SATELLITE
evolution ASIA

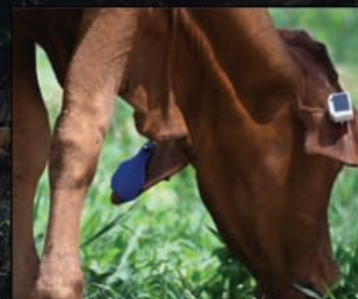...your connection to the industry...

Growing demand
for connectivity

Plus

Q&A Cobham SATCOM
Livestock tracking solutions
Comms on the move
5G interference problem

SAILOR.
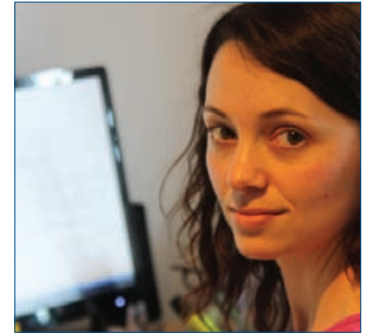COBHAM

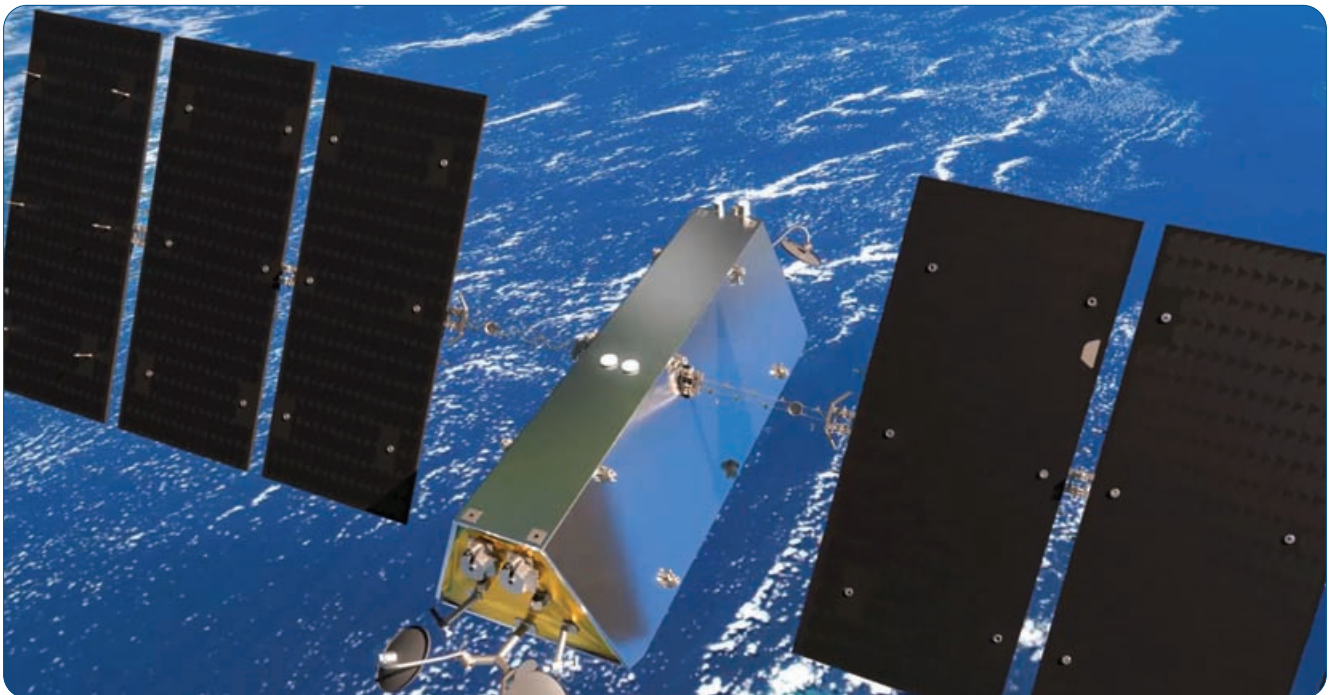# From today, nowhere is beyond reach

Amy Saunders
Editor

One small rock for mankind

Another surreal month for humanity trying to power through a pandemic: New, potentially vaccine-resistant variants of COVID-19 have already been found in several countries across the world; the COP26 climate conference due to be held in November is facing trouble due to a shortage of affordable vaccines among poorer countries; and the UK Government has gone back on one of their key election pledges, raising National Insurance in a regressive taxation move. However, it's been a record-breaking month for mankind in terms of off-world adventures.

Indeed, September saw NASA's Perseverance rover successfully capture its first sample of Mars material. The rock sample, around the size of a small cigar and dubbed 'Rochette' checks off a crucial first step in the decade-long expedition to bring back humanity's first Martian samples to Earth. If all goes well, the Perseverance rover will spend the next ten years looking for ancient signs of microbial life and collect dozens of samples to return to Earth inside an air-tight container sometime in the 2030s.

> "If all goes well, the Perseverance rover will spend the next ten years looking for ancient signs of microbial..."

In this Connectivity Special Issue of Satellite Evolution Asia, we've spoken with Cobham SATCOM's Jens Ewerling about the current wave of maritime digitization, IoT adoption at sea, and software-controlled antennas for communications on the move. Continuing on the IoT narrative, Gavan Murphy from Globalstar reports on the latest projects in satellite-supported livestock tracking in Africa, Norway, and Mongolia. We explore recent developments in off-world connectivity, with several highly significant lunar communications projects due for completion within the next couple of years; and a detailed analysis of communications on the move (COTM) advances with input from Viasat Government Systems' Craig Miller. Approaching 5G connectivity from different angles, ETL's Simon Swift outlines the potential for interference and potential solutions, while Manik Vinnakota from Telesat discusses the need for low Earth orbit satellites in the 5G ecosystem. Finally, Martha Suarez from the Dynamic Spectrum Alliance (DSA) details spectrum challenges currently underway in the Asia Pacific. ∎

Advanced Telesat Lightspeed satellites, manufactured by Thales Alenia Space

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Front cover: Photo courtesy of Shutterstock

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Save and protect: Express-AM5 satellite will warn about seismic activity

The Russian Satellite Communications Company (RSCC) and an international service provider Hunter Communications have put in place communication channels to monitor the earth's seismic activity. High-precision seismometers are installed in a number of regions of Yakutia, transmitting data via the Express-AM5 communications and broadcasting satellite located in geostationary orbit at 140° E.

Over one and a half million square kilometres of Yakutia's territory are earthquake prone. Every year, hundreds of earthquakes of various strengths occur here - up to 9-10 points on the 12-point MSK-64 scale. The most dangerous are the northeast and south of Yakutia. The sensors allow you to record the vibration of the earth's crust, even if the source of the shock wave is located in another region of the globe, which makes it possible to predict an earthquake in advance. Going forward, the coverage of the VSAT network for monitoring seismic activity will be expanded to include the whole of Eastern Siberia.

According to Hunter Communications president Brent Perrot, "Sixteen years ago, Hunter helped establish the first such seismic monitoring network in the Caribbean. For that many years, early warning signals from seismic sensors made it possible to arrange timely evacuation of residents from the dangerous areas and save several hundred thousand lives. In 2021, it was information about an impending volcanic eruption, received from the sensors on the Saint Vincent Islands off the coast of Venezuela that made it possible for local authorities to stave off catastrophic consequences and avoid loss of life. We are confident that our expertise in building such networks and well-developed technologies will help in our joint work with RSCC on a project in Russia."

For his part, RSCC General Director Alexey Volin noted that RSCC seeks to maximize the use of satellite technologies: "Today our satellites support options to receive not only communication and television services. They can be used in other areas that are extremely important for the economy and life in general. The use of satellites for monitoring seismic activity is one of the new aspects of our business. I am sure that our efforts will not be limited only to Eastern Siberia. Since our satellites now cover 69 percent of the Earth's surface, this service may be in demand in other regions as well." ∎

OneWeb confirms successful launch of 34 satellites from Baikonur

OneWeb has successfully launched another 34 satellites. Launched by Arianespace from the Baikonur Cosmodrome in Kazakhstan, this latest successful launch brings OneWeb's total in-orbit constellation to 322 satellites, nearly half of OneWeb's entire 648 LEO satellite fleet that will deliver high-speed, low-latency global connectivity.

The successful launch builds on the strategic distribution partnerships and agreements across a wide array of providers and businesses, including several earlier this month, including with AT&T, Hughes Network Systems, and Peraton. These agreements, along with others struck earlier with partners including Alaska Communications, BT, and Northwestel, are aimed at bringing improved digital communication services to some of the hardest to reach parts of the world.

Lift-off occurred on 14 September at 7:07pm BST. OneWeb's satellites separated from the rocket and were dispensed in nine batches after 3 hours 45 minutes into the flight, with signal acquisition on all 34 satellites confirmed. With this launch, Arianespace also celebrates passing the mark of 1,000 satellites successfully launched to space.

OneWeb remains on track to start service this year at the 50th parallel and above with its constellation and to deliver global service in 2022. The company continues to see growing demand from telecommunications providers, ISPs, and governments worldwide to offer its low-latency, high-speed connectivity services to the hardest to reach places. OneWeb has raised US$2.7 billion since November 2020, with no debt issuance.

Neil Masterson, OneWeb CEO, commented: "The team

continues to stay focused on execution and delivering our network. I am enormously grateful to the team and all our partners who are making these milestones possible. We continue to see a huge and growing demand for our services from global customers, and we are incredibly excited about both introducing commercial service and scaling our global network."

Spire Global to acquire exactEarth

Spire Global, Inc., a leading provider of space-based data, analytics, and space services, and exactEarth Ltd. announced that the companies have entered into a definitive arrangement agreement under which Spire will acquire exactEarth for approximately US$161.2 million in cash and stock. Once completed, exactEarth will become a fully owned subsidiary of Spire and continue to operate from Cambridge, Ontario, Canada under the leadership of exactEarth's CEO Peter Mabson, reporting directly to Spire CEO Peter Platzer.

"Peter and I share a vision about the opportunity for space-based maritime data and the digitalization of the global maritime industry, and I look forward to pursuing that vision together," said Peter Platzer, Spire's CEO. "I have great respect for the highly experienced team at exactEarth and am excited to continue driving this digital transformation together, serving more customers with a more robust data and solutions platform."

The combined company aims to be transformative for customers and the maritime industry. Bringing together real-time and historical space-based maritime data, Spire and exactEarth will provide customers with innovative solutions that drive the digitalization of the almost US$2 trillion global maritime industry, such as better fleet visibility for more efficient routing, cost savings from reduced fuel consumption, and a lower environmental footprint.

"We look forward to joining forces with the Spire team to not only have an impact on the maritime industry, but also to have an impact on the planet, through offering customers enhanced data solutions that are designed to impact not only a company's bottom line, but also its environmental footprint," said Peter Mabson, exactEarth CEO.

Strategic Rationale

- Increases Spire's customer base by over 75 percent. In the maritime S-AIS (Satellite-Automatic Identification System) industry, exactEarth will accelerate Spire's expansion by adding over 150 customers. These customers in the commercial and government sectors will provide substantial cross-selling opportunities of Spire's data and analytics products.
- Minority indirect ownership stake in IoT provider Myriota, a fast-growing player

in the low-cost, low-power, secure direct-to-orbit satellite connectivity for Internet of Things. This affords Spire a solid first foothold in this high-growth industry of space-based IoT solutions. exactEarth will retain its board seat.
- Strong Addition to ARR. With approximately 90 percent of exactEarth's US$18.2 million LTM revenue under subscription contracts, and a Net Retention Rate of approximately 130 percent, exactEarth will accelerate Spire's growth in annual recurring revenue (ARR).
- Expands Historical Database to accelerate AI/ML driven product development. exactEarth's 10-year archive of AIS data will substantially increase Spire's historical maritime (AIS) data set, accelerating Spire's new product offerings and solutions.
- Adds depth of experience to maritime and product development teams. With an average tenure of over 7

years, exactEarth's experienced sales and product development team will enhance Spire's global market capability and reach in the maritime industry.

- Expands Spire's geographic footprint. exactEarth sells to 39 countries around the world.

Details on the Proposed Transaction

The total transaction consideration of US$161.2 million is comprised of approximately US$103.4 million in cash and US$57.8 million in Spire's Class A Common Stock.

The completion of the transaction is subject to approval by at least two-thirds of the votes cast at a special meeting of exactEarth shareholders which is expected to take place in November 2021. The transaction is also subject to applicable regulatory approvals and the satisfaction of certain closing conditions customary in transactions of this nature. The transaction is not subject to any financing condition.

The directors, officers, and certain shareholders of exactEarth, collectively holding approximately 60 percent of its outstanding common shares, have entered into voting support agreements under which they have agreed to support and vote in favour of the transaction.

This acquisition is expected to close in calendar 4Q21 or in calendar 1Q22. ◼

SES sees uptake in cloud-enabled media playout service worldwide

An increasing number of broadcasters and channel operators worldwide are adopting SES's Cloud Playout service to better manage their linear TV channels and content assets flexibly and cost-effectively according to SES. This recent shift to cloud-based services means that SES now has more than 60 TV channels from Africa, Europe and Asia-Pacific that started utilising SES Cloud playout services since Q1 2021.

Leveraging the elastic scale and economics of the cloud, SES's Cloud Playout enables TV broadcasters and channel operators the ability to reliably prepare TV content for broadcast in a matter of minutes regardless of where they are since there is no need for on-premise hardware. Designed natively in the cloud, SES's Cloud Playout provides unparalleled flexibility and scalability while leveraging virtualized hardware with modular design of playout functions such as archiving, playlist, playback, encoding or graphics – all to ensure resiliency and cost-savings for the media customers.

One market with recent Cloud Playout momentum is Ethiopia. An increasing number of broadcasters on Ethiosat, Ethiopia's first-ever dedicated free-to-air (FTA) TV platform, have moved to SES's Cloud Playout service to better manage their linear TV channels and content assets flexibly and cost-effectively.

One such Ethiopian customer, Engidawork Gebeyehu at Yegna TV, said, "With a focus on local, in-country content, the Ethiopian TV market has been expanding significantly in the last years with TV playing an integral part of people's lives – ranging from entertainment to education – especially during the COVID-19 pandemic. With SES, we are able to respond to viewer demand and bring content to their homes faster and more flexibly than ever before via the cloud, meeting viewer demand for more local content. Using the cloud playout services also means that we are no longer restricted by hardware constraints and can get a channel ready for distribution much faster than before."

"At SES, we believe the cloud can maximise opportunities for growth with an inherently flexible and highly scalable broadcasting solution, enabling our customers to focus on attracting new audiences and create engaging content," said Yvonne Bertalot, Director of Broadcasters Segment Market Management at SES. "It is therefore rewarding when we see how our customers feel the same as they increasingly adopt our cloud capabilities to expand their offerings." ◼

Leaf Space partners with Australian in-space logistics provider Space Machines Company

Leaf Space, a leading provider of ground segment as-a-service (GSaaS) solutions, has partnered with Australian in-space logistics provider Space Machines Company to support its first orbital transfer vehicle, Optimus-1, launch next year.

With corporate headquarters in Lomazzo, Italy, and US headquarters in Northern Virginia, Leaf Space provides ground segment services for both satellite operators and launch providers throughout the entire lifecycle of their operations, beginning with launch and early operations (LEOP), ongoing mission operations, and extending through decommissioning of the space asset. The company has focused on developing disruptive services and technology that are innovative and affordable to a range of customers.

"We are excited to announce this partnership with Space Machines Company as it highlights the growing need for precise in-space logistics as we see more and more satellites go into orbit, each with specific mission requirements," said Jai Dialani, Managing Director at Leaf Space. "Leaf Space is looking forward to providing our fast, reliable and flexible ground station solutions to support Space Machines Company's Optimus-1 mission next year."

The partnership will enable Space Machines Company to utilise Leaf Space's Leaf Line solution, which will employ Leaf Space's global ground station network to support the launch of its first Orbital Transfer Vehicle in 2022.

Space Machines Company is an Australian start-up that develops in-space logistics capabilities, including deploying satellites into desired orbits, servicing, powering, and assembling space infrastructure and supporting deep space missions.

Rajat Kulshrestha, Space Machines Company founder and CEO, said this partnership is another critical step in preparing its first mission in 2022. "We are proud to partner with Leaf Space as it is an important step in furthering Australia's sovereign capability and expanding our services globally."

Leaf Space pioneered the concept of ground segment-as-a-service (GSaaS) for satellites and launch vehicle operators around the world and have successfully partnered with more than 20 customers to increase performance and availability of crucial data while simultaneously lowering costs and decreasing latency. ◼

Apax Partners to sell a majority shareholding in Marlink to Providence Equity Partners

Providence Equity Partners, a premier private equity firm that specialises in the media, communications, education, software, and services industries, has agreed to acquire a majority shareholding in Marlink from Apax Partners SAS, a leading European private equity firm based in Paris. The transaction results in an enterprise value for Marlink Group of approximately US$1.4 billion; further details were not disclosed.

Apax, who maintain deep conviction in the Company's

growth prospects, will retain a significant minority shareholding. Marlink's management team and world leading investment house Ardian have also committed to minority interests.

Headquartered in Paris and Oslo, Marlink is a world leading satellite service operator (SSO) offering business-critical intelligent hybrid networks and digital solutions to empower the remote operations of a wide range of maritime, enterprise, energy, humanitarian, and government customers around the world.

"Marlink offers a comprehensive set of smart network solutions combining the entire spectrum of satcom and terrestrial connectivity, IT, Cloud, cyber security and IoT managed services." said Karim Tabet, Senior Managing Director at Providence. "We are pleased to be partnering with such an outstanding business, and, together with Apax and Ardian, we look forward to supporting Erik Ceuppens and his team as Marlink continues to be a market leader and seeks to capitalize on increased demand for higher bandwidth connectivity and digital solutions."

Michaël Vervisch, Managing Director at Providence, added: "We have been impressed by the Company's transformation into a branded broadband provider leveraging its own hybrid network and capturing scale benefits by taking a leadership role in the industry. Furthermore, we see significant future growth opportunities, including through offering value added digital solutions."

Bertrand Pivin, Partner at Apax Partners, said: "Apax Partners first invested in Marlink 15 years ago. Under the leadership of Erik Ceuppens, the company transformed its business model, tripled its revenues, and multiplied its EBITDA by ten. It emerged as the worldwide leading Satellite Service Operator, first in the maritime sector, and now, with the recent acquisition of ITC Global, in the enterprise sector. The 10,000-strong remote broadband terminals installed worldwide will serve as a springboard to design and deliver the much-needed digital services which Marlink's direct customers are seeking for their business-critical operations. We believe Providence is the partner of choice to conduct the next stage of this extraordinary journey. Apax is keen to roll-over part of its investment and hold a significant fraction of the share capital, in order to continue to back this remarkable company."

Erik Ceuppens, CEO of Marlink, said: "This important shareholder transaction is a reflection of their belief in our company's strength and future growth potential. Marlink has become a leader in B2B satcom solutions through significant organic growth and a series of well-targeted strategic acquisitions. With our Smart Network strategy, Marlink is fully focused on supporting the rapid digitization of our customers' remote operations and on making them more sustainable. We are delighted to partner with premier private equity investors Providence and Ardian as our new majority shareholders and to benefit from the continued support of Apax, our investor-of-the-first-hour. With our solid investor backing, management team and employees, we form a powerful force to take Marlink Group to the next level."

Alexandre Motte, Head of Ardian Co-Investment said: "We have been impressed by Marlink's unique position in the B2B satcom industry and the accomplishments of Erik Ceuppens and his team. We are thrilled to participate in this new chapter of Marlink's development, supported by increasing connectivity and service needs as well as further growth opportunities, notably through acquisitions. We thank Marlink, Providence and Apax for their trust and look forward to supporting this partnership." ∎
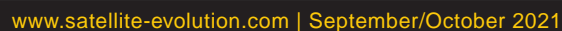
Making waves in the connectivity market

With the launch of Cobham SATCOM's SAILOR XTR antenna platform, the company has been enjoying some strong early feedback. Jens Ewerling, VSAT Product Manager, outlines why the product has been making waves and how the pandemic has altered demand in maritime connectivity as it continues to become more heavily digitised.

Jens Ewerling, VSAT Product Manager, Cobham SATCOM

Laurence Russell, Assistant Editor, Satellite Evolution Group

Question: Cobham has conducted and observed research on the 'new high standard for the future of maritime satcom.' What were your findings?

Jens Ewerling: We prioritize a strong research focus on the evolution of maritime satellite communications demand. We've found that when ships leave coastal regions, they leave terrestrial range within just an hour. So, the satellite takes over almost immediately and is the pivotal fulcrum of a ship's connection to the world, its networks, and the vessels around it. We're quite aware of our responsibility to provide the kind of reliability and flexibility that our partners can trust.

Question: As we begin to grasp the post-pandemic world, what are the modern connectivity demands of the maritime sector?

Jens Ewerling: There have been times during the pandemic when there were up to 200,000 seafarers stranded on their respective ships, meaning there were no ports that were available to admit them, and they were unable to bring new crew aboard. Some of those labourers had been aboard the same ship for a year and a half and were legally unable to leave.

Usually, the standard in modern shipping allows for crew exchanges every three to four months, which are broken up by breaks between six weeks and two months long to spend with their families. If those ships had lost connection, they would have been completely cut off from their loved ones for an incredibly long time.

Naturally, the pandemic accelerated the uptake and upscaling of communications technology in order to assure that kind of reliability. Before these unprecedented times, there was a reluctance in the industry to accept digitalization, however there is now more recognition of its potential to increase operational efficiencies and deliver ROI, which has led to owners and operators actually installing more advanced systems to stay ahead of demand.

Question: The SAILOR XTR antenna platform is the first of a new generation of software-controlled antenna systems designed for quick deployment, operational reliability, simplicity, and best-in-class radio frequency (RF) performance. Could you expand on its capabilities?

Jens Ewerling: The XTR system was designed to cater to the emergent capabilities that satellite constellations can provide to the maritime market. Our focus on accessibility and reliability are encompassed by what we've been calling 'rapid deployment technology.'

It wasn't that long ago that maritime VSAT was so complicated that it necessitated two or three specialised engineers equipped with dedicated technology to establish and maintain connections. All that work has now been replaced with the functions of software that come packaged with the VSATs. That's changed the nature of the

SAILOR XTR antenna. Photo courtesy of Cobham

marketplace, which we're keen to expand upon with the simplicity of the XTR antenna.

Question: What are the potential efficiencies of maritime digitization and IoT adoption?

Jens Ewerling: With the antenna being such a pivotal gateway between ship and shore, we need to make sure every safeguard is in place so to ensure its reliability. That means real-time monitoring with cloud technology. That's vital to ensuring results.

On a wider scale, there's simply a massive demand for ship digitization. Most ships in operation aren't digitised and remain analogue. There's an extensive potential there for updating vessels for IoT support and the yields such innovations would bring.

For example, courier companies like FedEx know the whereabouts and service status of all of their trucks and can reliably determine the service cycles of important aggregates like engines. That kind of awareness is a far cry from the shipping industry, which remains nowhere near that level of control.

We've seen how the transport industry has benefitted from the assurance of real-time tracking and system health monitoring on land already. Those efficiencies are yet to be realised at sea, but there's a lot to gain from it.

Question: What are the benefits of a software-controlled antenna?

Jens Ewerling: The unique antenna platform of SAILOR XTR is driven by software and therefore can handle important management and set-up tasks from the safety of the ship's superstructure, which would otherwise require mechanical intervention leaving operators exposed to the elements. No one needs to measure and apply cable attenuation or position the antenna mechanically. The SAILOR XTR finds its own centrelines via satellites and checks antenna cables itself.

This system has been streamlined

> **"The XTR system was designed to cater to the emergent capabilities that satellite constellations can provide to the maritime market. Our focus on accessibility and reliability are encompassed by what we've been calling 'rapid deployment technology."**

to the point that it's as user friendly as the average smartphone application.

Question: Many actors are concerned about the increasing threat of cyberattacks on their operations. How does Cobham SATCOM technology and SAILOR XTR answer their worries?

Jens Ewerling: In a proper installation, maritime antennas and user terminals in general are not directly connected to the Internet. However, should such direct connection be made either on-board directly or over a satellite Internet connection we also employ an encryption key chip in our antenna which collaborates with our software, making it impossible for hackers to read the private keys associated with them after set-up.

Question: How has SAILOR XTR fared on the maritime market? What feedback have you received from customers and partners on the product?

Jens Ewerling: We've seen some fantastic feedback so far, though at the time I'm answering we are still in the product launch phase, having begun shipping a month prior.

After a two-and-a-half-year development process and a June 2021 launch, we've only just begun to hear the extent of our partners' thoughts on the product, but what we have heard has been very positive.

Many of Cobham SATCOM's goals are associated with the production and launch of the XTR antenna platform. We've been working with many of the up-and-coming satellite constellation companies in the interest of understanding their requirements on the ground and we're quite pleased to find that what we designed our antenna to do, has been exactly in line with what the satellite companies and service providers have been expecting.
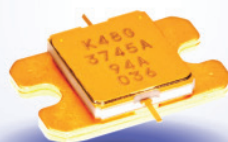
We're well-positioned for the LEO/MEO revolution to come, and to continue serving the march of global digitisation in order to serve the maritime market as effectively as possible. ∎

SAILOR 1000 XTR Ku. Photo courtesy Cobham

Spotter horse tracking. Photo courtesy Globalstar

Satellites and IoT combine in best-of-breed tracking solution for livestock owners

Internet of Things (IoT) technologies have changed the world undoubtedly for the better, with industries including mining, energy, oil and gas, agriculture all benefiting hugely from the ubiquitous, remote connectivity opportunities available today. For livestock owners, IoT has enabled a massive leap forward in capabilities, achieving unparalleled operational improvements.

Gavan Murphy, Director of Marketing EMEA, Globalstar

We've seen an explosion of innovative ways in which the Internet of Things (IoT) can be harnessed to solve real-world problems. These range from keeping tabs on high-value engineering equipment to monitoring sea-faring support vessels in the energy sector. IoT technologies are helping oceanographers track and mitigate the spread of plastic pollutants while elsewhere IoT-enabled sensors are helping beer to stay at exactly the right temperature and pressure in their tanks while in transit in order to yield the perfect pint on arrival.

Additional to the need for an always-on communication link with the items in question, all the scenarios described above share another overarching element – they all involve assets and objects travelling into locations where conventional wireless communications, including GSM, simply can't be relied on.

For effective tracking of something in motion as it travels across remote settings, on land or at sea, coverage ubiquity

and dependability are only possible through satellite communications.

In the years since the IoT became common parlance, one of the sectors which has seen the most dramatic levels of IoT solution expansion, and which has perhaps derived the most direct and powerful benefit, is agriculture and farming, even leading to the creation of a category of technology called 'agtech.'

The need for solutions which help track and manage livestock is a major part of this. *A big milestone for Globalstar happened earlier this year with the commercial debut of C*eres Tag. Launched by Ceres, an Australia-based company, Ceres Tag is an animal monitoring solution which has Globalstar satellite communications at its core.

Ceres Tag is the result of five years of development and testing, with involvement of several Australian government agencies, always with animal welfare the abiding priority. The company built its bespoke solution, now being marketed internationally, based on Globalstar's ST100 chip. A critical factor was that the ear tag needed to be very small and

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Gavan Murphy, Director of Marketing EMEA, Globalstar

lightweight so as not to harm the animal. The tag is solar-powered with a battery replacement life of 10 years, providing livestock managers with an ultra-low-maintenance, resource-efficient system.

The automation of information about where livestock animals are, their welfare and condition any time of the day, and understanding their behaviours can fundamentally improve farmers' ability to manage animals and land for a more sustainable and productive future.

Traceability, biosecurity, performance, health, and welfare have never before been in the spotlight as they are today. Ceres Tag can generate automated daily records of animals and inform on pasture feed intake – primary to determining feed efficiency – as well as genetic selection and managing of greenhouse gas. Ceres Tag has been named #1 Big Breakthrough Technology for AgChange in the Next Decade by the AgJournal magazine.

As the numerous ways in which monitoring herd animals can lead to their improved overall well-being have become more widely understood, longer-established specialist technology providers are continuing to develop. They're creating next-generation solutions which offer ever-more sophistication and features.

Next-generation horse tracking is now enriched with breeding data

For instance, in response to market demand, in 2014 Mongolia-based Globalstar VAR, Spotter, created a tracking solution for horses.

Horses are central to daily life of Mongolians, and horse racing is a major sport. But since the sparsely populated nation's 4.5 million semi-wild horses roam fence-free, keeping tabs on the valuable equines is a major challenge.

While the region's horses typically don't travel more than 50km from home, they sometimes wander hundreds of

kilometres to find good grass, or they can get lost in high winds and storms. Some go missing for months, and others never make it back to their owners, increasing the risk of theft.

Spotter built its collar around Globalstar's SPOT Trace tracker, chosen for its economical price, but also its small size which made it easy to integrate. SPOT Trace's ease-of-use, configurability – allowing the owner to choose the frequency of tracking – and fixed price for transmissions were also deciding factors.

GPS trackers and systems relying on GSM had already proven inadequate. So, Spotter's satellite-enabled solution was an instant hit.

Spotter subsequently developed another collar – this time built on Globalstar's SmartOne C IoT transmitter – which it brought to market in 2019. With its long-lasting battery, it's ideal for tracking far-roaming herds.

Enkh-Amgalan Ganbaatar, Spotter co-founder and CEO, explains that both types of collars are useful for different customers: "Requirements differ for tracking racehorses compared with ordinary horses, and depending on the location. Racehorse owners are eager to keep particularly close tabs on their valuable animals, so they appreciate the hourly tracking SPOT Trace enables. Meanwhile owners of family herds and those who use horses for transportation, meat and milk value the extended tracking duration and lower maintenance made possible through SmartOne C's extended battery life."

Today some 5,000 Spotter collars are deployed in Mongolia with uptake expanding widely into Kazakhstan, Kyrgyzstan, and Tajikistan.

Spotter's solution continues to be in high demand; this has spurred Spotter on to develop further. Spotter recently released new Android and iOS apps with a choice of three different mapping solutions. One of these offers offline mapping, so that when the farmer heads out to tend to horses in extremely remote steppe, where there's no mobile signal, the Spotter solution can still help find the animals.

By the end of 2021, Spotter customers will also be able
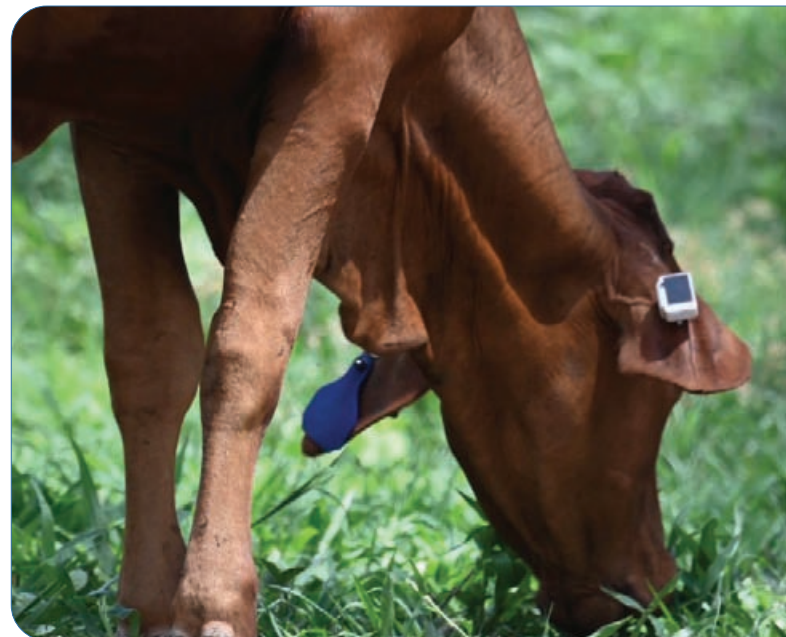
Ceres-Tag. Photo courtesy Globalstar

to benefit from integration of a rich dataset of individual horse registration information. The lineage and other breeding data for any particular horse, with photos, will be viewable with just a single click on the Spotter interface. This capability will give owners unprecedented depth of knowledge of their free-roaming stock. "We are creating a complete horse-centric platform to give farmers highly granular understanding of their herds, enabling them to take informed future-looking livestock management decisions," says Spotter's Ganbaatar. Additionally, Spotter's customers can register their horses with microchips and link to the livestock theft prevention division of local police.

Tech devised by pioneering Norwegian sheep farmer now helping safeguard 50,000+ livestock

Norway-based FindMy has been a true trailblazer in this field and epitomises satellite IoT animal tracking innovation. FindMy was set up by Halvor Mjoen, his sister Marit Mjøen Solem, and her husband Arnstein Solem. The Mjoens have been sheep farmers for generations, and they know all too well how vital it is to safeguard the family's livestock. In the 2009 mountain grazing season, predators claimed over a fifth of their herd.

Determined to find a solution to protect the family's livestock in a region where there's no mobile coverage, Mjoen created a satellite-based collar that acts as a virtual shepherd, alerting the farmer to potential problems. The result was FindMySheep AS, and the start of a close partnership with Globalstar.

The Norwegian government also wanted to co-fund an initiative to track livestock in order to understand why hundreds of sheep were disappearing each year. This funding which FindMySheep secured enabled it to launch as an entire solution with back-office functionality that enables farmers to visualise the location of their animals at any time. Since rebranding as FindMy, and having become a Globalstar partner, the solution's geo-fencing capability alerts the farmer when an animal or flock is wandering too far so that the animals can be herded to safety.

FindMy built the collars around Globalstar's STX3 chipset for its small size, ruggedness, long battery life, easy integration, as well as its competitive price, enabling Mjoen to set farmer-friendly price points.

In 2019, as it celebrated its 10th anniversary, and the milestone of 50,000 deployed collars, FindMy introduced its next-generation platform to the international market. The new design is smaller and more lightweight, has Bluetooth, and requires much lower maintenance thanks to new extra long-life replaceable batteries. The latest collars feature a custom-designed antenna which ensures high messaging success rates. Explains Mjoen: "We've also now industrialised our solution, and the new collar is both more energy-efficient and robust; it can really take a beating."

FindMy's software delivers new functionality, including delivering a complete herd/flock location update at particular convenient times of day as specified by the farmer. If the track points suggest something's wrong, the farmer knows exactly where to head. The system also now includes an

FindMy animal tracking is enabled by Globalstar technology. Photo courtesy Globalstar

improved accelerometer and motion detector sensitive enough to detect if an animal is in distress, such as if it's frightened or being chased.

FindMy collars communicate with Globalstar satellites to geo-fence livestock, helping to ensure animals graze only in designated areas, and to locate those which have escaped or are injured.

FindMy's data trail empowers farmers to analyse areas of best-quality grass and they can proactively manage grazing for future seasons. Farmers deploying FindMy report a significant reduction in animal loss, with consequent direct positive impact on their business.

FindMy additionally helps protect free-roaming reindeer for owners across the Nordic region, reaching inside the Arctic Circle, where reindeer husbandry has been practised for a millennium by the indigenous Sami culture.

In its 12-year partnership with Globalstar, FindMy has successfully transmitted over 20 million satellite-enabled IoT tracking messages. Says Mjoen: "We owe our success to listening carefully to our customers, understanding their everyday operations, and working to deliver what they really need."

Satellite IoT helping Africa's farmers and wildlife conservationists

Africa's farming sector, where livestock often roam fence-free, has seen huge growth in demand for satellite IoT tech in recent times. Livestock theft is a serious day-to-day problem, and predators pose extra risk. Farmers are embracing satellite technology as they see the value of reliable tracking and geo-fencing.

Streamline South Africa developed its IoT-enabled Guardian Animal Tracking Collar based on Globalstar's ST100 IoT chip, and it's growing in popularity. In one deployment, Streamline's collar is tracking 7,500 cattle on 67,000 hectares in South Africa. This is the home of the world's biggest herd of Pinzgauer cattle, an Austrian breed praised for its fertility, disease-resistance, and high beef quality. In the past, in any year as much as 30 percent of the herd could be written off with causes ranging from lost stock, theft and fatality from cliff falls.

Due to the vast expanse, challenging topography, and limited GSM coverage, it takes a large amount of resource in the form of personnel, air and land vehicles and fuel to conduct searches for missing animals.

As cattle move in herd groups following leaders, it's usually sufficient to track only the leader cows. Each Streamline Guardian collar is powered by a solar panel with 500mAh battery. The Globalstar ST100 board is enclosed in polyetherimide casing and 40-50mm industrial web belt with embedded steal cable is used for the collar material. The collar is fastened with secure lock bolts with counterweights to keep the module positioned with best line of sight.

Additionally, in this huge deployment, 34 ground patrol staff are employed as part of the livestock management programme. However, with limited GSM, it was a challenge to keep in contact with them. The team now carry Globalstar SPOT Gen3 satellite devices, which give managers the ability to track the staff's locations and provide a means of communication while outside of cellular coverage.

Data from the cattle's collars and the SPOT devices are pushed to the Spot My Globalstar platform which allows for an overview of farm activity. For the ground patrol, geofences are set in specific farm management areas for enter, exit or both. The customer is sent messages indicating time of entry and exit at specific geofence locations throughout the day.

Geofences are set around the cattle containment area as well as near high-risk cliff areas. When animals reach the geofence perimeter or the high-risk area, the farmer receives an alert. The nearest ground patrol team is identified and dispatched to respond.

In yet another African farming deployment, SPOT Trace is being used to simultaneously track farm cattle and local lions. In Botswana, wildlife reserves have no fences and people live among the animals. In these areas, keeping farm cattle safe from predation is of the highest priority. With the help of a German research institution, villagers are using SPOT Trace as an early warning system to alert farmers and the local community when lions get too close to cattle, or to the village.

Satellite and IoT technologies are helping ensure Australian cattle get best-possible grazing, meanwhile they're helping preserve ancient reindeer herds, husbandly practices and cultures in Europe's far north. Elsewhere, they are supporting farmers in the southernmost reaches in Africa safeguard livestock from nearly lions. As technologists, there can hardly be a context more meaningful to support than the relationship between humans and the animals around us on which we so rely. ∎
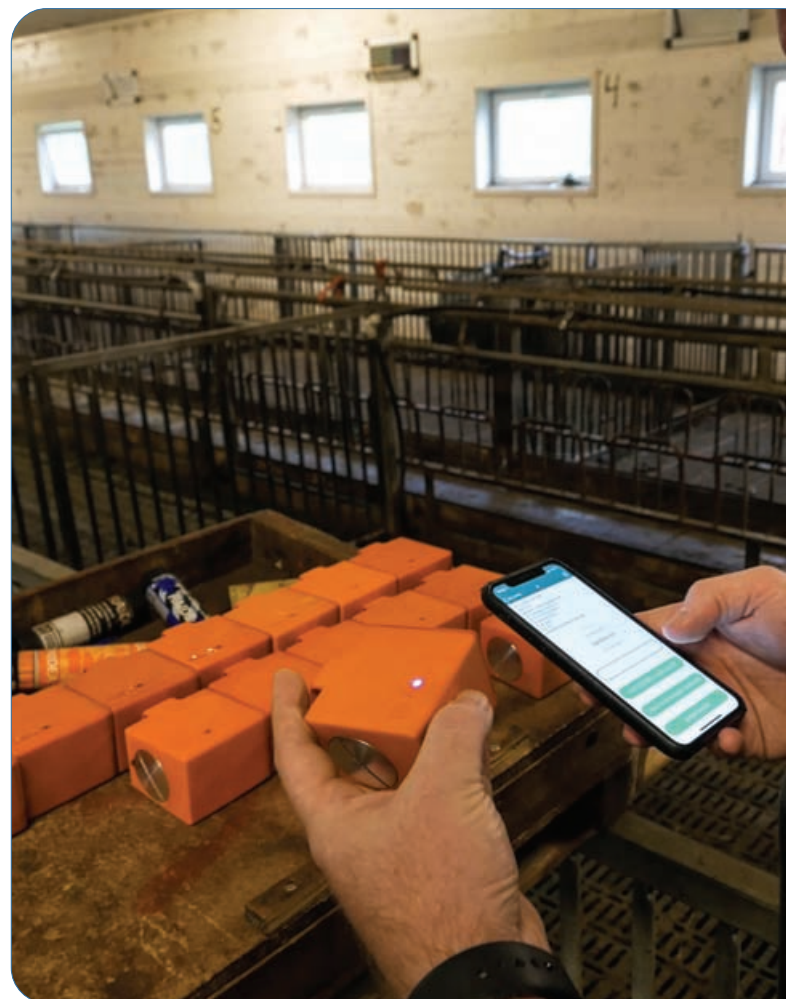
FindMy animal tracking is enabled by Globalstar technology. Photo courtesy Globalstar

A GetSat Microsat terminal fitted to the roof of a van via GRC mag mount. Photo courtesy GetSat

Keeping comms on the move secure

Comms on the move technologies answer the common and crucial demand of keeping operators in contact in remote environments and on-route to objectives. While a long-time requirement in military strategy, these heavy-duty communication links are being increasingly required in the commercial world in step with the digitization of industry 4.0. As airlines, transportation and shipping routes, besides countless government requirements seek always-online connectivity, the private sector stands to also adopt the much-needed cybersecurity of defence development.

Laurence Russell, Assistant Editor, Satellite Evolution Group

A recent product launch by Kymeta brought us the u8 MIL hybrid terminal, serving mission-critical applications with communications on the move (COTM) and networks on the move (NOTM) technology.

"For years, Kymeta's advanced technology has been a proven resource for mission-critical operations. Our new u8

MIL hybrid terminal is tailored specifically for military users, providing them with a rapid-deployment solution and the fastest out-of-the-box communication anywhere," said Bill Marks, Executive Vice President and Chief Development Officer of Kymeta.

The addition of the Kymeta Connect managed service offers reliable connectivity via a comprehensive, by-the-gigabyte package that utilises satellite and satellite/cellular capacity.

The release follows Kymeta's indefinite-delivery/indefinite-quantity (IDIQ) contract with the Department of Defence of up to US$950 million as part of their procurement efforts to produce systems supporting a unified force across air, land, sea, space and cyber domains to achieve what they refer to as Joint All-Domain Command and Control (JADC2).

The new reliability and power of Kymeta's u8 hybrid terminal serves a very apparent demand. Modern COTM does more than communicate; mobile connectivity in contemporary terms often means remote computer access, real-time imaging and video transmission and voice recognition commands. Perhaps one day it'll evolve into even more unrecognisable forms, rendering networked augmented reality overlays to grant operators unthinkable new insights into their objectives and environments.

While a term popularly associated with the military, COTM is now becoming more relevant to industries and consumers. The In-flight connectivity (IFC) markets, opportunities in the rapidly digitising maritime communications industry, as well as the hotly anticipated business of connected car and autonomous vehicle services are just a few of myriad opportunities to connect the world of moving devices.

Mission-critical civilian communications
Plenty of mission-critical technologies are required by the commercial sector, and not just with respect to emergency services, disaster response, non-governmental organisations (NGOs) but also various critical infrastructure providers.

Key transportation, civil service and utilities services worldwide, on the move or otherwise has seen fit to access mobile connectivity with mission-critical reliability. Of course, the expansion of endpoints that comes with widespread digitisation has its drawbacks, incurring conversations around cybersecurity.

Commercial and civilian sectors, particularly those of critical infrastructure are also perfectly suitable – if not preferable – targets of powerful cyber-attacks. As these bodies digitise to the standard of every other organisation in our time, they represent prime targets for bad actors, whether they be stateless meddlers or deliberate interference by unfriendly intelligence services. Needless to say, cybersecurity cannot be compromised.

Many UK residents can remember the Ransomware attacks on the NHS in the summer of 2017, which resulted in such chaos that non-critical patients were turned away by the crippled hospitals. It was widely reported that the healthcare service had been so poorly funded that thousands of computers in 42 separate NHS trusts were still using Windows XP.

This is to say nothing of the multiple breaches of US systems by what have been identified as Kremlin-affiliated cyber actors, who have targeted power, water, aviation and government facilities in addition to small commercial facilities since 2015. The UK's 2020 'Russia Report' lists similar invasions, describing Russian interference in UK politics as

Craig Miller, President of Viasat Government Systems

'commonplace.' Given the difficulty that comes with identifying the origin of a cyberattack, commentators have suggested the incidents that the Pentagon is aware of could well be the tip of the iceberg for Russian cyber interference.

With the fifth domain becoming ever more advanced in a world wholly unprepared for it, we must begin taking cybersecurity in industry and critical infrastructure ever more seriously.

Craig Miller, President of Viasat Government Systems, told *Satellite Evolution* that he believes that his company could be part of the solution. "Viasat possesses all manner of DoD-certified infrastructure customers on our network benefitting from government-standard cybersecurity. I think we're only going to see more of that happening as cyber gains prominence: Governments partnering with industry to develop best-of-breed solutions supporting comprehensive measures to protect what's important."

Defence technology for the commercial sector

Defence procurement is increasingly looking to commercial providers to develop their equipment, just as traditionally military developers move their portfolios into commercial markets. Mobile communications are set to be a big part of this new paradigm.

"One of the most interesting aspects of military technology in the 2020s and 2030s is the expansion of autonomous systems on all sides. That means the demand for comms, sensors and actuators are set to grow. Machines that see and do," explained Viasat's Miller. "These machines need comms to work, and networks to work well. The big data we can predict will be generated from a hypothetical information-age conflict would require a lot of heavy lifting. It's the kind of complication that'll take a suite of new technologies from the commercial edge that aren't currently thought of as part of warfare. Comms on the move will stitch those near-future systems together."

On the subject of the security risk of industry digitisation multiplying endpoints, Miller explained that "While a moving endpoint is no less secure than a stationary one, comms on the move technologies do increase your attack surface, because as you integrate more nodes, you increase the endpoints with which to access your network. Of course, access is the easiest step for hackers, and a lack of entryways into closed systems has not been a strong deterrent.

"That's exactly why we've seen a change in cybersecurity philosophy. Designers now work harder to consider threats that are already in the network. Bricking over your front door and windows when you know you've got a backdoor and skylight isn't the most practical strategy. With cyberattacks as sophisticated as they are, we need countermeasures to secure us at every level, not put another padlock on the access points we keep seeing them get around. The expansion of connectivity is inevitable. Cybersecurity needs to evolve beyond the threadbare strategy of having fewer endpoints."

Miller went on to recall how Viasat's cybersecurity successfully contended with the Mirai botnet, a disruptive malware first identified in 2016, when it struck their partners' networks. These were 'zero day' intrusions that ripped cleanly through an unforeseen backdoor, ignoring any and all conventional access points, which were mitigated thanks to reactive cybersecurity. "When you design with the assumption that everything is compromised, your architecture becomes a more flexibly performing combatant in crisis. It won't run out of moves and roll over when you hit DEFCON 1. It fights to the last line of defence."

Prioritizing holistic systems

The security of our communications networks both at the defence and civilian cutting-edge is likely to increasingly progress in tandem. The Internet is borderless. The front line against black hats and hostile states is drawn around your work laptop as cleanly as it is around the White House. There is no line separating defence and commerce in cyberwarfare.

But we must shirk the anxiety that exponential growth in COTM systems is expanding vulnerabilities. Cyberwarfare was always going to present significant risks, no matter our attack surface. We simply need to prioritize holistic cybersecurity systems and best practices to take these threats with the seriousness that they are warranted. ■

The u8 MIL hybrid satellite or cellular terminal is low profile, multi-orbit multi-network (GEO-LEO) ready, and easy to mount on vehicles and vessels. Photo courtesy Kymeta

1.88 billion people in Asia-Pacific still lack access to the Internet. Photo courtesy Canva

Unleashing Asia's digital potential with Wi-Fi in the 6GHz band

Spectrum has been a hot topic in recent years, with spectrum rights debated in far flung corners of the world as terrestrial and space segment users' clash. The COVID-19 pandemic has accelerated the uptake of Internet usage across the globe, prompting calls to change spectrum access to enhance availability.

Martha Suarez, President, Dynamic Spectrum Alliance (DSA)

By 2023, there are predicted to be more than three billion Internet users in the Asia Pacific (APAC) region alone. As usage grows, the number of connected devices will continue to rise, and faster broadband speeds will continue to become the expectation. Countries must continue to open up the entire 6GHz spectrum band (5,925-7,125MHz) for license-exempt access, in order to meet the growing demand for connectivity.

Wi-Fi needs more spectrum
Wi-Fi is no longer a luxury commodity, but an essential part of modern life. Used as a vital piece of infrastructure in response to the COVID-19 pandemic, the Internet has facilitated distance learning, been utilized as a tool for the healthcare industry, and allowed critical communication throughout. As of 2020, countries such as South Korea, Brunei and Japan saw Internet penetration rates of up to 96 percent, and it is predicted that by 2023, there will be over two billion IoT devices used in North Asia alone.

The 2.4GHz and 5GHz bands currently used by Wi-Fi devices have become more and more crowded and congested and ill-suited to sustain current and future technological advancements. As applications become more bandwidth intensive and connected devices with increasing data demands continue to proliferate, the sustainability of digital ecosystems relies on license-exempt technologies such as Wi-Fi. At the same time, fixed and mobile broadband networks continue to get faster and more data hungry with the evolution of fiber as well as the transition from 4G to 5G.

The 6GHz band is uniquely suited to support future growth of Wi-Fi due to both its propagation characteristics and its proximity to existing Wi-Fi deployments in the 5GHz band. The new generation of Wi-Fi, known as Wi-Fi 6 is required for high-bandwidth applications, such as high-definition video streaming and lower latency applications like Augmented Reality and Virtual Reality. With the evolution to Wi-Fi 7,

By 2023, there are predicted to be over 3 billion internet users in the Asia Pacific (APAC) region. Photo courtesy Canva

access to the whole 6GHz band will be vital to deliver new applications and services. A lack of access to wider channels would have a detrimental impact on real-time video services and high-bandwidth immersive services, such as augmented reality and virtual reality (AR/VR) services.

That being said, a disproportionate digital divide still exists across Asian countries. About 1.88 billion people in Asia-Pacific still lack access to the Internet, which equates to nearly half of the population. Without access to broadband, the pandemic cut many people off from vital assistance, services, and information – with about 300 million in South Asia, East Asia, and the Pacific beyond the reach of even a mobile network. Wi-Fi can work with any backhaul – mobile network, cable, fiber, fixed wireless access, satellite and having all 1,200MHz available will support competition across platforms and providers.

With complete standards, interoperability certification open, and equipment already emerging onto the market – there is no time to waste. Wi-Fi 6E technology is ready now, and countries that do not allow sufficient available spectrum will let the potential of new Wi-Fi generations pass them by.

Why the full 1,200MHz and why now?

Recent studies show that opening the full 6GHz band to license-exempt Radio Local Area Network (RLAN) technologies is the best public policy choice for regulators globally. The full 1,200MHz of spectrum should be made available, in order to support millions of innovative use cases that are emerging thanks to Wi-Fi 6E while protecting existing incumbent services in the band (such as Fixed Satellite, Fixed and Mobile Services).

The DSA not only considers the current crucial role of Wi-Fi, but our members also look ahead to future use cases, applications, and demands that are not yet in the market, to

help create the regulatory and technology environment today that will address the exponentially increasing consumer and business requirements of tomorrow. A whole new generation of RLAN technologies in the 6GHz band will be enabled to address future networking needs for broadband access and beyond. To make this a reality, connectivity must expand and improve for these services to be placed into routine use by citizens and businesses.

For rural and unserved areas, license-exempt technology is essential to enabling affordable services. Rural Internet access networks that use Wi-Fi (e.g., as part of a 60GHz mesh or TV White Spaces Network) and Wi-Fi at the edge of satellite links, and new low Earth orbit satellite constellations, will give regulators new tools to address underserved populations.

However, with variable pricing by market and the deployment of community Wi-Fi models, a more affordable service offering is possible. That is what is happening in Indonesia, where an individual subscription supports time or data bound service to potentially hundreds of users consuming small data bundles (in the megabytes) through a publicly accessible Wi-Fi Access Point (AP).

In areas with high network demand such as schools or hospitals, APs are deployed more densely. Often, the practical limit of how densely APs can be deployed is reached due to the resultant increase in radio frequency interference, and so the only way to add capacity is through the use of multiple wider channels - enabled by opening the full 1,200MHz of the 6GHz band.

Steps in the right direction

There is global momentum to make the 6GHz band available for license exempt use by Wi-Fi and 5G NRU (new radio unlicensed, unlicensed 5G applications). The US, UK, Canada, Brazil, Chile, Saudi Arabia, South Korea, the Electronic Communications Committee (ECC) of Europe and

many others, have decided to allow license-exempt use of the 6GHz frequency range for Wi-Fi 6e and 5G NRU. In Asia, administrations in Australia, Japan, Malaysia, New Zealand, Taiwan, India, and Thailand have released public consultations or are conducting studies in 2021 to assess the 6GHz and potentially making available the 6GHz as a license-exempt band.

Connectivity as an economic driver

Governments and regulators in Asia should look to those opening the full 6 GHz band, to realize the economic potential that the step enables.

Allocating the entire 6GHz band to license-exempt use provides important economic benefits. The Wi-Fi Alliance has conducted studies with Telecom Advisory Services to estimate the impact of Wi-Fi on global and national economies, concluding that globally, assuming regulators open the full 6GHz band to Wi-Fi, the US$3.3 trillion in WiFi value to the world's economy in 2021 will rise to US$4.9 trillion in 2025.

A digital future for Asia

As Internet use grows in Asia, predictions show there will be 12.5 billion IoT devices by the time we reach 2023, with the largest number of users and devices in India, Japan, Korea, and Indonesia. What's more, broadband speeds are set to double, and traffic via Local Access Technology will rise each year, from just below 140 exabytes per month, to almost 180 between now and 2022.

To support this mass growth and enable the continent's population to fully benefit from Wi-Fi 6E, governments should make the 6GHz band available for usage by licence-exempt technologies. Incumbent users will be able to thrive, while the demand for broadband for work, education, and entertainment will be met, and internet access becomes a reality for those living in underserved regions. ■

Wi-Fi needs more spectrum to meet the connectivity requirements of citizens and businesses. Photo courtesy Canva

Photo courtesy ETL

Is there a real 5G interference problem?

As 5G rapidly rolls out across the globe - 5G coverage is now available in 383 UK towns and cities, and most of the UK is expected to have it by 2022 - the advent of this new network is set to provide better connectivity for consumers. However, 5G can cause interference in the C-band frequencies used for satellite networks and with other cellular networks creating major problems. Herein is discussed potential resolutions for this new type of interference, and the themes discussed by the Satellite Innovations Group (SIG) panel at SatelliteAsia.

Simon Swift, Engineering Manager, ETL Systems

According to the International Telecommunication Union - Radiocommunication Sector (ITU-R), a key component of international frequency management is the Radio Regulations (RR). This international treaty determines how the radio frequency spectrum is shared between different services.

It's important to remember that satellites are used for communication, but also an array of other applications where interference can lead to significant problems, including astronomy, weather forecasting, broadcasting, and mapping. The RR directs how equipment and systems must operate to ensure peaceful cohabitation in today's overcrowded networks.

One of the participants on the panel at SatelliteAsia, Christian Wahsweiler, Senior Manager of CSM and computer infrastructure solutions at SES, outlined that using the same spectrum we have been using traditionally doesn't work if we want these technologies to coexist.

5G signals are powerful enough to interfere with sensitive C-band satellite systems, potentially causing a loss of service. One of the possible resolutions being implemented by some nations is to minimise the overlap between 5G and C band frequencies by setting operational frequency limits on both. However, even if the satellite signals received by the C-band terminal are limited to a specific segment of the spectrum, there is still a risk of 5G signal interference where overlap occurs. Christian argues that both 5G network operators and satcoms companies need to work together to enhance and complement one another's offering, which will give the best user experience.

A key to this would be for companies in both sectors to build a specific product portfolio that works towards harmony between the satellite industry and cellular networks.
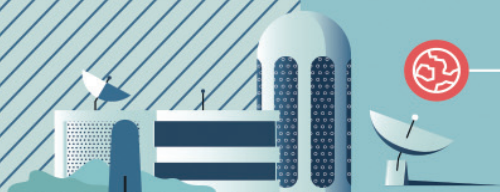
Managing spectrums on a more automated basis
In the USA, the Federal Communications Commission (FCC) has asked MNOs and satellite operators to cooperate to gain
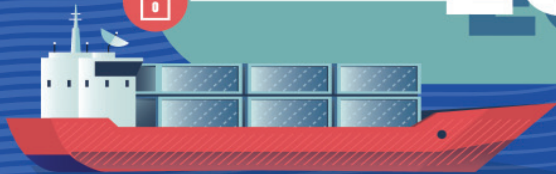
RSCC
Russian Satellite Communications Company

TV

SATELLITES FOR DIGITAL ECONOMY

Simon Swift, Engineering Manager, ETL Systems

a better understanding of 5G interference and work out which towers or stations are causing the problem.

Another participant at SatelliteAsia, Marke Clinger, Strategic Account Director at Kratos, explained that due to the extreme distance between satellite and Earth stations, the incoming power flux density of the satellite signal at the earth station is very low and susceptible to interference.

In the USA, it is well defined both operationally and in regulatory terms that mobile network operators are responsible for backup and interference mitigation. However, outside the US these types of protections largely haven't been put in place. A technology that is designed to identify a problem and redirect the antennas might solve the situation.

What is available?

Marke Clinger elaborated on how spectrum monitoring can be extended to find unused frequencies. It looks at the whole spectrum, it tells you who is using what, what type of protocols are being used, and also how much of that spectrum is being utilised.

He went on to state that to have a dynamic system that has some artificial intelligence (AI) built into it, you would need an open space platform. Instead of manually deploying a network or a service, satellite operators need to automate. If satcoms companies were to extend that even further and cooperate with the mobile network operators, there is a way to develop a system that looks at all of the spectrum. A priority-based system, he suggests, could reallocate the bandwidth between mobile networks and satellite networks based on demand.

Some national regulatory authorities have reallocated the C-band spectrum, reassigning the frequency bands for exclusive access. For instance, in the USA the FCC reached a deal in 2020 worth billions of dollars with satellite operators to free spectrum to be used for 5G service.

Various companies now use the C-band spectrum to serve

TV broadcasters and the Community Access Television (CATV). Portions of the C-band have also been ring fenced for 5G mobile usage in many other countries including Australia, Finland, Germany, South Korea, and the UK.

Building filtering units for 5G

An Anritsu study looking at resolving interference issues at satellite ground stations explains that interference problems have already been seen in many cases where the satellite downlink signals operate in frequency bands close to those used by 5G.

To avoid this, satellite Earth station operators should consider installing special bandpass filters in their network. 5G operators may also need to reduce power depending on their proximity to Earth stations.

At ETL Systems, we are yet to see a huge take-up of 5G filtering products, but we believe we will as more and more operators see it as a viable solution to the interference challenge.

One of the key things is to make sure that the guard-band between the two sets of frequencies is adequate. In the USA, the situation is government handled, funded by the FCC from the income generated by selling licenses to the mobile industry. In other parts of the world, regulation hasn't reached this level of organisation, but as the problem grows, it is increasingly likely that government mandated regulation will come into play.

A comprehensive solution is necessary for interference challenges posed by 5G in the satellite network, including the ability to monitor spectrum, avoid interference, troubleshoot signal problems, spectrum clearing, and pinpointing the position of an interference source.

Reasonable regulation, balance and governance of which frequencies are used for which applications are the keys. The satellite industry has to plan for the fast-approaching future and find their role alongside 5G.   ∎

*Photo courtesy sutadimages/Shutterstock*

C- & KU-BAND CAPACITY FOR THE EASTERN HEMISPHERE

Yamal-601 (49°E) Yamal-402 (55°E) Yamal-401 (90°E) Yamal-300K (183°E)

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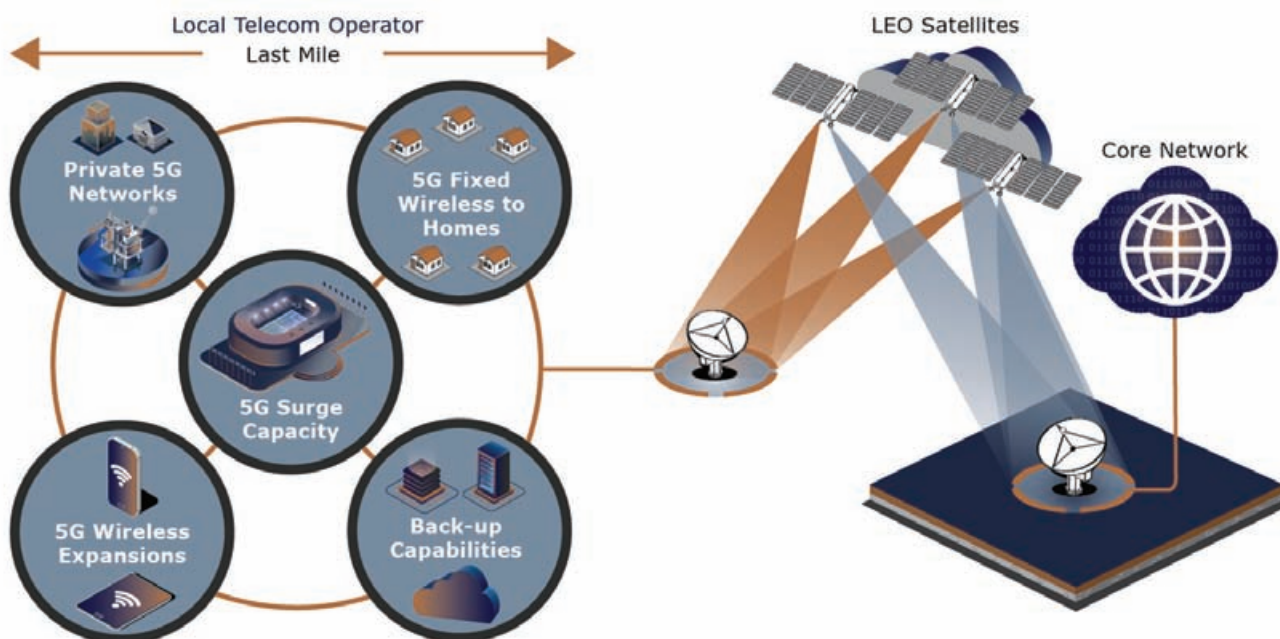
Ubiquitous 5G will require low Earth orbit satellites

5G technology is the next major mobile standard coming into play, with new devices already equipped to utilise it. Low Earth orbit (LEO) satellites have a key role to play in the future of 5G, helping bring connectivity to advanced nations and bridging the digital divide in remote and rural areas.

Manik Vinnakota, Director of Commercial and Product Development, Telesat

The 5G revolution is well underway as telecom operators race to deploy 5G networks across the globe. The fifth-generation connectivity for data networks is a major leap forward in networking protocols, and promises faster data speeds, low latency communications and higher data caps for mobile devices. With an expected tenfold improvement over 4G speeds, 5G technology will be a key enabler of artificial intelligence (AI), the Internet of Things (IoT) and virtual reality (VR), driving innovation and new business models. 5G networks are expected to cover a fifth of the global population by the end of this year, primarily in dense population centres. For consumers and enterprise customers in remote communities, it may take years to gain access to 5G technology.

The coverage gap

According to GSMA, approximately eight percent of the world's population still does not have access to mobile Internet services, with 4G connections accounting for approximately half of all mobile connections globally. This coverage gap exists primarily in rural and remote communities located far from existing fibre infrastructure and often difficult to connect due to the topography of the region. With low population densities, it is challenging for service providers to achieve a positive return on their investment due to the high cost of backhaul to connect these underserved communities to the operator's core network.

Today, geostationary (GEO) satellites, located 36,000km from Earth provide satellite backhaul links to deliver Internet and 4G to rural communities throughout the world. However, the latency, or round-trip time for data to travel to the satellite and back to the core network is too high. This results in a poor Internet user experience and inability to access secure web pages, cloud-based applications, or online gaming. With 5G promising lower latency and faster data speeds, the high capacity backhaul link for connecting rural communities must be able to achieve the same performance metrics.

Redefining satellite backhaul

Next-generation satellite networks that are 35 times closer to Earth are now being deployed, and these networks all provide low-latency connectivity that is 30-50 milliseconds for a round trip RF signal between the ground and satellite.

SATELLITE

BROADCAST

CO-LOCATION

Manik Vinnakota, Director of Commercial and Product Development, Telesat

With latency on par with today's fibre networks, telecom operators can leverage LEO satellite backhaul to connect remote communities to provide universal, city-like high-speed connectivity.

With low-latency LEO backhaul connectivity that offers standards-based (plug and play) interfaces, telecom operators can cost-effectively extend the reach of 5G mobile networks for consumers to accelerate ubiquitous access. Furthermore, mobile network operators can rapidly roll out networks to generate new revenue streams by offering 5G fixed wireless broadband to homes. In both of these consumer applications, the 5G community backhaul will require multiple Gbps data links to support 4K/8K enhanced video, live sports streaming, and online AR/VR content and gaming.

LEO satellite network benefits are not only limited to consumers rural communities. In cities, consumers often struggle with wireless connectivity during large-scale sporting or concert events, where tens of thousands of people are using the network in a small geographic area. LEO networks that are designed for enterprise connectivity, like Telesat Lightspeed, can dynamically focus incremental high-speed capacity to meet the short-term consumer demand. With a standards-based approach in enterprise LEO networks, telecom operators can easily integrate their 5G networks with LEO for increased flexibility to meet traffic surge needs or as a backup in case of a network outage.

The 5G enterprise opportunity with LEO

The most promising growth opportunity for telecom operators is in 5G enterprise connectivity. 5G technology will allow telecom operators to slice networks, meaning that the same physical network can host several logical networks. This allows an Internet service provider to control the quality of service and offer different performance characteristics in terms of traffic priority, download speeds, and latency on the same physical network. While this type of control is available in fibre networks, Telesat Lightspeed will make it available in a fully programmable, API-first model via a global satellite network. Enterprise customers represent the highest ARPU opportunities for telecom operators, and similar to the consumer business, the ability to extend 5G enterprise connectivity to remote enterprise locations will also rely on a robust LEO backhaul link.

In Asia, many private LTE-based networks have been deployed, allowing enterprises to have more control over their connectivity and solve their evolving latency, coverage, edge, or security requirements. This trend is expected to continue with 5G private networks. One such example is a private 5G network on an offshore oil platform. With a local 5G private network, data traffic among the 300-500 employees working on the platform and the business applications they are using can be prioritized by user groups. A low-latency satellite backhaul link will be required to connect the platform back to its headquarters or data center. An enterprise-grade LEO network can seamlessly support the same user group prioritization attributes from the local access 5G network over the satellite backhaul link as well.

As telecom operators and enterprises across the globe deploy 5G networks, LEO satellites can accelerate the reach of 5G capabilities beyond densely populated city centres. But it is important to remember the LEO refers to an orbital location, not the technology capabilities of each constellation. While all LEO networks can provide low-latency connectivity, there are vast architecture and performance differences between consumer and enterprise LEO networks. Telecom operators must carefully consider the traffic prioritization requirements, the volume of data to be uplinked via LEO backhaul, the ease of integration with their terrestrial networks, and the resiliency and security of the LEO network to ensure the 5G performance characteristics are replicated across the entire transport value chain. ∎

Advanced Telesat Lightspeed satellites, manufactured by Thales Alenia Space. Photo courtesy Telesat

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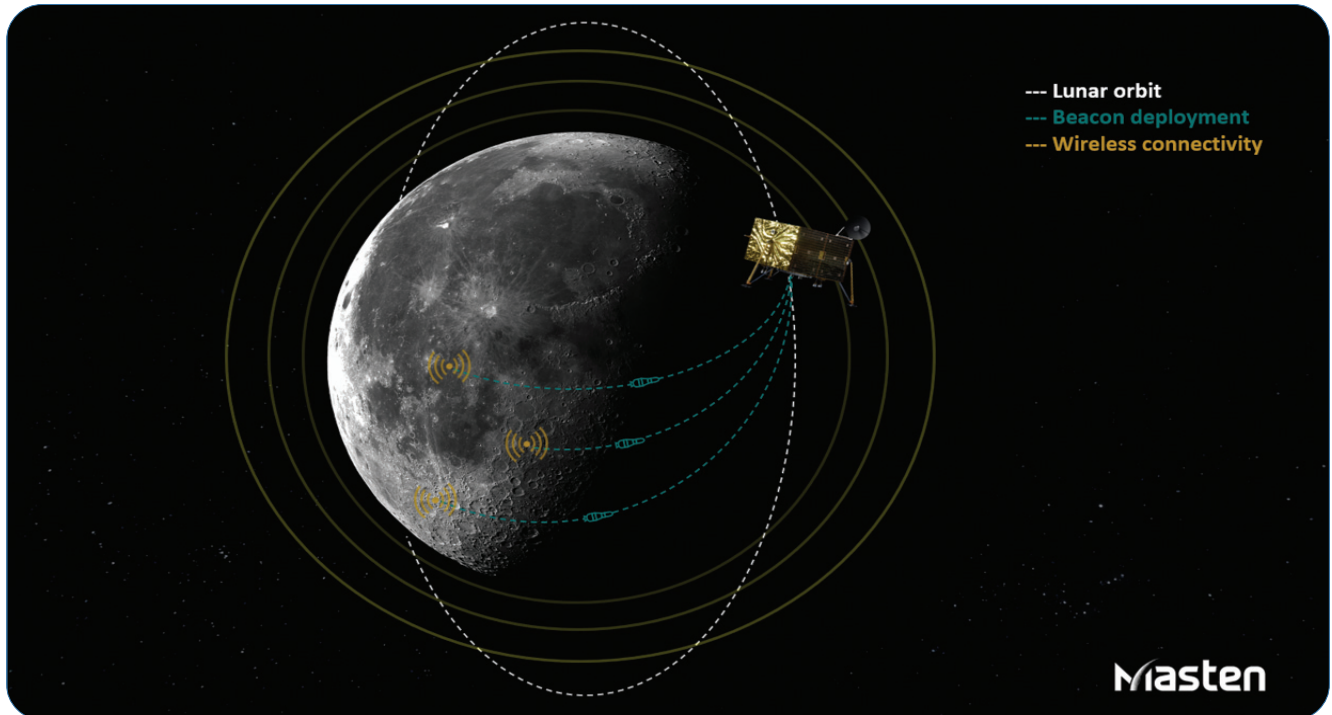
PNT beacons can be deployed in orbit to penetrate the lunar surface and enable consistent wireless connectivity. Photo courtesy Masten Space Systems

Connecting to the Moon and beyond

As mankind edges ever closer towards an intergalactic future, with space tourism already being brought to reality earlier this year, assured, reliable connectivity off-world is a vital component of our future. With secure world-to-world communications, travellers between planets can better achieve their goals.

Amy Saunders, Editor, Satellite Evolution Group

Currently a matter for science fiction, deep space communications for parties travelling through space to the Moon, Mars and beyond, will certainly require reliable, secure communications between the spacecraft and Earth. With the ambitious plans of our current batch of billionaires – Musk, Bezos, and Branson - it's looking increasingly likely that the first manned interstellar trip may well take place during our lifetime.

The only entity to date with an advanced established Deep Space Network (DSN) is NASA, which operates the largest and most sensitive telecommunications system in the world in order to support its off-world missions. The DSN is operated by NASA's Jet Propulsion Laboratory (JPL) and consists of three facilities spaced equidistant from each other around the Earth some 120 degrees separated in longitude – at Goldstone, California, near Madrid, Spain, and near Canberra, Australia.

The placement enables constant communications between spacecraft and Earth even as the world rotates.

The antennas at the three DSN sites – which are indispensable for commanding spacecraft remotely and receiving data and images from missions – require regular upgrades to maintain reliability. Earlier this year, the Spanish site welcomed its newest addition, the Deep Space Station 56 (DSS-56) dish, a new 34m antenna. The new antenna is a Beam WaveGuide dish which required a more complex commissioning phase than its predecessors due to its novel nature of being the first 'all-in-one' antenna capable of communicating with all missions/probes that use the DSN. All other DSN dishes have limited frequency ranges, meaning they cannot communicate with every mission. That changes with DSS-56, which utilizes the DSN's full range of communication frequencies. This has an added benefit of allowing the new dish to serve as a backup for any of the Madrid complex's other antennas regardless of the mission they're talking to. A fifth 34m dish, again with the same 'all-in-one' antenna, will join the Spanish site later this year.

"The Deep Space Network is vital to so much of what we do – and to what we plan to do – throughout the solar system," said Thomas Zurbuchen, NASA Associate Administrator of the Science Mission Directorate. "It's what connects us here on Earth to our distant robotic explorers, and, with the

improvements that we're making to the network, it connects us to the future as well, expanding our capabilities as we prepare human missions for the Moon and beyond."

The Moon's first LTE/4G system

Possibly the first modern network expected to come to fruition on the Moon is Nokia Bell Labs' LTE/4G solution. Back in 2020, Nokia released further details on being selected by NASA to deploy the first LTE/4G communications system in space, which will help pave the way for a sustainable human presence on the Moon. The local network, which will extend around 5km to allow communications between astronauts and equipment on the lunar surface, is a low-power, space-hardened solution is expected to be deployed by the end of next year. Nokia is partnering with Intuitive Machines to integrate its ground-breaking network into their lunar lander for delivery to the Moon's surface.

The network will provide critical communication capabilities for many different data transmission applications, including vital command and control functions, remote control of lunar rovers, real-time navigation and streaming of high-definition video. These communication applications are all vital to long-term human presence on the lunar surface.

Nokia's LTE network is ideally suited for providing wireless connectivity for any activity that astronauts need to carry out, enabling voice and video communications capabilities, telemetry and biometric data exchange, and deployment and control of robotic and sensor payloads. The network will consist of an LTE Base Station with integrated Evolved Packet Core (EPC) functionalities, LTE User Equipment, RF antennas and high-reliability operations and maintenance (O&M) control software. The solution has been specially designed to withstand the harsh conditions of the launch and lunar landing, and to operate in the extreme conditions of space. The fully integrated cellular network meets very stringent size, weight, and power constraints of space payloads in an extremely compact form factor.

The same LTE technologies that have met the world's mobile data and voice needs for the last decade are reportedly well suited to provide mission critical and state-of-the-art connectivity and communications capabilities for any future space expedition. LTE is a proven commercial technology,

Lunar lander. Photo courtesy Nokia Bell Labs and Intuitive Machines

has a large ecosystem of technology and component suppliers, and is deployed worldwide. Commercial off-the-shelf communications technologies, particularly 4G, are mature, proven reliable and robust, easily deployable, and scalable. Nokia plans to supply commercial LTE products and provide technology to expand the commercialization of LTE, and to pursue space applications of LTE's successor technology, 5G.

GPS on the Moon

Something we take for granted here on Earth as an essential for everyday life – particularly if, like me, you can live somewhere for five years and still be incapable of navigating further than a 15-minute walk from your home without Google Maps – but which is proving so vital for lunar exploration that we're already seeing multiple planned projects, is an accurate, reliable positioning system installed on the Moon.

August saw the US Air Force Research Laboratory's AFWERX programme award a Phase II Small Business Innovation Research (SBIR) contract to Masten Space Systems to develop and demonstrate a lunar positioning and navigation network prototype. With functionality similar to GPS, the network will enhance cislunar security and awareness by enabling navigation and location tracking for spacecraft, assets, objects, and future astronauts on the lunar surface or in lunar orbit. As the lunar ecosystem grows, the network will also help advance lunar science and resource utilization by improving landing accuracy and hazard avoidance near critical lunar sites.

In Phase I, Masten completed the concept design for the network prototype that offloads position, navigation, and timing (PNT) beacons from a spacecraft into a dedicated sensor array on the Moon. In Phase II of the project, scheduled to be complete in 2023, Masten will develop the PNT beacons that are equipped to survive the harsh lunar environment. Masten is collaborating with Leidos to build shock-proof beacon enclosures that can be deployed in lunar orbit to penetrate the lunar surface and create an autonomous surface-based network. Similar to a mesh network, the surface-based network can enable consistent wireless connectivity to lunar spacecraft, objects, and orbital assets. In Phase II, the PNT technology will also be tested aboard Masten's rocket-powered lander, Xodiac, to demonstrate payload integration and beacon operations in a terrestrial environment, enabling a path towards lunar demonstration.

"Unlike Earth, the Moon isn't equipped with GPS so lunar spacecraft and orbital assets are essentially operating in the dark," said Matthew Kuhns, Vice President of research and development at Masten. "As a result, each spacecraft is required to carry heavy navigation hardware and sensors on-board to estimate positioning and detect potential hazards. By establishing a shared navigation network on the Moon, we can lower spacecraft costs by millions of dollars, increase payload capacity, and improve landing accuracy near the most resource-rich sites on the Moon."

Another positioning project was announced a little earlier in May; the European Space Agency (ESA) announced plans to build a telecoms and positioning network around the Moon utilising a constellation of satellites. Under Project Moonlight, which aims to accelerate lunar research efforts, two consortia are working in competition.

SSTL leads the first consortium with a Phase A/B1 Study into the Moon telecoms system, in collaboration with SES Techcom, Airbus, Kongsberg Satellite Services and the
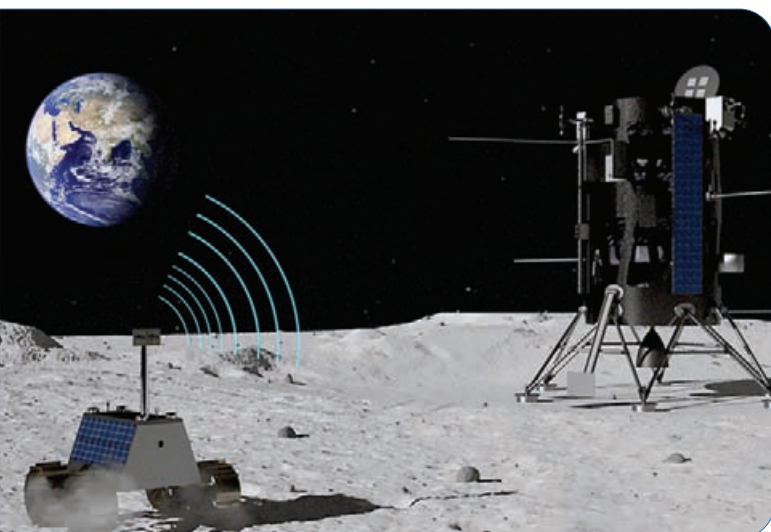
Goonhilly Earth Station. A second consortium led by Telespazio will study the architecture of the Lunar Communication and Navigation Services, working with Thales Alenia Space, Inmarsat, MDA, Telespazio's subsidiary in Germany, OHB Systems, Hispasat, the Italian Aerospace Logistics Technology Engineering Company (ALTEC), Argotec, Nanoracks Europe, the Politecnico Milano and the Università commerciale Luigi Bocconi.

An initial three or four-strong satellite constellation around the Moon is envisaged, alongside small base stations on the surface to be used to hone positioning. With the use of radio astronomers and lunar rovers, the far side of the Moon could also be effectively opened up. ESA hopes the network will be interoperable with NASA's planned LunaNet.

LunaNet

With the Moon the first target for off-world exploration in the years to come, the delivery of assured, reliable communications between the lunar surface and Earth are essential.

Photo courtesy Gorodenkoff/Shutterstock

Entirely distinct from the Nokia LTE/4G system, NASA is also aiming to establish a relay communications and navigation architecture called LunaNet to make it easier for lunar devices to communicate with each other and with Earth. Much like the Internet on Earth, LunaNet would enable communications among robotic landers, rovers, scientific devices, and astronauts, and also allow them to transmit data back to Earth through Moon-orbiting relays, such as satellites, smallsats or a Moon-orbiting space station. Provided each network node can relay data to its immediate neighbour, the LunaNet architecture can be assembled from a variety of infrastructure systems, independent of frequency band, type of spacecraft or provider. LunaNet's multi-hop relay network could be accessed from anywhere on the Moon by surface or orbiting devices, provide direct access to Earth stations when required and supporting high-definition video for multiple users.

LunaNet is expected to include three categories of services:

- Networking services capable of moving data between nodes that adhere to confidentiality, integrity, and availability requirements;
- Position, navigation and timing services for orientation and velocity determination, as well as time synchronization and dissemination. These services could be used for search and rescue, surface navigation and location tracking; and
- Science services providing situational alerts and scientific measurements that could not only further research, but also support predictions of major solar eruptions that affect space weather and provide information about space radiation.
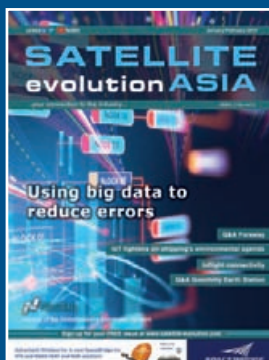
NASA anticipates many advantages to a relay navigation system. LunaNet would be critical for communications during deliveries of science payloads to the far side and polar regions, where direct communication with Earth ground stations will be impossible without a relay. For manned missions to the South Pole, having a relay satellite in an appropriate orbit would allow for more flexibility in mission scheduling and landing site selection and would provide more options in contingency situations. NASA's communications with rovers would be easier because LunaNet would be much closer to lunar vehicles, shortening the distance signals must travel and allowing the use of smaller, less powerful transmitters and receivers. Orbiting spacecraft, especially small satellites, also would benefit from precise timing and position information readily available from LunaNet.

To provide reliable service for the Artemis missions in 2024, LunaNet would have to be operational well in advance, so NASA wants the technology ready for operation no later than 2023.

An intergalactic future

Considering just a small handful of the ongoing off-world communications projects of today serves to exemplify that the future of humankind is, indeed, intergalactic. And we're not just talking about the distant future either – Nokia Bell Labs' LTE/4G system is due online next year, while LunaNet is expected just one year after. With the rapidly accelerating space travel capabilities we're witnessing right now, these off-world communications networks are indeed much needed in today's world. ∎

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