Systems earlier this year to look at developing state-of-the-art antennas for existing and future Global Xpress satellites

Intellian: Currently Intellian, as a leading technology provider within the maritime VSAT sector, is monitoring the flat panel systems and technology available.

Iridium: Iridium is in the process of launching its next-generation L-band broadband solution called Iridium CertusSM, that will run over terminals with phased-array antennas. Unlike existing satellite terminals in the market, Iridium Certus antennas are extremely light-weight (<3Kg) and small in form factor (approx. 30cm in diameter and height). Today, there are two value-added manufacturers (VAMs) who have Iridium-certified terminals to support the service. For the maritime market, Cobham's SAILOR 4300 terminal and Thales' VesseLink and MissionLink terminals, will deliver Iridium Certus to customers anywhere in the world. For the first time, the maritime market will have a choice when it comes to broadband communications, with a solution that is a reliable, high-speed and cost-effective option, offering capabilities and flexibility that do not exist in the marketplace today.

ITC Global: ITC Global, and parent company Panasonic, are looking into various antenna technologies to support both short- and long-term initiatives to meet the expanding VSAT network and their customers' requirements. For the mass commercial market, our expectation for any flat panel solution would be to match its parabolic competitor in size, price and most importantly, performance. While performance levels may not be at the point to meet customer's growing operational requirements, we anticipate that as the technology progresses, we should see flat panel innovations come closer to meeting expectations.

Marlink: Our portfolio is 100% technology agnostic, so if there is a use case from specific customers then flat panel antennas can certainly be considered. At the moment the technology is still developing, but in the long term we see that certain segments, yachts and superyachts for instance, may be most suited to flat panel antennas.

SM: In the maritime and oil and gas market, where do you see growth for the next 2-5 years in specific market segments or regions?

Inmarsat: Inmarsat recently published original research covering attitudes and intentions towards digitalisation in the global supply chain, and its findings point strongly towards accelerating uptake for high bandwidth services, such as Fleet Xpress.

The Inmarsat Research Programme 2018 report is based on 750 interviews and included 125 maritime respondents. One of its most compelling

findings was that average expenditure per business on IoT-based solutions will amount to US$2.5 million over the next three years. The finding points towards strong growth in demand from the maritime sector for high speed data connectivity ship to shore connectivity over the coming 2-5 years that will enable digitalization in fleet management and ship operations.

In part, this demand will be driven by the need to control costs, a trend that is already demonstrated by 57% of participants saying they are either using or trialling route optimisation software as part of their vessel management. However, regulation is also providing a prompt for adoption. With rules tightening on emissions from ships, 65% of respondents say they already use IoT-based solutions to monitor fuel consumption, rising to the 100% by 2023.

Inmarsat also expects continuous growth in use of its FleetBroadband services as current and new users migrate up the data chain. In addition, Inmarsat expects to secure significant market share among lower data users as a result of its newly flexible package of tariffs made for Fleet One, targeting the needs of fishing and leisure clients in key regional markets.

Intellian: Growth will come from all regions, as we see a positive uptick in the energy market. As a hardware provider we anticipate that demand for multiband antennas will increase, and also with the increase in day rate chartering there will be a need for more flexible skid-based solutions.

Iridium: In the next 2-5 years, we anticipate growth in the digitalization of shipping and increase in the automation of ship/vessel processes. Iridium's network is an ideal solution to support this new digital era, since it is the only network that can enable connectivity anywhere on the planet. Regarding regions, we have seen an increase in demand for Arctic and Polar communications, and as the only network able to deliver connectivity in those areas, we anticipate seeing some gains there for not only the maritime market, but in additional industry verticals like land-mobile, IoT and aviation.

ITC: We're seeing that the oil and gas sector is beginning to move past recovery and refocus on project investments. ITC Global expects to see growth in both technology and automation. The latest analyst reports point to the world's energy companies moving to start to approve an estimated $300 billion in spending on large projects in 2019 and 2020, an amount greater than the combined spending during the previous three years from 2015 to 2017.

Many customers are shifting from a cost-savings approach to an investment and execution approach. There are certainly still expectations for cost-effective solutions, but that comes in the form of efficiencies and optimization from technology and digitization implementations. We'll see a push toward greater savings and higher productivity through vessel automation, which in turn is driving increases in communications requirements.

A continued laser focus on HSE is also now driving digitization requirements, and we'll certainly see this grow for offshore operations. In some cases, we're seeing this in the form of a reduction in offshore personnel, with more equipment and offshore processes being managed and operated by staff back at corporate locations. For other clients, we're seeing this take shape in the form of more monitoring, especially for assets that are nearing the end of their lifecycle. These improved production and safety objectives are being addressed through the implementation of sensor technologies and cloud-based data analytics – resulting in major increases to data needs. With these changes, more offshore companies are partnering with reliable service providers for connectivity, a partnership that is enabling companies to

Inmarsat Control Operation Center for L-Band.

reduce downtime, increase asset optimization and improve operational efficiency.

Crew welfare is also a growing necessity for companies as they try to provide the same connectivity to their crews offshore as they are used to having onshore. However, these innovations can be secondary to cost in some segments of the maritime market.

Marlink: The cruise market leads the way in demand for bandwidth and we expect the growth here to continue, in part driven by the need to give customers high quality Internet and social media access. Cruise companies also benefit from the free marketing that this provides. There is also a growing trend in the cruise sector to develop services based on the data that guests generate on board.

We see a very significant trend towards digitalisation in merchant shipping, where leveraging connected technologies can deliver more operational efficiency. For instance, engine monitoring can contribute to reductions in bunker costs and emissions, while enabling a more efficient maintenance and service process. Data has to be available ashore to realise efficiencies though, making satcom a vital component in the on-going development of so-called 'smart ships', and in the future, autonomous ships.

We also see growth in the commercial fishing sector, where crew welfare improvements and regulatory issues demand more reliable connectivity, while the leisure sector continues to grow, especially within superyachts as owners and charter companies simply want the most powerful communications on board. We are also seeing a slow recovery in in the offshore oil & gas sector, reflected by the re-activation of our services on a number of previously laid-up support vessels.

SM: Do you now provide, or have any plans to provide, value-added IoT services for the maritime and oil and gas sectors?

Inmarsat: In September 2018 Inmarsat launched Fleet Data, a new Internet of Things (IoT) service to enable ship owners and managers to access and analyse real-time onboard data more efficiently and help accelerate the adoption of IoT across the maritime industry.

Developed in partnership with Danelec Marine, Fleet Data will record data from the onboard Voyage Data Recorder (VDR), and other vessel sensors, pre-process that data, and upload it to a central (cloud-based) database equipped with a dashboard and Application Process Interface (API). This will allow ship owners and managers to identify equipment issues and failures quickly and easily, and seamlessly link 3rd party applications to monitor vessel performance and fuel efficiency.

Fleet Data is the only service that offers a highly reliable, dedicated bandwidth-inclusive service, on a sensor agnostic platform that allows ship owners and managers to access the full potential of IoT and efficiency-enhancing vessel performance applications, in real time. Trials are due for completion this month aboard two ships operated by a leading ship manager, which have been verifying performance over a six-month period by relaying data collected through fuel optimisation software.

Laboratory tests with other applications to run over Fleet Data, such as ECDIS chart updates on the FleetBroadband service, are also underway in Ålesund, Norway, the home of Inmarsat's research and development activities for the commercial maritime sector.

Today, all passenger and all cargo ships of 3,000gt and above must carry a VDR under the Convention for Safety of Life at Sea; able to interface with input signal sources, recording/playback equipment, and power supply/reserve power.

Building on its Fleet Xpress service, Inmarsat is also already involved in a number of application and IoT projects in the maritime sector as part of its Certified Application Provider programme working with companies such as Rolls-Royce and Samsung Heavy industries to provide energy management and remote monitoring applications.

Intellian: These kinds of services would generally be provided as an extra value-add from a service provider rather than from an antenna hardware manufacturer like Intellian.

Iridium: Iridium's satellite-IoT products and services play a role in every vertical we serve, including the maritime and oil and gas markets. Even today, we see a lot of IoT cross-over in the maritime business, especially for applications like vessel diagnostics and preventative maintenance. For example, large shipping companies use Iridium's satellite-IoT

devices to track and monitor deployed assets and can even use the same technology to track cargo, making sure it arrives to its final destination on time and in-tact. With respect to the oil and gas markets, a great example of a popular partner application is the Osprey TMC solution by ASE, which is used on oil rigs to monitor air quality and control hydrogen sulfide (H2S) levels, thereby ensuring crew's health and safety.

We anticipate seeing an increase in IoT applications for mariners, especially with the launch of Iridium Certus. The latest IoT product, called Iridium Edge®, can be used by any end user within any vertical to extend the reach of its terrestrial-based IoT solutions. The device can be rapidly deployed for fleet management, telematics and other remote monitoring applications, whether on land or at sea, anywhere in the world.

ITC: ITC Global designs and delivers the most robust, comprehensive network solution to ensure that the client's network can manage all the desperate IoT applications and systems being implemented to optimize operations. New and upcoming partnerships enable ITC Global to tailor services based on customers' needs by introducing additional capabilities and providing fully reliable IT and engineering solutions.

As more energy and maritime companies start to realize the benefits data analysis can have on business, we'll see an increase in the implementation of IoT technologies. ITC Global's experience in navigating new technologies makes it the ideal partner for companies looking to expand network capabilities for short- and long-term operations. With the added depth of Panasonic's own business model and technology review process, ITC Global is examining a wide breadth of Panasonic technologies, including remote monitoring and sensing, real-time video data analytics for efficient offshore operations and more. As companies in these markets begin re-evaluating their investment plans, improving efficiency in operations and maintenance will be key to staying ahead of the game. ITC Global has both the satellite network and industry expertise to help these companies succeed.

Marlink's Eik receiving station.

Marlink: IOT is a broad term but certainly, Marlink is already operating in this field by providing machine-to-machine connectivity. To develop this further, as part of our Smart Connectivity strategy we seek to support new partners and applications to work together to enable more digitalisation and business efficiency.

SM: Considering the Ku and Ka bands and the new constellations of LEO satellites, how are you addressing this new trend in the maritime and oil and gas market?

Inmarsat: Inmarsat is facing an intensification of competition in the maritime space, due to the arrival of new L-band capacity and strategies to attract customers away from existing L-band services to the greater bandwidth offered via Ku-band.

Nevertheless, a recent study by Euroconsult verified that Inmarsat has been the fastest growing provider of maritime VSAT services in the first half of 2018, with 60% of all new maritime VSAT deployments being Fleet Xpress.

Inmarsat also commands an 85% market share of maritime L-band revenues and a 21% share of maritime VSAT revenue – a figure which has also been verified by Euroconsult. Inmarsat will redouble its efforts to maintain its share of the L-band segment, with an imminent doubling of FleetBroadband data rates via a firmware upgrade expected to bring significant rewards.

Two next-generation Inmarsat-6 satellites are also due to be launched in 2020 and 2021 which will offer hybrid Ka-band/L-band capacity, whose

Manufacture of HTS satellites is rapidly rising with HTS capacity over oceanic regions growing almost 10-fold from 2017 to 2020. Photo shows Telstar 18 VANTAGE multi-mission satellite, built by SSL, for Telesat. Last month, SSL said the satellite has begun on-orbit operations. Photo Credit: SSL

arrival will sharpen Inmarsat's competitive offering across the Fleet Xpress and FleetBroadband segments.

Intellian: Intellian was the first to deliver an antenna system that can switch between different bands and different constellations on the fly with the new v240MT tri-band antenna solution combined with the Intelligent Mediator device. This antenna system is well proven at sea with many installations operating today providing record-breaking data throughput speeds in Gbps ranges

Iridium: In today's landscape, we find that often times end users are relying on both Ku/Ka and L-band networks for a well-rounded on-board connectivity suite, as they complement each other. With the new LEO constellations being proposed and launched, none include a cross-linked architecture, which is key to enabling reliable connectivity anywhere on the planet (like Iridium). For these new constellations, it will be difficult to properly service the maritime market over open oceans since there are no ground stations. Regarding how Iridium is addressing this trend, the launch of new products and services, Iridium Certus, will be competitive and will meet the needs of all mariners and oil and gas customers. It is anticipated to fill an existing gap in the marketplace, with a solution that is global, affordable, flexible and most importantly, reliable. Iridium Certus will be the fastest L-band satellite broadband solution, and once commercially available, will deliver next-generation capabilities over small form factor antennas and terminals, making it a desirable option for customers of all sizes.

ITC: ITC Global is committed to providing solutions that best fit its customers' needs. We leverage our extensive network portfolio to support the diverse needs of our customers, delivering Ku-band, Ka-band and C-band systems as needed based on what is best suited for a customer's specific requirements. ITC Global looks to provide the lowest cost-per-bit for its customers without sacrificing the quality of the services it provides.

When it comes to the equipment requirements and additional antennas needed to work with LEO satellites, the impact of additional costs and coverage changes must be considered when suggesting this as a solution for customers. While LEO satellites may have advantages for some operations, ITC Global is conscious of the costs required to implement this change. In partnership with Panasonic, ITC Global is studying these systems and the value they can offer for our global mobility network.

Marlink: With maritime satcom, there is no 'one size fits all', which is why we are focused on delivering a wide orbital spread using satellites from all major operators. Through this we can meet any requirements from our customers. We continue to add new satellites and beams, even offering double and triple redundancy to ensure that we can deliver the amount of bandwidth needed. So, in the context of LEO constellations, we are watching very closely. We see that the low-latency could have some benefit in specific maritime applications but generally, the influx of new capacity will only be a positive thing for Marlink customers and the maritime industry.

As we can extract from the round table the market for Maritime has more potential of growth comparing with the Oil & Gas that starting slowing coming back. But to give another flavor Eurocon-

sult another Market Research Company provide the following profile for this market.

Smart shipping is some of the major factors pushing maritime operators to install the latest generation of satellite systems on their vessels. Autonomous shipping, performance monitoring, fleet management and cybersecure applications, brought by an increasing number of IoT-connected and sensing devices will drive capacity demand in the next decade.

For the maritime market, if all satellites are launched as planned, the total available HTS satellite capacity over oceanic regions will grow almost 10-fold from 2017 to 2020, to cater to the ever-growing demand. The hardware, such as receiving antennas and modems, is also evolving rapidly; smaller, lighter, and more efficient antenna systems are gaining traction as the industry continues to evolve.

Euroconsult forecasts that the maritime satcom market (both MSS and VSAT) will grow to more than 500,000 terminals in 2027 as compared to 337,300 terminals in 2017. Total revenue for satellite operators should grow from $953 million in 2017 to $1.6 billion by 2027, a 10-year CAGR of 5.2%. The revenue for maritime service providers is estimated to grow from $1.8 billion in 2017 to $2.9 billion in 2027 with a 10-year CAGR of 5.3%.

Consolidation in the past several years has enabled leading VSAT service providers to gain market share and the five largest companies hold 90% of the market. Competitive pressure is increasing; the development of new VSAT terminal installation facilities and the democratization of the technology are lowering entry barriers for regional service providers, especially in the Asian and Middle East markets. Still, greater competition combined with the need to improve profit margins and leverage economies of scale will favor further integration and consolidation in the value chain.

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FEATURE

How Are You Factoring 5G into Your Future?

The satellite and teleport sectors need to ensure their fare share of massive wave of investment that 5G will create

by Robert Bell

Mobile backhaul and base station networking have long been an important business for satellite and teleport operators. It is humbling, then, to also acknowledge that satellites carried less than 1.4% of global mobile traffic in 2016, according to NSR.

With 49% of the world's people still not online, there should be plenty of room for growth. NSR has estimated that satellite-based cellular backhaul in-service units will grow at double-digit rates from about 40,000 in 2016 to more than 120,000 in 2027. The dramatic decline in satellite capacity prices, spacecraft costs and launch costs all portend a future in which satellite may claim a rising share of a growing market.

Massive Growth in Bandwidth Requirements

The roll-out of 5G mobile service has the potential to accelerate that growth. The 5G standard will provide devices on the network with between 1 and 10 Gbps of speed with practically unlimited capacity. Supporting that user capacity will drive a 100x growth in mobile backhaul.

New features already being deployed in 4G LTE encourage mobile operators to concentrate heavy-duty processing in data centers linked to remote base stations, which also creates a market for "fronthaul" that is currently provided by fiber but is likely to need satellite in a 5G future.

Factoring 5G Into the Future

Factoring 5G Into the Future is a new report from the World Teleport Association that looks at the 5G opportunity from the point of view of satellite-based service providers. What specific opportunities are likely to emerge? How are standards evolving in ways that are friendly or unfriendly to satellite? What industry partnerships are working to ensure satellite a place in the 5G specifications?

There are still more questions than answers, but some things seem clear. The first 5G deployments will take place in urban markets where fiber dominates. An industry association contributing to the report noted that "5G will be gradually introduced, but even by 2026, the coverage is expected to be very limited. Cisco is projecting that 5G will account for 1.5% of total mobile data traffic by 2021, and on average each connection will generate 4.7 times more traffic than the average 4G connection."

Other contributors offered an alternative view. Partly because it represents such a technology leap, 5G deployment may be driven less by geography and population density than by use cases. "It is quite conceivable that there will

be 'islands' of coverage," said one respondent. "For example, an industrial park in an otherwise unserved area may have its own 5G network, enabling automation and/or logistics for particular location or company. A small cell could just cover one business." The executive also noted the opportunity to overlay 5G architecture on existing 4G macro cells. "It could scale faster than we think. Enterprises and verticals are a key target for 5G so hitting those industries – along industrial corridors, ports or industrial parks where there is a need for massive IoT connectivity – will be key to success."

The Internet of Things is already a market driver for teleport and satellite operators. The 5G specification is expected to become the standard for IoT, so integration with it will be a priority. Communications with objects in motion, currently a satellite specialty, will also be covered by the 5G standards, which will tend to increase demand for service. Most valuable of all may be video. 5G will support a massive increase in video to mobile devices – and the economics suggest that caching video files at the edge could become a major business for teleports.

A Seat at the Table

The 5G standard will not be published in final form until 2020, and there are as yet no 5G consumer handsets on the market. But the satellite industry is pushing as never before to be at the table as specifications are established – because 5G is an architecture that will have a massive impact on how the whole world communicates. The mobile industry wants to finalize the standard as fast as possible and is pushing back on adding a satellite component. The satellite and teleport sectors need to keep up the pressure to ensure their fair share of the massive wave of investment that 5G will create over its decade-long deployment.

Robert Bell is Executive Director of the World Teleport Association, which represents the world's most innovative teleport operators, carriers and technology providers in 46 nations. He can be reached at rbell@worldteleport.org. Factoring 5G into the Future is available free to members and for sale to non-members.

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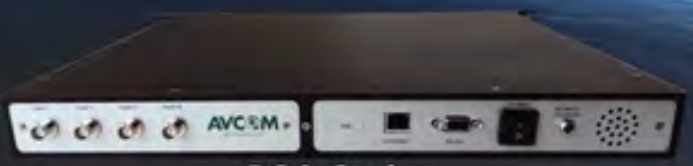

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From Capitol Hill, via Geneva, to Accelerating the HTS "Teenage" Dynamic

Martin Jarrold

The fourth quarter 2018 calendar features two of GVF's regular major events – one in Washington DC in October presented in partnership with COMSYS, the other in London at the beginning of December, part of the GVF-EMP portfolio – and in November we have another of the association's important innovations, a Workshop Symposium collaboration with the International Telecommunication Union.

The 2017 inaugural VSAT Congress presented a much lauded opportunity to learn from world-changing thinkers and innovators in the satellite communications VSAT industry, and on 15th & 16th October 2018, the 2018 program (https://www.vsatcongress.com/), again hosted at the offices of Jones Day on Capitol Hill, will offer the opportunity for attendees to engage directly with keynote speakers and open-forum executive roundtables that will feature leading LEO, MEO and GEO satellite operators, VSAT service providers, manufacturers, customers, and subject-matter experts.

The VSAT Congress will address itself to resolving the debate and finding answers on such strategic issues and key questions as: Can the industry defend in the fight for frequencies? | To what extent does industry need to integrate with terrestrial services? | How can VSAT become an essential extension of the 5G infrastructure? | Can the industry integrate different orbital constellations? | Are LEOs, MEOs and HAPS a threat or opportunity? | Are standardization and commoditization an inevitability? | … As well as many more.

The Congress will additionally encompass such facets of current industry dialogue as: VSAT terminal cost viability and technology developments; industry's ability to compete on data pricing and data volume requirements; the survival of independent VSAT operators; differentiation and competitive advantage; VSAT's place in an industrial IoT world; strategies for seamless GEO, MEO and LEO connectivity; cyber security; potential for constellation collision and catastrophic collapse; and, analyzing viable business structures and strategies and investor belief in satellite's continuing potential.

The Day One program will feature series of keynote addresses and panel discussion sessions which will include key figures from across the industry's major and emerging players and related stakeholders, in alphabetical order): Aurora, BridgeSat, Clarke Belt 2.0 Project, Dynamic Spectrum Alliance, Globecomm, Hawkeye360, Hispasat, Hughes, iDirect, Integrasys, Newtec, NxGen Partners, Panasonic Avionics Corporation, Talia, Telesat, Trinity Advisers, and UHP Networks. Discussion will center on such themes as re-thinking business models, the highs and lows of twinning GEOs and LEOs, market demand for cost-effective roaming and switching flexibility in VSAT platforms, acquisitions and consolidations. A final panel session will investigate Strange Technology Stretches.

The second day will continue with keynote analyses from ViaSat, Yachtprojects International/

Procom365, Global Eagle, and Spacecom, together with panel discussion sessions, including a focus on FPCESPAAILWM-MMCRE – Flat Panel, Conformable, Electronically Steerable, Phased Array, Auto Install, LightWeight, Meta-Material, Multi-Constellation, Reliable, Efficient – antenna development which will be discussed by representatives of (in alphabetical order): Alcan Systems, C-COM Satellite Systems, Gilat, Intellian, Isotropic Systems, Kymeta, and Phasor.

Additionally, the VSAT Congress will provide the satellite community another opportunity to meet GVF's new Secretary General, David Meltzer, who took up his appointment on 27th August.

The headquarters of the International Telecommunication Union (ITU) will host around 400 delegates from 150 countries at the World Radiocommunication Seminar 2018 between 3rd and 7th December. In addition, on 29th and 30th November, the ITU will collaborate with GVF in presenting a two-day Workshop Symposium focused on capacity building, will the objective of providing exposure to information about latest technology innovations in satellite communications; creating a greater level of understanding of the rapid mobilization of satellite based communication links; promoting skills and tools for reduction and mitigation of satellite interference; and, elevating understanding of satellite communications regulatory, policy & spectrum coordination issues.

Also taking place in early December, on the 4th of the month, will be the GVF-EMP HTS Roundtable 2018… GEOs … MEOs … LEOs: Enabling a Brave New World (www.uk-emp.co.uk/current-events/hts-roundtable-2018/). The Roundtables have taken place only for the last four or five years and in that time whilst the range of their program discussion themes has well reflected the unique dynamism of the high throughput environment, this will be the first opportunity to acknowledge that the HTS era has reached its teenage years.

Yes, the HTS era is 13-years-old, an era that began with Thaicom 4/IPstar's 45 Gbps of Ku-band launched in August 2005. That most well-known of Thaicom's orbiting assets will still be in service in 2022, and perhaps to 2024, by which time the time many of the drawing board mega-constellations of today will be above us in low Earth orbit (LEO). Since the debut of HTS, 13 years ago, the high-throughput technology and service market has undergone much change, including exponential growth

The rapidity of changes in HTS will be a key focus in London. Above, HTS satellite manufacturing at SSL's facility. Photo Credit: SSL

potential in the market for satellite-based broadband solutions, a massive expansion in in-orbit capacity, and a downward trend in capacity pricing. Now, soon, the LEOs – and maybe more medium Earth orbit (MEO) systems too – will aggregate into the orbital equation.

After seeing HTS systems and technology advance over the Americas, Europe and Africa, global and regional operators in Asia are beginning to direct their attention to launching HTS satellites in large numbers, bringing the HTS focus back full circle to

the region where it all started.

The rapidity of change in HTS will be a key focus in London. The program will offer an in-depth exploration of the drivers and trends behind the continuing massive growth potential in the market for satellite-based broadband solutions, extending to an evaluation of the opportunities arising from a host of new applications that are being enabled through the deployment of more-highly bandwidth efficient networks.

There are aspects of the industry's ride to orbit that these days show it far from being a smooth one, and here too there is an Asian connection.

Space Systems/Loral, builder of Thaicom 4/IPstar, is reportedly considering exiting the GEO business. This is news that follows on from market analysis that has shown that in the last three years or so orders for traditional GEO spacecraft have fallen away, 26 in 2014, to 15 in 2016, and only seven in 2017. However, whilst the final 2018 count for new GEO satellite orders may not be much better, we do have, as noted above – and in the context of the general trend for increasing numbers of more powerful HTS spacecraft in orbit – the swing to increasing HTS capacity over Asia as exemplified in SES-12, Eutelsat-172b, Intelsat/JSAT Horizons-3e, Telesat/APT Satellite Telstar-18 Vantage/Apstar-5C, and more AsiaPac HTS capacity being on the way from Kacific, China Satcom and mu Space. Measat, too, hopes to have orbited by 2021 HTS capacity to provide broadband services.

HTS capacity is getting progressively cheaper. Current and future generations of HTS platforms provide capacity at prices significantly lower than that of the first generation exemplified by Thaicom 4/IPstar, prices which mean that satellite operators are moving into the provision of services space in addition to providing raw capacity. Downward trends in satellite capacity pricing – arising from the increasing numbers of more powerful HTS spacecraft in orbit – is a significant market shift. Whilst, as Northern Sky Research (NSR) has shown, capacity price erosion is slowing, prices are now trending between 35% and 60% lower than two years ago, and this slide will continue into 2019. (Note: NSR's analysis addressed only GEO, excluding the MEO O3b constellation and upcoming LEO mega-constellation–based systems.)

NSR identified multiple factors that are contributing to the continued pricing decline. In the longer term the planned LEO constellations, with their promises of lower pricing, may amplify pricing and capacity concerns. HTS supply growth from GEO spacecraft will be overshadowed by the emergence of NGSO constellations, projects that promise massive volumes of capacity supply, low latency and global (or near-global) coverage. NGSO-HTS projects such as the continued expansion of O3b in MEO, and OneWeb, SpaceX, Telesat and LeoSat in LEO would combine to add over of 40 Tbps of capacity. And, there is the promise of more to come.

"...HTS capacity is getting progressively cheaper... arising from the increasing numbers of more powerful HTS spacecraft in orbit..."

However, there is always a caveat. In this case the caveat is that the LEOs are not yet being manufactured, much less launched, and their multibillion dollar financing no longer looks as secure as the confidence of original business plans suggested. Key to this confidence is the LEO constellation model ability to deliver low-cost capacity to address the underserved consumer broadband market, the only market segment capable of absorbing the enormous quantities of new satellite capacity. However, making the consumer market viable requires low-priced consumer hardware in the form of flat panel, non-mechanically steered, antennas the market availability of which remains a short-term uncertainty.

Against this broad and complex contextual background the key interesting questions to be considered during the HTS Roundtable 2018… GEOs… MEOs… LEOs: Enabling a Brave New World are myriad. Just some examples are: Are operator offerings essentially the same? | Which operators are taking only the Ka band route to new services delivery, and which are developing multiband service strategies in their HTS play? | Where are hybrid technology solutions to be positioned? | Are the operators

forging into direct competition with their own solution re-seller customers? | How will the GEO-HTS and mega-LEO services compete… or will they be complementary? | Will GEO-HTS and LEO-HTS systems augment each other and network together? | Is all high throughput alike? | Where will latency issues fit into any potential future "cooperation" dialog? | Do HTS solutions represent a stronger defense against cyber-attacks, or are they a point of vulnerability? | How are regional market variations being reflected in the offerings which comprise regional operator initiatives? | How are such high demand applications markets as PSTN infrastructure extension/ telco trunking, broadband Internet access, and mobile terrestrial backhaul for GSM & 3G to LTE & 4G on planes, trains & ships to be satisfied? | and, Who will come out on top among the satellite operators, the manufacturers, integrators, network licensees and, ultimately, the users amongst the wireless operators, maritime & aeronautical interests, oil & gas companies, military, civil government agencies, and the individual consumer?

Across a keynote opening address and four 90-minute themed interactive panel sessions the HTS Roundtable 2018… GEOs… MEOs… LEOs: Enabling a Brave New World will offer an exploration of the ongoing evolution in the underpinning business and market economics of HTS, continuing to zoom-in on a range of specific analyses on the HTS ecosystem, including: The changing focus of the operators & evolution in the space segment; Emerging threats and opportunities for re-sellers in the value chain; Technology shifts in the ground segment; and, Mobility as the core revolutionary dynamic in today's broadband satcoms.

As at 1st October the HTS Roundtable 2018 draft program is as follows:

Opening Keynote Address: Satellite's Accelerating New Dynamics – Expanding Markets, Enhanced Services, Evolving Technology Platforms

Roundtable Session 1: The Operators… New Focus & New Orbits

Constellations Reimagined | HTS Supply – the Aeronautical & Maritime Corridors | Is the "App" Now Driving Satellite Design | HTS, the Cloud & IoT | Bandwidth – (Price) Wars in Space? | Orbits & Latency – A Competitive Divide? | Competing Down the Value Chain | How will GEO HTS & the Mega-LEOs Compete?

Roundtable Session 2: The VARs… New Challenges in an HTS World

Transforming the Satellite Broadband Value Proposition | Changing the Satellite Internet Paradigm | Today's Most Dynamic Markets | Changing Throughput/Pricing Dynamics | Cloud & the IoT – New Opportunity to the VAR Proposition? | What Does the Mobile Market Need from VARs?

Roundtable Session 3: The Ground Segment… Evolving Dynamics

Next Generation HTS Mobility Solutions | VSAT Antennas… Getting Smaller, the Changing Form Factor | Parabolic to Phased Array… Markets & Scales Characterized | In the Cyber Zone… Best Practice in Vendor & Customer Collaboration | Growth in Terminal Numbers & Interference Dynamics | Terminal Cost, Design & Function… Does the Customer Get What the Customer Wants?

Roundtable Session 4: Mobility, Mobility, Mobility

Where Next for Mobility? | HTS for IoT on Land, on Sea, in the Air | Mobile Trunking & Backhaul – A Defining Role with Satellite Integration in the 5G Mobile World? | Mobility – Who Are the End Users? | Navigating a Changing Value Chain – Acquisitions & Alliances | But, What about Enterprise VSAT, Consumer Broadband, Video, Government & Military?

Registration for the HTS Roundtable 2018… GEOs… MEOs… LEOs: Enabling a Brave New World is open. See you on 4th December at London's Strand Palace Hotel. You can contact me for more information at martin.jarrold@gvf.org.

Martin Jarrold is the Chief of International Program Development of GVF. He can be reached at martin.jarrold@gvf.org.

INTERVIEW

Executive Spotlight Mr. Fu Zhiheng Executive VP of Great Wall Industries

Despite ITAR restrictions, China continues to to build its domestic space capabilities to the point where its satellites are becoming competitive in the global market.

How do find Great Wall's position in the global launch market today?

China Great Wall Industry Corporation (CGWIC) has been in the international launch services market since early 1990s. As of today, Long March launch vehicles have performed more than 280 flights with high reliability. Among all these flights, CGWIC has provided over 50 launch services to our international customers, serving customers' needs with cost-effective solutions.

However, due to the US export control restrictions, Long March launch vehicles have not been able to compete fairly in the international launch services market since late 1990s. Currently, CGWIC has not been able to launch any western built communications and earth observation satellites, and our main focus on the launch market is on the small and micro satellite launch services, along with providing packaged in orbit delivery solutions with Chinese satellites, launch services and ground segment bundled together. Since there are highly intensive domestic launch manifest in China in recent years, CGWIC is also actively providing piggyback launch services, sending a lot of secondary payloads to space for international customers. CGWIC is also promoting newly delevoped small launchers to the market to provide quality and affordable services to the mirco and nano satellites.

What do you think of the International Traffic in Arms Regulations (ITAR) rules and how are you adjusting your sales and marketing strategy given the ITAR regulations?

For China's space industry, ITAR is a kind of political obstacle preventing us to compete fairly in market. It is somewhat used as a trade barrier for us. There are quite significant demands for our products and services, but we are not able to serve these demands due to ITAR constraints. We can fairly say that we would have a much bigger market share if no ITAR constraints existed, and many satellite operators would have an additional alternative choice to their business success.

However, the political barriers have not prevented CGWIC from becoming an active player in the commercial space market. CGWIC has been promoting launch services for unrestricted satellites, with more countries being able to manufacture such small in size but capable in performance satellites using COTS components. In the meantime, CGWIC's main strategy is to provide tailor-made packaged solution with launch services, satellite, ground tracking and control facility, satellite application, insurance, financing, and technical training in case of need. This approach is quite successful among customers in emerging spacefaring countries, who have not many experiences in procuring and operating a satellite system, and it has also attracted more and more established operators as well. Many es-

In July this year, CGWIC successfully launched a remote sensing satellite for Pakistan. The spacecraft, ground control and application systems, as well as technical support services, were all provided by CGWIC and its subsidiary companies.

tablished operators have recognized that our Long March rockets already have an excellent track record, and now people are realizing that Chinese satellites are also competitive and reliable.

Can you elaborate on your sales strategy? What markets are you going after and how are you approaching these markets? How different is your strategy with your competitors?

Packaged commercial space solutions differentiate us from our competitors in the market. Few of our competitors would like to provide the bundled solutions like we offer in the market. We are a system integrator for space product and services based on customers' demand. We even help some of them to do the early program planning. Our roadmap is to start business with emerging government customers, and expand to established operators. Our products are becoming more competitive especially in the medium capacity communications satellite market. We are also developing more competitive and advanced products for this market.

How are your newer satellites like the DFH-4 platform for your customers performing in orbit?

The DFH-4 platform is the third generation communications satellite bus in China and it is becoming more mature and more reliable. Our first DFH-4 satellite operational in orbit is VeneSat-1 for Venezuela, launched in 2008. Until now it has been in orbit for about ten years without any problem. It has been in operation in very high usage rate in capacity and has brought good economical returns to the customer. The international customers of DFH-4 satellite also include Nigeria, Pakistan, Bolivia, Laos, Belarus as well as commercial operators like APT of Hong Kong. Generally speaking, all these DFH-4 based satellites are performing well in orbit, which are also recognized by international insurance companies.

Talk about your newest satellite platform the DFH-5--what new technologies are you using for this satellite and what are its advantages over other satellite platforms in the market today?

As the next-generation geosynchronous orbit platform in China, the capacity and technical performance of DFH-5 satellite platform will be at a par with the main stream products in the market. With a lift-off mass up to 8000 kg, it will be able to accommodate much larger and complex payload, with higher output power and enhanced flexibility. New cutting edge payload technologies will also be adopted. DFH -5 platform will be able to meet the requirements for very high throughput satellites as well as other missions with various configurations.

How do you see the planned Low Earth Orbit (LEO) satellite systems?

As for the emerging LEO systems, It's true that they have some advantages over the traditional GEO systems, and they may have learnt some lessons from the previous generation LEO systems. But, to be realistic, I don't believe that all these systems will succeed due to limited resources available, both technically and financially. These LEO systems also have to face the intensive competition with the terrestrial as well as GEO systems. I think that the Chinese space industry is following the trend in the market and several systems are under planning. Generally speaking, it is a good thing for the satellite manufacturers and launch services providers, which may bring more opportunities as well as great challenges. For example, as a manufacturer and service provider, we have to innovate our production process in order to meet the demand for the deployment of the constellation as quickly as possible. In return, this will help the space technology and industry forward.

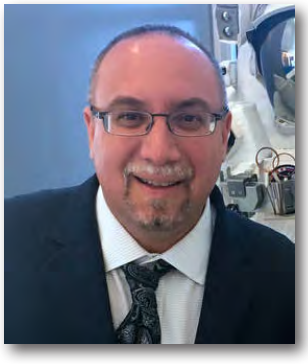
David Chegnion to Succeed Mustapha Elriz at the Helm of Satconsult, Subsidiary of Euroconsult Group

Paris, France, October 4, 2018 — SATConsult, a member of the Euroconsult Group, has announced the appointment of David Chégnion as managing director. In this capacity, David will succeed Mustapha Elriz who founded the company in 2006 and has served as its CEO since this date. Mustapha will continue to have a close relationship with the company, remaining a major shareholder and holding a position of Member of the Senior Advisory Board.

In order to provide for a smooth transition process, David joined SATConsult in March of this year to work by Mustapha's side in the position of deputy managing director. David brings with him over 25 years of experience in the telecom and satellite services industries and a balanced track record in international strategy and the management and development of organizations. Previously, David served as vice president, head of Strategic Development - Secure Communications at Airbus Defence & Space - CIS from 2014 and vice president, Sales & Business Development - Government Communications from 2008. David also managed the London-based satellite operator Europe*Star (sold to Intelsat in 2005) after holding several managerial positions in Alcatel Space (now Thales Alenia Space).

Following his nomination, David Chégnion thanked Mustapha and Pacôme for the trust that they have placed in him, allowing him to continue the work initiated by Mustapha. "I am especially grateful to Mustapha for his continued support and confidence over the decades that we have known each other."

Maxar's VP of Regulatory and Policy, Michael Gold, Joins NASA Advisory Council



Westminster, Colo., Oct. 3, 2018 — Mike Gold, vice president of Regulatory and Policy at Maxar and General Counsel of its Radiant Solutions business, has been appointed to serve as a representative member of the NASA Advisory Council by Administrator Jim Bridenstine, where he will chair the newly formed Regulatory and Policy Committee. As a NAC member, Gold will be part of a group that advises NASA's leadership on critical issues.A strong advocate for the commercialization of space and a trailblazer in his field, Gold guides Maxar through the regulatory and legal landscape affecting the space industry, enabling the company to deliver on its promise of unlocking space for both commercial and government organizations. Additionally, Gold continues to serve as the Chair of the Federal Aviation Administration's Commercial Space Transportation Advisory Committee.

"While technical development is important, it remains equally important for regulatory and policy to keep pace. There are numerous challenges ahead on this front, particularly as NASA seeks to develop and execute additional commercial activities on the International Space Station and transition to private sector space stations" Gold said.

NASA Advisory Council members are appointed by the NASA Administrator and provide expertise and insight regarding the agency's strategic plans, programs, and policies. Gold has written three law review articles and one book chapter on the intersection of export controls and commercial space.

John Hawker Joins **Kacific Sales Team,** Leading Efforts Across Melanesia and **the Pacific**

Singapore, Oct. 1, 2018 — Kacific Broadband Satellites has appointed John

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Hawker as vice president Sales, Melanesia and the Pacific. Hawker has held senior roles in both the telecommunications and satellite industries in several of Kacific's key markets throughout the Pacific and South East Asia. His experience in developing broadcast, data and telecommunication networks is highly relevant to the company's plans for the region.

Hawker comes to Kacific after serving as VP Sales Australia, PNG and Pacific islands for ABS Global. He previously held the position of Director, Asia Pacific for International Datacasting.

At Kacific he will establish service provider relationships to grow broadband services in Melanesia and the Pacific, including Papua New Guinea, Solomon Islands, Vanuatu, Fiji, Micronesia, Tuvalu, French Polynesia and Kiribati.

He will be able to draw on his experience with VSAT service providers in the Pacific, Southeast Asia and Africa as he helps the company forge strategic alliances to expand the Kacific ecosystem in the region leading up to the launch of Kacific-1 in 2019 according to the company.

Brian Holz Joins Akash Systems

San Francisco, Calif., Sept. 27, 2018 — Akash Systems, focused on resolving the explosive growth of data consumption by enabling smarter and lighter satellite systems, has appointed Brian Holz as chief architect. Holz brings extensive space satellite experience from his work directing the design and construction of satellite constellations for leading commercial organizations.

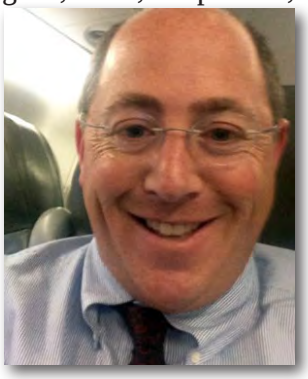
Akash Systems, focused on resolving the explosive growth of data consumption by enabling smarter and lighter satellite systems, has appointed industry leader Brian Holz as chief architect to design and build its satellites.

"With competition becoming fierce in the crowded satellite industry, we recognized the need to bring the best minds to our team," says Akash co-founder, CEO and GaN-on-Diamond inventor Felix Ejeckam. "A proven visionary, Brian is one of those minds, and he will bolster our systems development as we ramp up efforts to deliver next-generation RF communications links to a world that continues to demand increased connectivity."

With extensive experience in space systems engineering, program management and executive leadership, Holz will further Akash's mission of reimagining tomorrow's communication systems by developing the next generation of small satellites and the components that power them.

He was previously CEO of OneWeb Satellites, and executive VP and chief technology officer, O3b Networks. He brings expertise in startup management, global supply chain operations, multi-discipline team leadership and core technology development.

Comtech Telecommunications Promotes Michael Porcelain to COO, Michael Bondi to CFO



Huntington, NY, Sept. 26, 2018 — Comtech Telecommunications has announced that Michael Porcelain, the company's senior vice president, chief financial officer, has been promoted to chief operating officer. Porcelain will be succeeded in his role by Michael Bondi, who is currently the company's vice president, controller. These promotions are effective October 1, 2018.

Fred Kornberg, chairman and CEO of Comtech, said Porcelain, "As vice president, controller, Michael Bondi oversees Comtech's accounting operations, financial reporting and internal controls. He has been with Comtech for nearly 15 years and has always demonstrated strong leadership qualities, outstanding management skills and deep technical accounting knowledge. He is abundantly qualified, has high integrity and is the ideal successor as he provides continuity in this critical role."

Porcelain has been senior VP and CFO of Comtech since March 2006 and was previously VP of Finance and Internal Audit of Comtech from 2002 to March 2006. Prior to joining Comtech,

Porcelain was director of Corporate Profit and Business Planning for Symbol Technologies, a mobile wireless information solutions company, where he was employed from 1998 to 2002. Previously, he spent five years in public accounting holding various positions, including Manager in the Transaction Advisory Services Group of Pricewaterhouse-Coopers.

Kacific Appoints Matteo Catanuto to Head Sales in New Zealand and the Pacific

Singapore, Sept. 12, 2018 — Kacific Broadband Satellites has appointed Matteo Catanuto as Vice President Sales, New Zealand and the Pacific Region.

Matteo is a senior telecommunications sales professional who joins Kacific following his role at Digicel Samoa as Sales Director. Prior to that he held high-level sales and business development roles working for TelstraClear, Orcon, Spark Digital, and Digital Mobile (part of the Vodafone New Zealand Group). He has extensive experience in New Zealand and the Pacific in areas highly relevant to Kacific's growth strategy, including satellite connectivity, bandwidth and solution sales.

Matteo will be responsible for establishing service provider networks and distribution channels in New Zealand, American Samoa, Samoa, Tonga, Niue and the Cook Islands for the company's range of satellite broadband products and services leading up to the launch of Kacific-1 in 2019. Matteo holds a MSc from Liceo Scientifico, Milan and reports to the Kacific's Chief Commercial Officer.

Virgil Russell Appointed New Director of Sales and Marketing

Nashua, New Hampshire, Sept. 10, 2018 — AQYR Technologies has announced the appointment of Virgil Russell as their new Director of Sales and Marketing. He will succeed Rory Eddings who is taking over as AQYR's Manager of Commercial Sales.

As Director of Sales and Marketing, Russell will responsible for meeting company growth objectives. He will drive strategy development, establish and manage sales, marketing and business development processes and tools, oversee and directly contribute to capturing government orders, drive the full spectrum of AQYR's marketing efforts, establish and mature critical partnerships and lead AQYR's sales and marketing team.

Russell comes to AQYR from Data Device Corp. where he was a Regional Sales Manager supporting databus products, power solutions, and space capabilities. During the past 12 months he drove sales while building and leading a regionally focused team of Outside Sales Managers, Inside Sales Managers, Local Representatives, and Field Engineers.

Prior to DDC, Russell held business development and sales positions in Harris Corporation's (NYSE: HRS) Electronic Systems and Communications Systems segments. After starting as an engineer in 2001 he moved into Business Development supporting Commercial, Civil, and Intelligence Community space opportunities.

OneWeb Names Adrian Steckel as CEO, Eric Béranger as President and COO


Eric Béranger

McLean, VA, September 7, 2018 — OneWeb has announced the appointment of Adrian Steckel as Chief Executive Officer and Eric Béranger as President and Chief Operating Officer.

During Eric's tenure as Chief Executive Officer, OneWeb grew five-fold and developed the technical foundation to launch its system. In his new role, as President and Chief Operating Officer, Eric will ensure that OneWeb's innovative system of satellites and ground infrastructure can deliver high quality services to customer communities around the globe.

Boeing Completes Acquisition of Millennium Space Systems

El Segundo, Calif. — Boeing completed the acquisition of Millennium Space Systems, a provider of agile, flight-proven small-satellite solutions. Millennium Space Systems will operate under Boeing Phantom Works as a subsidiary called Millennium Space Systems, A Boeing Company.

It will retain an independent operating model while benefiting from Boeing's resources, scale, manufacturing capability and technology research as the leading provider of aerospace products and services.

Boeing first announced the agreement with Millennium Space Systems on August 16, 2018, pending U.S. government approval. Terms of the approved deal were not disclosed and do not affect Boeing's financial guidance or the company's commitment to returning approximately 100 percent of free cash flow to shareholders.

Headquartered in El Segundo, Calif., Millennium Space Systems has approximately 260 employees and has developed high-performance satellites and space systems for exacting missions ranging from 50 KG to more than 6,000 Kg.

Intelsat Announces Settlement of **Tender Offer for Intelsat Jackson** Holdings S.A.'s Outstanding 7 ¼% Senior Notes due 2020

Luxembourg, September 19, 2018 — Intelsat S.A. (NYSE: I) today announced the settlement of its previously announced tender offer by its indirect wholly-owned subsidiary, Intelsat Jackson Holdings S.A., to purchase any and all of its outstanding 7 ¼% Senior Notes due 2020.

Intelsat said the offer expired at 5:00 p.m., New York City time, on September 14, 2018. Based on final information provided to Intelsat Jackson by Global Bondholder Services Corporation, the depositary and information agent for the Offer, $1,723,269,000 in aggregate principal amount of the Notes were validly tendered (and not validly withdrawn) at or prior to the Expiration Time, and Intelsat Jackson accepted all of such Notes.

Settlement of the Offer was completed by Intelsat Jackson as of September 19, 2018, as set forth in the Offer to Purchase and the Notice of Guaranteed Delivery, each dated as of September 10, 2018. Intelsat Jackson used a portion of the net proceeds from its offering of its 8.50% Senior Notes due 2024 to fund the settlement, which offering also closed on September 19, 2018.

Global Invacom Acquires Assets **and Development Team from Skyware Technologies**

Singapore, Sept. 5, 2018 — Global Invacom has announced the acquisition, in the ordinary course of business, of certain assets together with the associated IP, R&D team and inventory from a number of companies across the Skyware Technologies Group.

The acquisition is for an initial cash consideration of US$3.1 million, with a further US$0.3 million to be provided as product, and a maximum additional US$0.5 million payable on delivery of revenue related earn-out targets. The consideration will be funded from existing cash resources on a debt-free basis.

Skyware Technologies designs and manufactures integrated transmitter/receivers for data over satellite (DOS) applications. The Group already has a leading position in DOS antennas and this acquisition will allow the Group to offer its customers the total DOS terminal solution. The Group is already unique in being able to offer reception electronics (Low Noise Blocks) and antennas for the Direct to Home market and the acquisition will allow the Group to extend this same unique position to the fast-growing DOS market.

The acquisition is expected to contribute to the financial performance of the Group in the first full year of ownership.

Trevor Gordon, Managing Director and Senior Vice-President of Skyware Technologies, will remain with the business post acquisition, along with the UK research and development team, based in Stockport.

Tony Taylor, Executive Chairman of Global Invacom, commented: "We are delighted to announce the asset acquisition of Skyware Technologies, which we believe will enable us to provide a complete antenna and electronics product set to customers across the data over satellite market.

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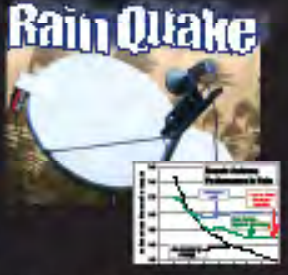

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Global PayTV and SVOD

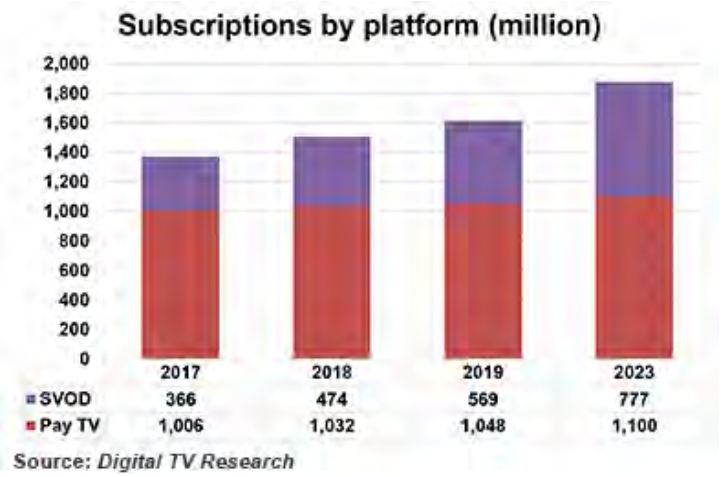
Subscriptions to Grow by 505-M

Middlesex, UK, Oct. 3, 2018 -- Global pay TV and SVOD subscriptions will reach 1,877 million by 2023. This total is up by 505 million (37%) from 1,372 million at end-2017 according to a new reserach. SVOD subscriptions will more than double between 2017 and 2023, but traditional pay TV will only add 94 million subscribers.

The US will have 289 million subscriptions by 2023; up from 222 million at end- 2017. Due to cord-cutting, traditional pay TV subscriptions will fall by 10 million to 80 million. However, multiple subscriptions will push the SVOD total from 132 million to 208 million.

Simon Murray, principal analyst at Digital TV Research, said "China is the brightest star by adding 171 million subscriptions during this period to take its total to 610 million. Its pay TV total will "only" grow by 32 million to 375 million, but SVOD will rocket by 138 million to 235 million subscriptions. India will add a further 49 million pay TV and SVOD subscriptions to take its total to 210 million in 2023."

Subscription revenues will only increase by 11% ($25.2 billion) to total US$ 251 billion between 2017 and 2023. Traditional pay TV revenues will drop by $18.5 billion to $183 billion. However, SVOD revenues will climb by US$ 43.7 billion to $69 billion. SVOD's share of the total will increase from 11% in 2017 to 27% in 2023.



Source: *Digital TV Research*

The US will remain the subscription revenue leader despite its total falling from $108 billion in 2017 to $105 billion in 2023. Pay TV subscription revenues will drop by $20 billion, with SVOD additions not quite high enough to make up the shortfall.

It is important to note that these figures are gross subscriptions. One household can have more than one subscription. For example, a household subscribing to pay satellite TV and Netflix would be counted as two subscriptions. Some homes pay for more than one SVOD platform. The TV Forecasts report provides forecasts for paying subscriptions across 138 countries.

New Research Says SVOD Service to Reach US$ 66.9-B by 2023

Hampshire, UK, Oct. 3, 2018 — A new Juniper Research has predicted that total revenues for Subscription Video On Demand (SVOD) services will reach US$ 66.9 billion by 2023, up from US$ 33.2 billion in 2018.

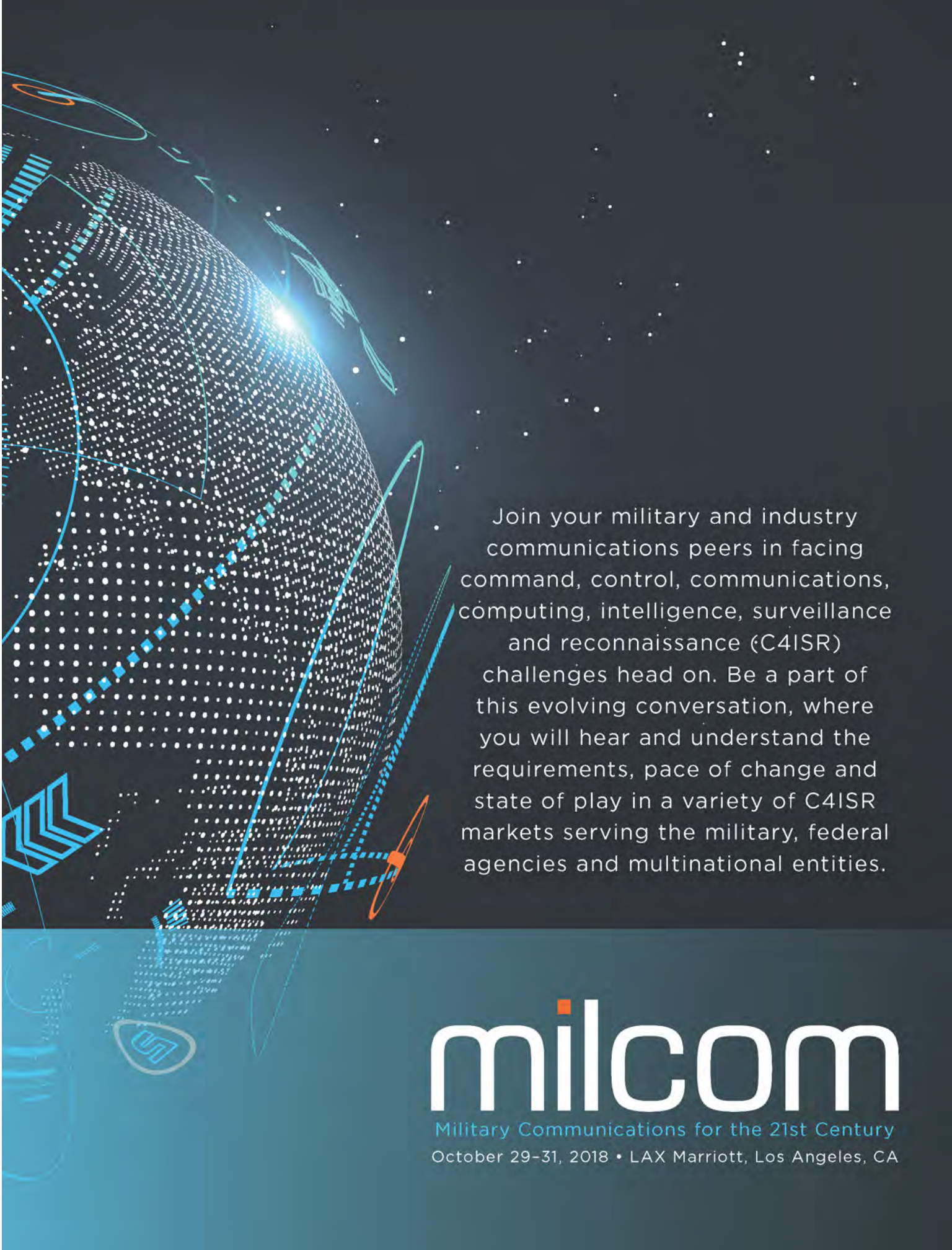
Producing its most comprehensive and in-depth study into the Digital TV & Video market to date, Juniper examined consumer attitudes and intentions, as well as current market trends and strategic opportunities for both traditional networks and disruptive OTT players.

Based on its findings, Juniper said SVOD has had significant press, with this format proving a substantial draw for 'cord cutters' or those doing away with expensive Pay TV subscriptions. Whilst initially these services were provided by OTTs, over the past 2 years a range of similar products have been launched by traditional providers.

These products include DirecTV Now which, for a starting price of US$ 40 per month, provides more than 65 channels as well as on-demand box sets and content. The service currently has in excess of 1.8 million subscribers in the US. In the UK market, Sky's Now TV offering has surpassed 1.4 million subscribers following its launch back in 2012.

The research also includes Case Studies of the leading Digital TV providers including Amazon, Netflix and Sky, as well as industry insights, trends analysis and 5-year forecasts.

Juniper noted that consumers



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in China are increasingly keen to pay a small fee to see advertising removed or to access premium content via sites such as iQiyi or Youkou Toudou. This is in contrast with the previous rapid growth in ad-supported FVOD (Free Video on Demand) services.

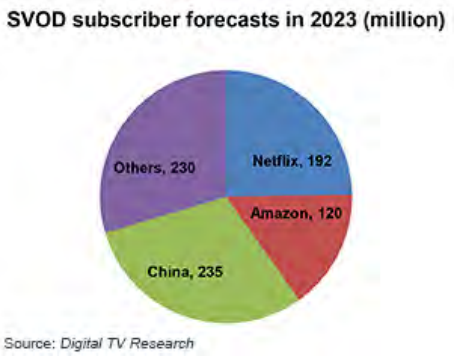
The survey stared in September 2018 when Juniper surveyed 500 smartphone users of streaming services, on their preference for SVOD (Subscription Video on Demand) and streaming services, alongside the devices used to stream, sports media watched, and content genres and opinions. The survey used natural fall out in terms of demographics and included respondents from the age of 14+.

Juniper's Digital TV & Video research includes a consumer survey conducted in the Chinese, UK and US markets to ascertain attitudes to online streaming services such as Amazon Prime and Netflix. The research also analyses current broadcast and OTT opportunities, monetisation strategies, key players, and future developments.

The study industry insights, sector dynamics, consumer survey, case studies, interviews, and benchmark industry forecasts.

Global SVOD Subscriptions to Reach 777 Million

Middlesex, UK, Oct. 3, 2018 — Worldwide paying subscription video on demand (SVOD) subscriptions will increase by 409 million between 2017 and 2023 to total 777 million and eleven countries will have more than 10 million SVOD subscriptions by 2023, a new research shows.



Source: *Digital TV Research*

China and the US will together account for more than half the world's SVOD subscriptions by 2023. China will have the most SVOD subs from 2019 – despite multiple subscriptions being commonplace in the US. China will have 235 million SVOD subscribers by 2023 – up from 97 million in 2017.

Simon Murray, principal analyst at Digital TV Research, said "The US will have 208 million SVOD subscriptions by 2023; up by an impressive 76 million on 2017 despite its relative maturity. Its share of the global market will fall from 36% in 2017 to 27% by 2023."

By 2023, Netflix will contribute 192 million subscriptions (25% of the 777 million subscriptions), Amazon Prime Video 120 million (15%), China 235 million (30%. Neither Netflix or Amazon Prime Video operate in China) and 230 million "others" (30%). Netflix will add 82 million subs between 2017 and 2023.

Amazon Prime Video launched in 200 countries in late 2016 – like Netflix, not in China. We forecast 120 million Amazon Prime Video's subscribers by 2023 – double the 2017 total. However, 110 million of the 2023 total will be in Amazon Prime territories, and therefore will not directly pay for the video platform.

SVOD revenues will reach US$ 69 billion by 2023; up by nearly $44 billion since 2017. The US will remain the SVOD revenue leader by a considerable distance – adding US$ 17 billion between 2017 and 2023 to take its total to US$ 29 billion.

The Global SVOD Forecasts report provides detailed forecasts for 694 platforms across 138 countries – covering movie and TV episode subscriptions, but not other services such as dedicated sports platforms. The figures are for paying subscriptions only and do not include trialists.

Gov't Funding in Space Exploration to Surpass US$ 20-B by 2027, Public & Private Initiatives Focus Interest on Moon Probe

Washington D.C., Sept. 27, 2018 — According to Euroconsult's latest report, Prospects for Splace Exploration, global government investment in space exploration totaled US$ 14.6 billion in 2017, a 6% increase compared to 2016. Fifteen leading space programs worldwide are estimated to contribute to this global investment with the U.S. accounting for 74% of the total.

Global expenditures have grown in the past five years driven by programs in leading countries and new countries investing in space exploration. In a still constrained budgetary environment, global space budgets for space exploration are expected to grow to over $20 billion by 2027.

"Future funding for space exploration is expected to grow to

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Moon exploration is receiving sustained growth in investment reaching US$2.8 billion by 2027. Photo credit: Boeing Company.

support the ambitious plans of the next decade. Nonetheless, national investments will remain constrained by their public finance environments that should dictate realistic and pragmatic investment strategies," said Natalia Larrea Brito, Senior Consultant at Euroconsult and editor of the report.

"Space exploration is attracting not only the interest of an increasing number of governments but also the private sector; start-ups to large companies seek to exploit the commercial potential of exploration activities. Space agencies are increasingly seeking to leverage partnerships with the private sector to achieve their goals more cost-effectively while fostering sustainable space exploration."

Key findings of the report include:

• At US$ 7.7 billion in 2017, transportation is the largest expenditure area; it is forecasted to reach nearly US$ 9 billion in 2027 supported by significant investments from multiple countries and particularly in the U.S. and China to support the development of next generation crew and/or cargo vehicles for LEO and Beyond-LEO activities.

• Orbital infrastructure is the second-largest application with US$ 3.5 billion in 2017, an investment which has been stable over the past five years. Funding should continue to grow, driven by investments in the ISS program and increasing funding for the development of the Lunar Orbital Platform-Gateway by ISS partners as well as China's investment in it space station.

• Moon exploration, which has received modest investment in the past five years, should experience sustained growth, reaching US$ 2.8 billion by 2027 to suport ambitious government missions and commercial partnership programs as Moon exploration becoes a central item in the exploration strategy of most agencies moving forward.

• Mars exploration budgets grew to US$ 1.5 billion in 2017; investment is expected to peak in 2018 as four missions are set for launch in 2020. After a cyclical downturn, new investment cycles to support planned missions might increase funding again to reach $1.3 billion in 2027.

• Other deep space exploration programs reached US$ 1.4 billion in 2017; global funding should reach US$ 1.8 billion by 2021 to support the development of multiple planned missions in the middle and end of the decade.

Over the past ten years, 19 planetary exploration missions were launched by six countries/agencies (the U.S., ESA, Russia, Japan, China and India). Over the next decade nearly 80 missions are expected to be launched, of which 63% will correspond to government missions. The next decade will also see the rise of commercial exploration initiatives, with close to 30 commercial missions forecasted by 2027, primarily driven by lunar initiatives.

In terms of applications, Moon exploration is expected to account for the majority of missions (64% of the total) to be launched by 2027, as lunar exploration becomes the focus in the strategy of private and public stakeholders. A total of 18 missions are anticipated to be launched for other deep space exploration, while the remaining missions will be dedicated to Mars exploration.

The Satellite Markets 20 Index™

Company Name	Symbol	Price Oct. 3	52-wk Range	
Satellite Operators				
Asia Satellite Telecommunications Holdings Li	1135.HK	5.90	4.62	7.49
Eutelsat Communications S.A.	ETL.PA	21.21	15.28	24.58
APT Satellite Holdings Limited	1045.HK	2.74	2.71	4.18
Inmarsat Plc	ISAT.L	501.40	334.30	651.50
SES S.A.	SES.F	19.37	10.64	20.25
Satellite Manufacturers				
The Boeing Company	BA	392.3	254.50	394.28
Maxar Technologies	MAXR	32.64	28.77	67.30
Lockheed Martin Corporation	LMT	347.44	291.52	363.00
OHB SE	OHB.DE	33.25	27.55	49.75
Honeywell International Inc.	HON	165.38	137.99	167.72
Equipment Manufacturers				
C-Com Satellite Systems Inc.	CMLV	1.06	0.98	1.30
Comtech Telecommunications Corp.	CMTL	34.24	19.30	36.94
Harris Corporation	HRS	169.09	133.66	170.72
ViaSat Inc.	VSAT	63.57	59.16	80.26
Gilat Satellite Networks Ltd.	GILT	8.75	6.24	9.34
Service Providers				
DISH Network Corporation	DISH	36.15	28.80	53.48
Globalstar Inc.	GSAT	0.51	0.40	1.72
Orbcomm Inc.	ORBC	10.72	8.50	11.96
Sirius XM Holdings Inc.	SIRI	6.26	5.17	7.70
Sky plc	SKY.L	1728.50	893.42	1730.50

The Satellite Markets 20 Index™ is a composite of 20 publicly-traded satellite companies worldwide with five companies representing each major market segment of the industry: satellite operators; satellite manufacturers; equipment manufacturers; and service providers. The base data for the Satellite Markets Index is January 2, 2008 - the first day of operation for Satellite Markets and Research. The Index equals 1,000. The Satellite Markets Index™ provides an investment benchmark to gauge the overall health of the satellite industry.

INDEX	Index Value Oct. 4
Satellite Markets 20 Index™	3,580.48
S & P 500	2,901.52

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- All-in-one positioner system & switchable manual or motorized operation
- Quick change tri-band feed and RF kits
- AvL AAQ computer-assisted pointing and acquisition
- Beacon receiver, ODU/modem integration and BUC/LNB integration
- Watch the video at avltech.com/media

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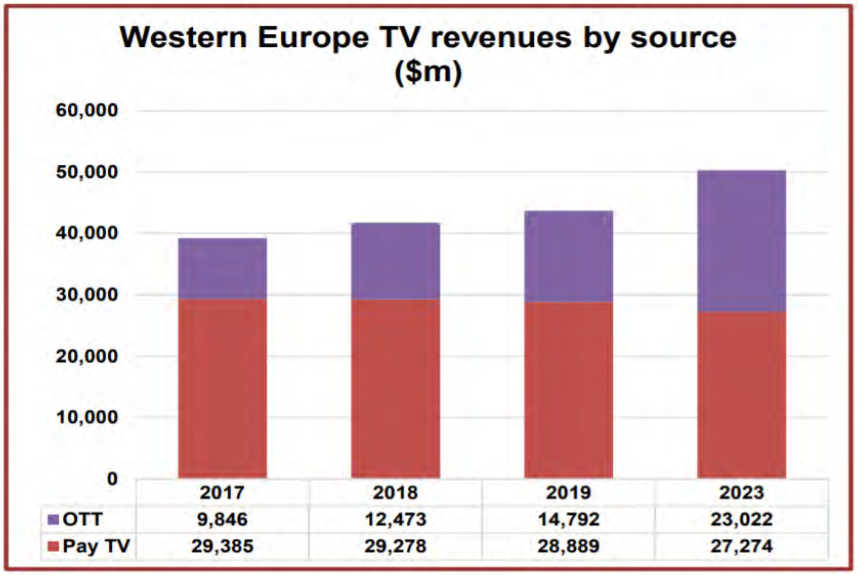
VITAL STATS



Western European TV revenues will reach US $50 billion by 2023; up from US$ 39 billion in 2017. OTT revenues for TV episodes and movies (including AVOD) will more than double from US$ 10 billion to US$ 23 billion. This will push OTT's share of the total up from 26% to 46%. Pay TV revenues will fall by US$ 2 billion over the same period. SVOD revenues will total US$ 12.47 billion by 2023 – up by $8 billion from $4.44 billion in 2017. Netflix will account for 57% Western Europe's SVOD revenues by 2023, up from 52% in 2017.