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Front cover photo courtesy ThinKom

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Developing connectivity technology - page 18 ●●●

ST Engineering iDirect partners with XipLink to implement advanced security feature for 4G LTE

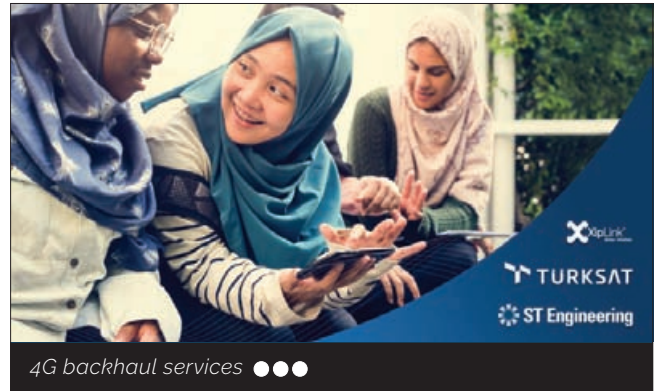
ST Engineering iDirect has collaborated with technology provider XipLink to implement a security feature required for 4G backhaul services. The feature will support IP security (IPsec) encryption with CMPv2 digital certificate management, building upon the existing high levels of security already offered by ST Engineering iDirect whilst maintaining satellite traffic optimization and acceleration. The new functionality has been tested and certified by satellite operator Turksat.

CMPv2 is a feature-rich and flexible certification exchange protocol standard which supports any type of cryptography. It is a standard requirement for mobile operators that ensures secure functionality and is essential to enable the optimization and acceleration of 3G, 4G and 5G backhaul services.

The three companies have invested time, equipment and expertise in the development and testing of the additional security feature in XipLink's software, which forms an integral part of the ST Engineering iDirect SatHaul-XE solution. Turksat will benefit from the ability to securely extend its mobile services throughout the Middle East region, providing a seamless customer experience. Leveraging Turksat's HTS architecture coupled with next-generation satellite ground infrastructure, will result in lower bandwidth costs, improved throughput levels, increased network efficiency and the best end-user experience. With the anticipated launch of the Turksat 5B satellite later this year which will expand the operator's coverage across Europe and Africa, Turksat will leverage the solution to provide 4G cellular backhaul coverage to 100 rural sites. Live tests of the feature have achieved 200 Mbps on satellite links without compromising acceleration or optimization.

"This new feature expands the scope of IPsec management for mobile networks," said Semir Hassanaly, Head of Cellular Backhaul and Trunking, ST Engineering iDirect. "Working closely with Turksat and XipLink, we were able to quickly respond and implement the functionality they needed that differentiates their service offering to MNOs, providing an enhanced user experience to the downstream subscriber."

"ST Engineering iDirect and XipLink have a strong relationship that is more than a decade mature," commented Jack Waters, CEO at XipLink. "In the last few years, we have assisted with enhancing the SatHaul-XE solution to include high capacity GTP acceleration, advanced packet



aggregation and the latest WAN optimization benefits. Today, our partnership extends IPsec security capabilities to include automation of encryption keys using CMPv2 standards, which have been fully tested by Turksat and their downstream MNO customers."

Developing a commercial space station

Nanoracks, in collaboration with Voyager Space and Lockheed Martin, has formed a team to develop the first-ever free flying commercial space station. The space station, known as Starlab, will be a continuously crewed commercial platform, dedicated to conducting critical research, fostering industrial activity, and ensuring continued US presence and leadership in low-Earth orbit. Starlab is expected to achieve initial operational capability by 2027. To meet US government, international space agency, and commercial needs in space, these industry leaders will develop Starlab specifically to enable the growing space economy and meet pent-up customer demand for space services such as materials research, plant growth, and astronaut activity. Together, these companies bring unparalleled experience in commercial space utilization, engineering design and performance, technology innovation, and investment strategy.

"Since the beginning, Nanoracks has sought to own and operate a private space station to fully unlock market demand," says Jeffrey Manber, CEO and Co-Founder of Nanoracks. "Our team has spent the last decade learning the business of space stations, understanding customer needs, charting market growth, and self-investing in private hardware on the ISS like the Bishop Airlock. Nanoracks and our team are excited to work with NASA and our friends across the world as we move forward with Starlab."

NASA recently announced the commercial low-Earth orbit (LEO) destination (CLD) project to support the development of private space stations. CLD will stimulate a multifaceted LEO economy and provide science and crew capabilities in LEO before the International Space Station (ISS) retires.

New orbital destination opens up space for business and travel, creating new ecosystem

Blue Origin and Sierra Space have announced plans for Orbital Reef, a commercially developed, owned, and operated space station to be built in low Earth orbit. The station will open the next chapter of human space exploration and development by facilitating the growth of a vibrant ecosystem and business model for the future. Orbital Reef is backed by space industry leaders and teammates including Boeing, Redwire Space, Genesis Engineering Solutions, and Arizona State University.

Designed to open multiple new markets in space, Orbital Reef will provide anyone with the opportunity to establish their own address on orbit. This unique destination will offer research, industrial, international, and commercial customers the cost competitive end-to-end services they need including space transportation and logistics, space habitation, equipment accommodation, and operations including onboard crew. The station will start operating in the second half of this decade.

Orbital Reef will be operated as a 'mixed use business park' in space. Shared infrastructure efficiently supports the proprietary needs of diverse tenants and visitors. It features a human-centered space architecture with world-class services and amenities that is inspiring, practical, and safe. As the premier commercial destination in low Earth orbit, Orbital Reef will provide the essential infrastructure needed to scale economic activity and open new markets in space. Reusable space transportation and smart design, accompanied by advanced automation and logistics, will minimize cost and complexity for both traditional space operators and new arrivals, allowing the widest range of users to pursue their goals. The open system architecture allows any customer or nation to link up and scale to support demand. Module berths, vehicle ports, utilities, and amenities all increase as the market grows.

The Orbital Reef business model makes it easy for customers and is strategically designed to support a diverse portfolio of uses. The team has all the services and systems to meet the needs of emergent customers, including researchers, manufacturers, and visitors. Orbital Reef offers standard interfaces at all levels – locker, rack, and module. Seasoned space agencies, high-tech consortia, sovereign nations without space programs, media and travel companies, funded entrepreneurs and sponsored inventors, and future-minded investors all have a place on Orbital Reef.

The Orbital Reef team of experts brings proven capabilities and new visions to provide key elements and services, including unique experience from building and operating the International Space Station. ■



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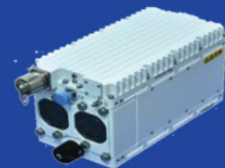
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Pléiades image of USA. Photo courtesy Airbus ●●●

Airbus delivers strong new market

Following the successful launch of Pléiades Neo, a breakthrough constellation of state-of-the-art Earth observation satellites, Airbus has delivered a strong new market offering for high resolution, reactive imagery for both multinational industries and innovative new business cases. François Lombard, SVP Head of Intelligence business, Airbus Defence and Space, explains the capabilities of the constellation, how it will change the market, both in and out of orbit, and where he sees Pléiades Neo, and indeed Earth observation itself, going in the near future.

Laurence Russell, Assistant Editor, Satellite Evolution Group

Question: With emerging markets utilising smart city and advanced mapping technologies set to rely heavily on satellite support, how well placed are the Pléiades Neo satellites for the growth markets of tomorrow?

François Lombard: Urban areas worldwide are growing rapidly with the continuous development of new neighbourhoods, office complexes, and utility infrastructure. This constant change places these areas among the most challenging on Earth to map. The new Pléiades Neo constellation, with its 30cm resolution and intraday revisit capacity is uniquely qualified to meet today's urban mapping challenges: Providing fast and accurate solutions to create multiple types of 2D or 3D maps and keeping them updated on a frequent basis.

Indeed, maps can now be produced from Pléiades Neo imagery at a scale and level of detail previously only possible from aircraft or on the ground. In urban areas, these maps will be highly relevant for use by tax authorities, civil engineering firms, energy utilities, and urban planning

departments to monitor and manage nearly every aspect of the municipal environment.

With its 30cm resolution, Pléiades Neo satellites can identify and inventory objects as small as parking lot stripes and geolocate them with an accuracy of less than five meters – generating maps at 1:2000 scale, which is true Cadastral-level mapping. Together, the four satellites of the constellation can capture two million km²/day of data. This means they are suitable for mapping projects of very large areas; they can for instance easily map a large metropolis in 24 hours.

Question: As military intelligence and emerging threats become more complex, often overtaking what any single administrator can keep track of, how vital is it that advanced assets like real-time satellite imagery be leveraged to stay ahead of the curve?

François Lombard: More than ever, there is a strong need for real-time and near real-time insights to support time-sensitive military and intelligence-gathering operations and shorten critical response delay. Rapidity is key in the decision-making process, but reliability and preciseness of the



*François Lombard, SVP Head of Intelligence Business,
Airbus Defence and Space ●●●*

information are equally important. The Pléiades Neo constellation possesses key assets to support intelligence and defence activities.

First, a native resolution of 30cm allows the detection and identification of objects on the ground or at sea (such as different types of vehicles, planes, and ships).

Furthermore, the reactive tasking and download capacities of Pléiades Neo allow us to update the tasking plans every 25 minutes. Urgent acquisitions to meet an immediate operational need can thus be performed 30 to 40 minutes later by the nearest satellite, and the data is received within the hour following the acquisition. This delay can even be further reduced with the use of our laser communication terminals with the Airbus SpaceDataHighway.

Finally, Pléiades Neo offers intra-day revisit: Concretely, depending on the area of interest, up to four revisits per day are possible. This means that instead of a frozen picture of a situation, you now get a storyline of what is going on, you garner an understanding of how a situation evolves on the ground. This is truly a game-changer.

Question: You've claimed Pléiades Neo is a breakthrough in Earth observation. How are these satellites innovating in their field?

François Lombard: To build the Pléiades Neo constellation, we leveraged Airbus' latest innovations and world-class expertise in satellite design. The result is four satellites that are significantly smaller, lighter, more agile, more accurate and more reactive than the competition, with such a compact design that it allows us to launch them in pair on a medium-sized launcher like Vega-C.

The Pléiades Neo satellites are also the first of their class (EO satellites providing high quality very high-resolution imagery) whose capacity will be fully commercially available. The orbital configuration of the constellation is unique in that it has been maximised to serve a vast panel of customers and applications, including but not limited to defence, and

beyond the $\pm 40^\circ$ latitudes. They are positioned on the same helio-synchronous orbit and phased at 90° .

This allows a high consistency of acquisitions (lightning conditions, shadows), as well as reduced angles for a preserved high GSD (ground sampling distance). As a result, fast homogeneous coverage of large areas with consistent high-quality images will be made much easier, which in turn will also make algorithms that will run on the data (automatic change detection or planes/ships identification for instance) much more accurate and effective.

It is also worth noting that Pléiades Neo satellites' 14km swath is unique on the market at that level of resolution and contributes to their capacity to cover large areas in a small amount of time.

To respond to the most critical situations, the Pléiades Neo constellation will also benefit from laser optical and Ka-band links with the Airbus SpaceDataHighway (EDRS) geostationary satellites to enable urgent acquisitions.

Finally, we developed a completely new ground segment concept to match the performances and acquisition capacity of the Pléiades Neo constellation. This new ground segment is a true technological breakthrough: It can handle huge volumes of data and is fully embedded with unique hybrid cloud technology, to enable a seamless stream of our imagery to both our OneAtlas platform and to a private secured cloud to handle the most sensitive imagery requests.

Question: Images and data from Pléiades Neo will be streamed to the OneAtlas platform, which in turn analyses it into actionable insights. Could you expand a bit more on the platform?

François Lombard: In a nutshell, I would say that the OneAtlas Platform is the entry point for instant cloud-based access to premium Airbus imagery, analytics and industry-specific services.

Concretely, on OneAtlas we provide access to our freshly acquired satellite images and ten years of archived satellite imagery data, as well as yearly fully updated base maps. In terms of analytics, we provide a toolbox of various services to extract insights from the data, ranging from general-purpose algorithms like change detection or object counting, to very industry-specific thematic services covering various markets, such as defence sites monitoring services for the Intelligence market.

All these data, analytics and thematic services are available either on the platform or via an API. All the acquired Pléiades Neo data will automatically feed the OneAtlas platform, to be easily and rapidly available to all.

Question: We've noticed a trend in satellite manufacturing in flexibility, interoperability, and lifespan, maximising the profit potential of singular systems in the long term. To what extent does Airbus consciously observe that priority? Do you think it holds an edge over business cases using cheaper, one-trick-pony models?

François Lombard: The last few years have seen the arrival of newcomers to the Earth observation (EO) market, all deploying constellations of cheaper and smaller satellites compared to traditional EO actors. They usually feature high revisit capacity but with rather low resolutions and still limited swaths.

Cost-effectiveness was of course one of our concerns when building the Pléiades Neo constellation, and we did focus on optimizing lifespan and reuse of some of our technologies. But our TOP priority was to build the high-end EO constellation that would deliver the best images commercially available on the market, in terms of quality and resolution. The level of innovation and expertise required to achieve that goal has a cost that is partly incompressible.

We believe that most of the value in the Earth observation market today is on the high-end part of the market, meaning the high-quality high-resolution segment. Hence, positioning ourselves in this premium segment was the strategic choice we took at Airbus by investing in Pléiades Neo.

There is definitely room for everyone in this dynamic market, and some newcomers do offer data that is complementary to ours to some extent, but I'm confident that there will be a natural selection that will operate, as the road to success in the field of Earth observation is a long and tenuous one. Achieving high-quality very high resolution (VHR) especially requires a level of technical expertise and financial support that only a few actors possess on the market. The support of a well-established global sales network and of highly skilled technical teams to maintain such highly demanding systems are also key success factors. Finally, company attractiveness to retain the rare and ultra-specialised talents needed in this field is also a key differentiator for us.

Question: What do you hope to see the Pléiades Neo satellites achieve over the next 5-10 years?

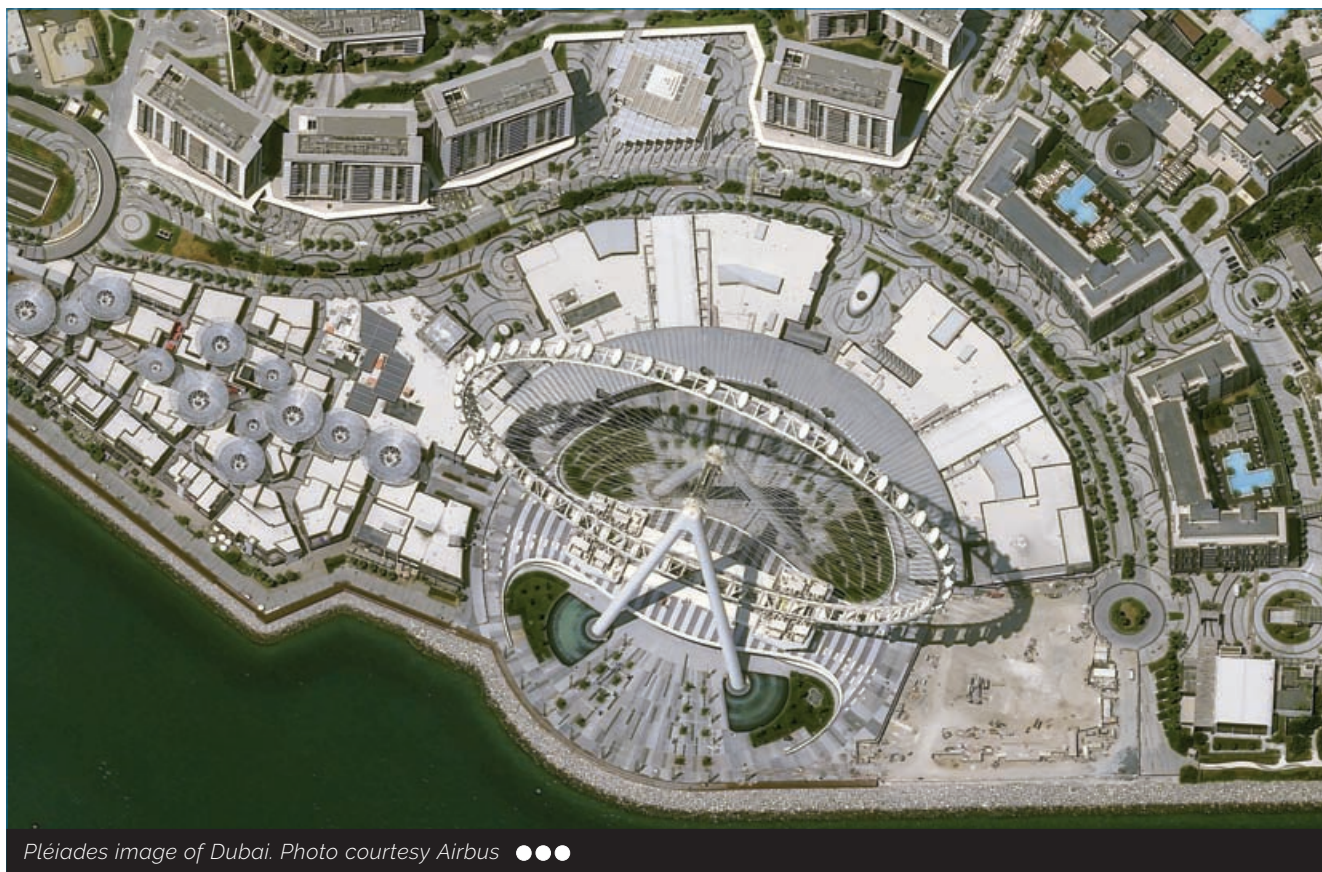
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François Lombard: The four identical satellites of the Pléiades Neo constellation will acquire every day two million km² of high-quality images at a 30cm resolution, as such it will represent a real supply boom of VHR imagery, a product that is in very high demand on the market. I hope that it will constitute for many customers the best and leading VHR imagery offer on the market, and that five years from now, Airbus will have established its place as the clear leader of the high-resolution market.

Finally, I hope that the access to Pléiades Neo high-end data will pave the way for many new and innovative use cases and applications. To that end, we are constantly trying to improve and ease access to our imagery for new industry players.

Based on the high-quality of the first Pléiades Neo images, we are confident that the market will love them. We start the commercialisation of the first Pléiades Neo images this autumn, and we can't wait for our customers to start using them.



Pléiades image of Dubai. Photo courtesy Airbus ●●●



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Steering towards the finish line

Antenna technology has leaped ahead in recent years as hardware updates and new operating frequencies mark a major new era in satcoms. With more than a handful of manufacturers bringing their new flat panel antenna products to market, the race is on to see which products offer enhanced value and unique advantages.

Amy Saunders, Editor, Satellite Evolution Group

The terrestrial antennas sector has been in a major state of flux in the last few years, with new technological developments keeping almost apace with that of orbital technology. While mechanically steered antennas remain by far the largest market share in the antenna family, all eyes are on the new flat panel, phased array, electronically steered innovations being launched as we speak. New higher

frequency operations for satellite communications go hand in hand with the hardware update, promising exciting new developments in the very near future.

At tipping point

The sector seems to be at the precipice of a tipping point, with the next few years set to see the work of the last decade truly brought to fruition as the mega constellations in NGSO come into play. NSR's latest thoughts on the topic, *'Flat Panel Antenna Analysis, 6th Edition report'* agree, predicting more than six million cumulative flat panel antenna shipments, generating almost US\$17 billion in revenues, over the next decade.

The fast-growing NGSO HTS consumer broadband market is expected to account for almost US\$5 million in shipments alone, driven by the expanding number of HTS constellations. Commercial mobility end-users will generate 60 percent of cumulative revenues, while consumer broadband applications will unlock US\$1 billion in revenues for manufacturers. HTS architectures in GEO and NGSO will account for almost 99 percent of in-service units by 2030 (up from 30 percent in 2020), and GEO-HTS remains as the largest cumulative equipment revenue source – more than US\$10 billion by 2030.

“Near-term, COVID-19 continues to present supply-chain challenges across the equipment supplier landscape,” states Principal Analyst and Report Co-Author Brad Grady. “However, customer demand remains robust, with FPAs reaching upwards of 15 percent satellite terminal penetration by 2030 – up from basically 0 percent today.”

“There is a lot of activity in the FPA market,” adds Charlotte Van Camp, NSR Analyst and report Co-Author. “Prices are



Isotropic Systems is leveraging fundraising to accelerate the development and delivery of its multi-beam antenna ●●●

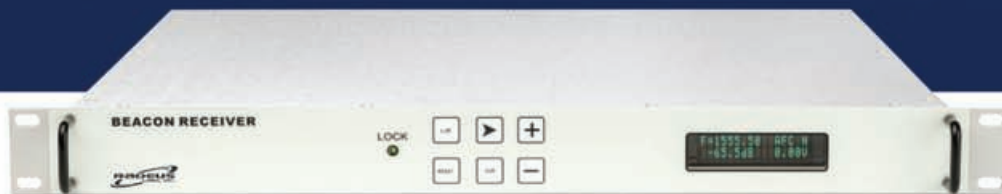


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being pushed down, and we've seen good improvements on antenna performance, but in the end, it will be one or the other," She adds, "Several players are still looking for a spot in the FPA market. The biggest winners of the market will be the "can do it all multi-orbit, multi-frequency, multi-beam antenna."

Moving on up (frequencies)

Higher frequency communications have been a huge trend for the last decade at least of satellite communications, with higher frequencies enabling more data throughput and the use of underutilized spectrum. From the traditional wide beam broadcast wavelengths, satcoms has moved to the higher frequency Ku and Ka-bands and is now looking even higher, with the first Q and V-band satellites being launched as we speak.

In July, ThinKom announced the development of a new phased-array user terminal specifically designed for operation in the higher millimetre-wave (mmWave) frequency bands for evolving next-generation communication satellites.

The new low-profile antenna will operate in the Q and V-band frequencies (37.5-42.5GHz and 47.2-51.4GHz). These bands have been designated for adoption by major satellite operators in low, medium, geostationary, and highly elliptical orbits (LEO, MEO, GEO and HEO).

"This new phased-array development is timed to fully enable the upcoming frequency revolution that promises to unlock massive new available bandwidth at these higher MMW frequencies for next-generation LEO and MEO satellite constellations," said Bill Milroy, Chairman and CTO of ThinKom Solutions. "And it uses our proven VICTS architecture, ensuring it will deliver the efficiency, instantaneous bandwidth, reliability, resiliency and overall availability our customers have come to expect from ThinKom."

Similar Q-band mm-Wave antennas have already been built and on-satellite tested by ThinKom for Q-band aeronautical and ground-mobile use.

"The new user terminals will include uninterrupted 'make-before-break' (MbB) and 'break-before-make' (BbM) connectivity options, depending on the requirements of a given application. The MbB terminals will support two simultaneous full-duplex beams that can be independently

pointed at two different satellites," explained Milroy. "The LEO and MEO satellites move rapidly across the sky from horizon to horizon, so the multi-beam capability of the new ThinKom MbB terminal ensures uninterrupted services while switching between rising and setting satellites. It also allows multiple satellites or channels to be bonded, either within the same or even across different constellations, doubling throughput capability. The antenna also supports full frequency and polarization diversity, which is another key enabler for maximizing satellite throughput."

ThinKom's full-duplex terminal is 75cm square and less than 10cm in height, weighing less than 23kg and requiring less than 100W of prime power; yet providing the same functionality as two separate 50cm diameter stabilized parabolic dish antenna radome enclosures.

Multi-link advantages

As well as new higher frequency options, we're now seeing greater interest in multi-beam and multi-link capabilities from within a single terminal, offering higher rates of redundancy and greater versatility than ever before.

In September Kymeta received a US Patent for its multi-beam antenna configuration, enabling redundant, simultaneous, multi-orbit satellite connectivity. The company's innovative now-patented technology can generate two beams simultaneously with a single antenna panel, enabling the tracking of two satellites across multiple constellations and seamless traffic hand off from the initial satellite to the second. Kymeta's metamaterials approach forms, receives, and transmits multiple distinct beams, each with its own receive/transmit (RX/TX) connection, for redundant connectivity and intelligent data management.

"Kymeta remains focused on adding relevant IP to our extensive patent portfolio and technology roadmap," said Ryan Stevenson, PhD, Vice President and Chief Scientist at Kymeta. "Our advanced technology will offer capabilities that are critical to end users because it allows for two or more essential channels of communication. Whether you want to connect to two low Earth orbit (LEO) satellites or one geostationary (GEO) satellite and one LEO satellite, for example, multi-beam capabilities enable a simultaneous connection and provide essential backup, optimized data routing, and a better user experience."

In the same month, Isotropic Systems announced that it had raised more than US\$37 million in an equity financing round led by Seraphim Space Investment Trust PLC, which fully funds the development of its game-changing multi-link antennas through to product launch in 2022.

Isotropic Systems' patented radio frequency optics technology enables the high-performance multi-link antenna to simultaneously connect to multiple satellites in multiple orbits without compromise in the performance of each link. With multiple new space constellations being launched by organisations including OneWeb, Inmarsat, Intelsat, SpaceX, Amazon, SES and Telesat, innovation in space needs to be matched by innovation on the ground, sea and in the air.

"We are delighted to announce this new funding today, which will bring our game-changing technology to reality within the next twelve months," said John Finney, Isotropic Systems Founder and CEO. "The strong interest we have received from across the industry has given us the confidence to accelerate our growth plans and bring forward the commercialisation of our groundbreaking new terminals, harnessing the potential of the thousands of new satellites being launched across multiple orbits in the year ahead." ■



ThinKom's new Q- and V-band terminals designed for operation on next-generation satellites ●●●



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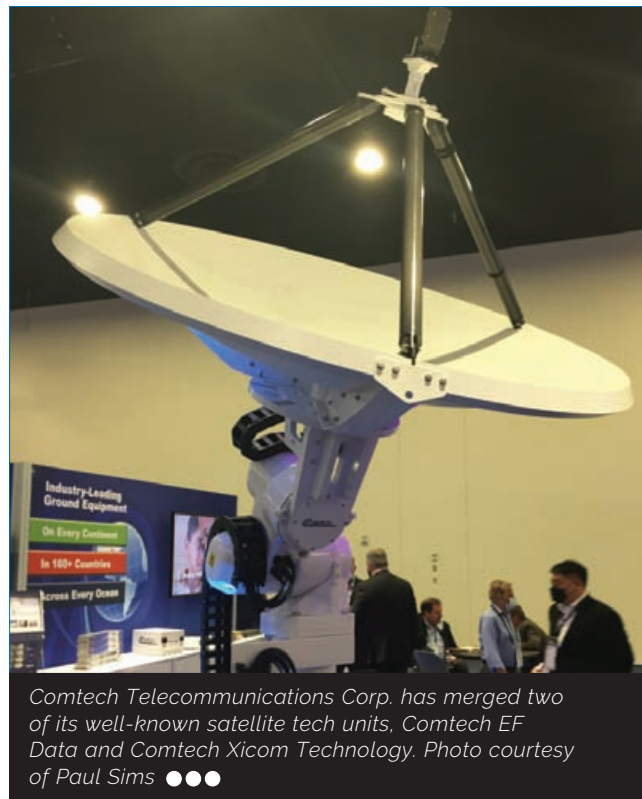
Increasingly sophisticated satellite constellations, networks and equipment must have advanced and orchestrated support systems to optimize operations. That's why Comtech Telecommunications Corp. has merged two of its well-known satellite tech units, Comtech EF Data and Comtech Xicom Technology, into one well-oiled one-stop shop called Comtech Satellite Network Technologies (CSNT).

Paul Sims, Contributor, Satellite Evolution Group

Unveiled at Satellite 2021, executives touted the move from supplier of top ground segment electronics, RF gear, and network optimization devices to an integrated provider of technology products and services ranging from installation and engineering to contract management. Eric Schmidt of Comtech Xicom, and Louis Dubin of Comtech EF Data, spoke to us during the Satellite Conference and Exhibition in National Harbor, Maryland to dive into details about the motivation behind the reorganization and the improved position to meet the fast-changing demands of vertical markets.

Question: What was the driving force behind the formation of Comtech Satellite Network Technologies?

Louis Dubin: More than a reorganization, this is an optimization of our capabilities and expertise. We're able to leverage the strengths of both companies in one seamless full-service provider. Our goal is to migrate into more vertically integrated programs so we're much closer and valuable to our customers in markets ranging from airborne to mobile network backhaul and government solutions. The word network in our new company name really says it all. We have components and we have the networking piece on top. Collectively we enable the Earth side of things in a satellite communications network to be linked together.



Comtech Telecommunications Corp. has merged two of its well-known satellite tech units, Comtech EF Data and Comtech Xicom Technology. Photo courtesy of Paul Sims ●●●

Eric Schmidt: You have to think about customer scenarios to truly realize the value our newly merged capabilities bring to the market. The people who use our gear in an Earth station environment, for example, are multitasking with a staff that has been reduced from dozens, even hundreds in some cases, to just a few. So, the equipment we provide, whether its RF gear such as amplifiers and converters or VSAT equipment, modems, or WAN acceleration devices, they need it quickly installed, they need it to work, easily serviced, and to last a long time. And they need a provider that can do it all – from delivery to service support. That's where the world is going, and that's the biggest force behind the move from a manufacturer of gear to a turnkey provider of gear and everything else companies need to optimize their systems.

Question: What are the benefits of the new company that seemed to resonate most with customers you met with at Satellite?

Eric Schmidt: One of the biggest value-adds that came up in conversations a lot during

Satellite is by having a tighter coupling we can take the best-in-class offerings and capabilities from each division.

We have a very strong manufacturing system in Santa Clara, California that our facility in Arizona may adopt, for example. While at the same time, the Tempe, Arizona factory has a stellar ERP management solution that we plan to implement across our operation in Silicon Valley.

Louis Dubin: There are compelling cost advantages as well. When we purchase parts under one roof now, we're seeing significant economies of scale, better pricing with vendors, and longer warranties. These are all cost savings we can move on to our customers as real benefits beyond the technical.

We can also support the entire customer solution from top to bottom, which can be a game changer for many of our



Comtech Satellite Network Technologies' Eric Schmidt unveils new Bobcat ground-based portable amplifier that's easily backpackable for military. Photo courtesy Paul Sims ●●●



Louis Dubin of Comtech Satellite Network Technologies shows off the new portable mudbox modem. Photo courtesy Paul Sims ●●●

customer companies where the closest thing to a satellite engineer might be an IT department.

Question: The world of satellite communications is changing so fast. How is Comtech Satellite Network Technologies positioned to meet the transformation globally?

Eric Schmidt: Sadly, we've seen a lot of the traditional systems integrators being squeezed out. As a result, the industry is expecting more from the satellite operators, service

providers, and certainly the equipment manufacturers to pick up those pieces.

We're seeing a growing trend to pick up more of the pieces, become somewhat more vertically integrated and provide services that maybe some of the ground segment equipment providers weren't comfortable providing ten years ago.

Louis Dubin: Satellite operators are now providing services. Ground equipment manufacturers are now providing some level of installation, service, finance, and packaging of continued maintenance. The satellite constellations are far more complex. The devices you're interfacing with, such as routers and switches, are more complex, and companies aren't equipped to manage and maintain them. That's where our expanding role fills the gap. We have added a global tiered services department with offices in the US, China, India, and Latin America providing 24/7 support.

Question: How integral is your service offering to customer operations, now that Comtech Satellite Network Technologies has rolled out its turnkey approach?

Louis Dubin: We are running full networks for satellite operators so that they don't have to add staff, train their team on our equipment. We have some contracts where a satellite operator wants to sell an end user bandwidth without dealing with the day-to-day running and monitoring of the equipment and SLAs. We can work with end users, many who prefer our equipment and the overall cost savings from leveraging authorized access to our network and NOC over a VPN or secure mechanism.

We can remotely run and monitor their network and check to see if their gear is up and running properly or if there's a problem. We can troubleshoot their network, support VSAT installations, and if we discover an issue, we tap local companies on the ground to fix issues.

Question: Aside from the unveiling of Comtech Satellite Network Technologies, what did you announce at Satellite 2021?

Louis Dubin: On the digital side of the business, we introduced an ultra-high-speed, multi-gigabit modem that will play in our SCPC and VSAT business. We are also introducing a new military modem that will enable us to address more effectively the foreign or four MOD market.

Question: What markets do you expect to drive significant growth for CSNT over the next few years?

Eric Schmidt: We are investing big in Ka-band Earth stations for LEO and MEO space, volume platforms that will drive growth affordably. Airborne is also a growing market for CSNT. Military aircraft and UAVs are leveraging our technologies for situational awareness, camera views, maps, weather, and jam proof services in the air.

Likewise, if you fly commercial airlines and have an internet connection at your passenger seat, chances are we are enabling that inflight connectivity service. As the pandemic recovery takes shape, we see growth in the airborne market.

We are on the verge of introducing some new higher-powered products in the airborne market very soon. Stay tuned. ■

Securing space

As satellite technology becomes increasingly integral to global operations and everyday life, attempts to hack these secure spacecraft are booming: The race is on to harden satellite infrastructure amid unprecedented cyber threats.

Rob Spicer, CEO, TriSept

Low Earth orbit (LEO) is becoming saturated with small satellites, but the vast majority of these spacecraft are ill prepared to fend off mounting adversarial threats and attacks. When you consider how much life on Earth revolves around satellites in space – everything from entertainment, energy, and financial services to weather forecasts, telecommunications, and national security – it's more critical than ever to effectively secure these orbiting assets.

One of the most recent ransomware attacks, a start of summer shutdown of the Colonial Pipeline in May, disrupted nearly half of the fuel supply across the Southeastern US – causing crippling gasoline shortages for millions of drivers and even airlines. Hackers had gained access to the infrastructure controlling about 5,500 miles of Colonial's pipeline, forcing the company to close down a major artery in a nationwide energy network that fuels the economy and the American way of life.

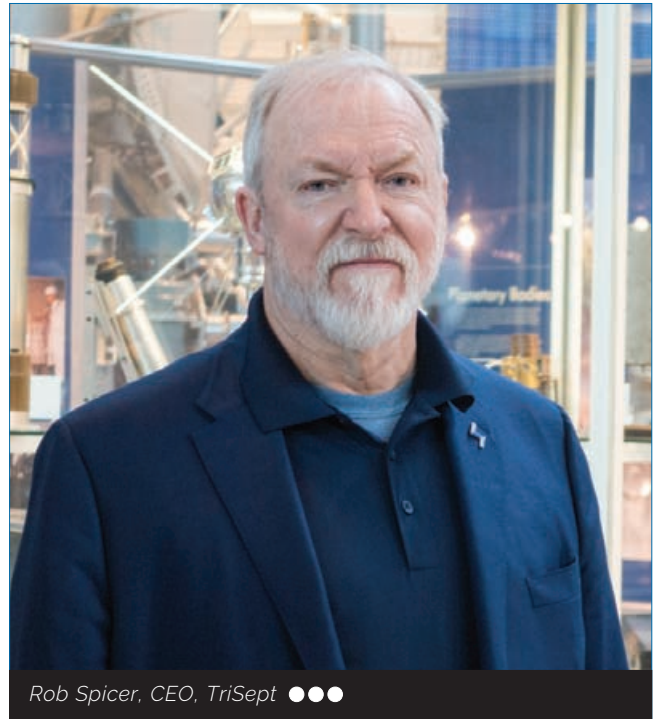
Satellites are just as susceptible to ransomware threats like the one that took down Colonial Pipeline. In fact, dozens of attacks have been carried out over the past two decades that demonstrate just how vulnerable spacecraft can be. Hackers successfully gained unauthorized control of NASA satellites at least five times in 2007 and 2008, for example. Ten years earlier in 1998, hackers took control of and destroyed the US-German ROSAT imagery X-ray satellite.

As the US plans and implements low Earth constellations to enable enhanced military communications and intelligence gathering, securing satellites and ground infrastructure has never been more vital. It's not a matter of if, but when many of the same Achilles heels in terrestrial networks manifest in space – whether it's a ransomware attack on a commercial constellation or the 'back door' penetration of the managed ground system controlling it.

Washington appears to be increasingly committed to cybersecurity measures, especially when it involves critical infrastructure. The National Security Agency (NSA) is studying satellite hacking with goals of developing systems that can detect and signal security breaches amid the rising concerns and numbers of small satellites in space.

Governments and companies alike find themselves in a race to harden on-orbit assets with solutions featuring 'zero trust' authentication layers capable of keeping the most advanced intruders out. One way to keep them out may be by inviting them in.

That is what the Air Force has in mind with its first-ever Hack-A-Sat event. The federal government has offered its



permission to finalists to hack an operating satellite offered up as the ultimate prize for top hackers who could reveal critical vulnerabilities and aid invaluable in the overall effort committed to satellite security. Over 6,000 competitors took part, across 2,213 registered teams, which was ultimately narrowed down to eight finalists.

Protection from the ground up

The modernization of spacecraft has driven satellite industry growth and innovation – opening doors to potential security breaches as well as inherent barriers against cyberattacks. New satellites and ground infrastructure often run on widely available operating systems such as Unix or Linux, making them equally vulnerable as other computer systems and servers when not properly secured. These systems will often diverge far enough from existing systems that they stop receiving critical fixes and security updates, creating a ticking time bomb for cyberattacks and other cybersecurity issues.

At the same time, there's a move toward more hybrid, interoperable architectures that will make spacecraft naturally more secure, according to Space Force officials speaking at the Small Sat Conference in August. Constellations of satellites that communicate with each other in space, requiring fewer touchpoints with ground stations, offer fewer opportunities for hackers to break in.

Traditional satellites, especially military satellites, have relied primarily on encryption devices to protect their operations and communications links. Encryption simply isn't enough to protect modern satellites because they can be accessed through ground control networks.

Non-military satellites may not have encryption capabilities or other traditional security features, such as vulnerability tracking, access controls, auditing, and integrity validation, which creates an easy target for bad actors who can establish basic communications with the spacecraft or network device.

There is no doubt that hacking groups, including seasoned industry researchers – many whose 9-5 duties come with the highest security clearances – are keenly focused on high



Securing satellite. Photo courtesy Axel Edling, TriSept ●●●

profile satellite launches, technology advancements, such as satellites for 5G and the weaknesses they pose, and widely publicized government and military space initiatives.

They are searching for chinks in the 'armor' of individual spacecraft as well as entire constellations and ecosystems being developed to enable everything from Space Force surveillance to the emerging space economy and on-orbit servicing, assembly, and manufacturing (OSAM) capabilities.

Closing the satellite security gap

A satellite that can survive launch and initiate operations in space is no longer the benchmark for excellence. A satellite must be capable of defending itself against all sorts of threats – with 'zero trust' at every layer of operations, in space and on the ground.

While more elaborate and diversified satellite architectures go a long way toward providing baked in security, satellite and system operators also need an affordable security software solution that runs on a widely deployed operating platform.

Our team at TriSept Corporation has been integrally involved with commercial and government satellite missions for nearly 30 years – from concept and systems engineering to launch and integration and mission support.

We have found that many of the commercial and open-source offerings available today lack even basic security out of the box. The biggest focus has been on securing the satellite communications, but it's important to go much deeper to fend off determined attacks.

There are a number of software solutions in various stages of development and price points today. As an example, TriSept will launch an affordable, modern security offering for small satellites called TriSept Secure Embedded Linux (TSEL) later this year, following a series of lab and in-space TRL testing this fall. TSEL is in direct response to pent up demand across the satellite industry for a managed solution that secures an embedded device in much the same way a server is protected.

Our solution offers a series of automated mechanisms and updates that deliver far more detailed audit data, the latest security patch updates that can be applied over the air, and 'zero trust' verification layers that help to protect against hackers and provide an accurate account of what's going on aboard the satellite at all times.

The motivation behind such a satellite security offering is the mounting concern that time is of the essence when it comes to filling the gap between the current state of security on many satellites and best practices the market has long aspired to deliver.

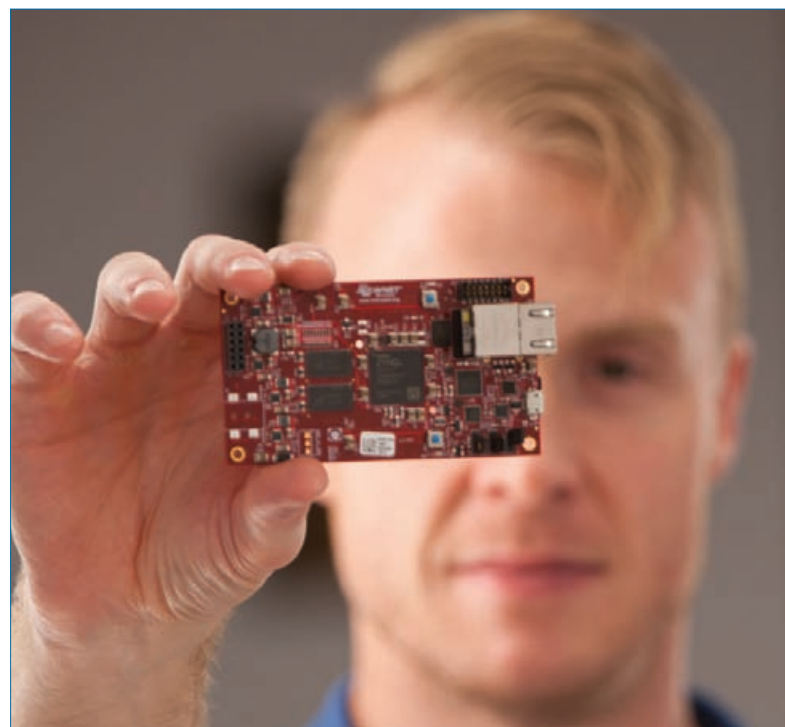
Modern embedded systems with updated resources make it possible to host more widely adopted software components, such as the Linux operating system kernel, the standard GNU suite of utilities, popular programming libraries and interpreters like Python and a variety of open-source applications.

Using a Linux foundation also enables the use and adaptation of proven security tools, decades of experience and industry knowledge to apply the same lessons learned from hardening government and commercial ground systems to better secure a new age of space and spacecraft.

Satellite security is a can that has been kicked down the road far too long, just like securing energy grids and oil pipelines. Just ask Colonial Pipeline and the millions of drivers who take fuelling up their cars for granted. Until there's no gas.

The services and applications delivered over the thousands of satellites in space this very moment are equally vital to the US and nations across the globe. Energy and food system management, television and radio content delivery, military surveillance and national security missions from space are among countless other applications at risk today.

The race is on to harden satellite infrastructure and the industry appears more ready than ever to toughen its stance against rising cyber threats throughout an increasingly dangerous world. ■



Steve Bjornaas and the TriSept Software Development team are lab testing TSEL on satellite hardware before in-space trials this fall. Photo courtesy Axel Edling, TriSept ●●●



Photo courtesy CPI Satcom ●●●

Developing connectivity technology

With the landscape of spectrum evolving, market commentators continue to hotly debate where the healthiest growth is spread across existing and emerging bands. Pam Lugos, Vice President of Business Development, outlines CPI Satcom Products approach to connectivity technology, and how they intend to respond to developing demands.

Laurence Russell, Assistant Editor, Satellite Evolution Group

Question: Could you outline some recent highlights and challenges for CPI Satcom?

Pam Lugos: CPI continues to grow and expand, both via acquisitions as well as through new product development. The increased synergies from acquisitions are leading to greater opportunities for various groups within CPI, including CPI SMP Satcom Products, which offers a variety of power amplifiers and BUCs, and other RF electronics for earth station use.

CPI continues to strengthen our product offering to include new, state-of-the-art technologies such as GaN and high-efficiency TWTs. We are particularly focused on frequencies such as Ka, Q, and V-band. We've also continued to develop customized and semi-customized products for airborne, or IFEC, applications, as well as in the rapidly evolving LEO/MEO network segments.

Question: The utilization of spectrum has seen some turbulence in recent years; what do you see as the most lucrative bands in oncoming markets?

Pam Lugos: Lucrative is in the eye of the beholder. We know that while there are those new bands (Q, V, reverse Ka, etc) that hold a lot of promise, there is still much to optimize in C-band and Ku-band. Ancillary technologies, including encoding, modulation, etc will have all had a hand in ensuring that the 'traditional' frequency ranges can continue to play a role in the global satcom industry.

Having the right balance of standard products versus custom products and focusing on those market segments that are looking for a higher level of reliability and service have always been goals for CPI.

Question: Could you tell us about CPI Satcom's developments with Q and V-band technology?



Photo courtesy CPI Satcom ●●●



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Pam Lugos: CPI has been in the extra high-frequency range industry (above 30GHz) for decades now, beginning with the global telephone application launched in the late 1970s. Whether using VED or solid-state technology, our experience in full amplifier development, which marries power supply technology with RF amplification devices, all while requiring expert packaging and thermal management, means that CPI is well-positioned to lead the charge in these emerging markets.

We offer amplifiers in these new ranges with either air-cooled or liquid cooled options. These products are available now for purchase, and we continue to expand the range of specialized features that are being requested by the market on these units, such as multi-band BUCs, which make greater than 1GHz transmission an easy reality.

Question: Have you had similar progress with Gallium Nitride (GaN) products?

Pam Lugos: Improvements in GaN technology continue to advance at a lightning pace. CPI continues to work with technology experts to ensure that our GaN amplifier products meet or exceed all of the market needs today.

Our 160W Ka-band solid-state GaN product has been in active production for over two years now and we have shipped a significant number of units to applications all over the world. We are using that platform to expand the Ka-band GaN product line to include various other power levels and frequency ranges.

Of course, CPI was also a leader in the identification of memory effect in GaN-based products. We pioneered methods to not only identify the phenomenon but also ways to mitigate it so that our products could be used with confidence and performed as advertised when needed.

Question: What's the current state of the in-flight communications market, and how does CPI Satcom hope to respond?

Pam Lugos: Along with CPI's Radant group, CPI SMP



*Pam Lugos, Vice President of Business Development,
CPI Satcom ●●●*

Satcom products is well placed in the airborne/IFEC markets. The knowledge base that CPI has in this market helps to shape and drive product development and innovation.

CPI SMP Satcom Products has DO-160 qualified KRFUs for airborne applications in both Ku and Ka-band, which can be offered as standard products or as customized units based on the customers' requirements. CPI has hundreds of airborne units in use around the world today.

Question: How is CPI Satcom prepared to answer the coming wave of LEO/MEO demand?

Pam Lugos: The LEO/MEO wave is here now. CPI is actively working on multiple programs to be the provider of choice for the RF amplifiers. Our unique position as a global provider with both commercial and technical assets all around the world make CPI the favoured supplier for those entities creating their global LEO/MEO networks.

Synergies with the various antenna and antenna systems products offered by CPI's SAT group means that CPI can provide an 'a-la-carte' method for the customer: Allowing them to select just the RF components that they may want/need, or alternatively, offering them a complete system with an antenna. This allows the global network designers to focus on their core competencies and leave the RF uplink to the experts.

When you combine the global CPI infrastructure and varied core competencies with robust, well-built products, all competitively packaged, you'll find that CPI is the obvious choice for the LEO/MEO systems world.

Question: What are CPI Satcom's primary goals in the industry moving forward?

Pam Lugos: CPI SMP Satcom Products will continue to focus on innovation and supporting the satcom market with the product offerings that are demanded by the customer base, while steering system designers to the best technologies that are available. We will continue to offer amplifier products in all three major technologies (solid-state, TWT, and klystron), further solidifying CPI's position as the most preferred supplier of HPAs and earth station electronics. ■



Photo courtesy CPI Satcom ●●●



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5G IoT connectivity

The exciting Luxembourg start-up OQ Technology is the world's first global IoT satellite operator and a fast-growing enterprise boasting all manner of cost-saving efficiencies across sectors, especially where fibre is unfeasible. Omar Qaise, CEO and Founder, describes the potential for 5G IoT connectivity, and how OQ Technology helps to make it a reality.

Laurence Russell, Assistant Editor, Satellite Evolution Group

Question: Could you give us a picture of the kind of funding profile and partners OQ Technology possesses?

Omar Qaise: Since its inception in 2016, OQ Technology has made a revenue of more than US\$7 million from government and institutional contracts, with the largest amount over the past year. In addition to government contracts such as the ESA contract for the advanced 5G IoT in-orbit mission this year (under the Luxembourg National Space program 'LuxImpulse'), Co-Founder Mohammed Al Muhairi, a serial entrepreneur with multiple successful businesses in the oil and gas industry in the UAE, has self-invested in the company and joined its leadership team.

Following our successful first commercial satellite launch in June, OQ aims to also start generating revenue via the satellite and the constellation in progress. We are planning to launch a constellation of more than 60 satellites over the next few years to address real-time global connectivity with URLLC (ultra-reliable low latency communication) and M2M (machine-to-machine). However, initial commercial service will be for 'latency-tolerant' low-power devices starting later this year. We have also grown geographically. In addition to our headquarters in Luxembourg and offices in Dubai and Rwanda, we are now planning an expansion into the US.

Besides our funding efforts, OQ Technology is working with international partners, including the Luxembourg Space Agency, European Space Agency (ESA) and the Mohammed-Bin-Rashid Space Center (MBRSC) in Dubai to achieve its business objectives. We are also in the process of building several African, US, and Middle East partnerships, and we are talking with chip companies.

Question: Where do you foresee the most addressable markets for OQ Technology's services?

Omar Qaise: With the M2M connections market expected to reach US\$26.52 billion by 2026 and an estimated 50 billion devices and machines needed to be connected by 2030, it's a huge market opportunity for OQ Technology. As it stands, the available 4G and satellite infrastructure are not enough and the cost to lay down fibre in remote regions is too expensive. That is why we have decided to address this market, in rural and remote areas such as Africa, Asia, the Middle East and the Americas, where infrastructure is lacking.



Omar Qaise, CEO and Founder, OQ Technology ●●●

The Asia-Pacific specifically is anticipated to become the fastest-growing region in the global 5G IoT market.

By providing 5G IoT and M2M communication through satellites without the need for terrestrial cell towers, we aim to connect 70-80 percent of the world without Internet access through a low Earth orbit (LEO) constellation of nanosatellites. In short, we are incorporating the cell towers into the payload of our LEO telecommunication satellites. This will open opportunities for many latency-tolerant applications.

Farms, for example, suffer globally from the lack of cellular connectivity. IoT-based smart farming involves monitoring the crop field with the help of sensors (light, humidity, temperature, soil moisture). We can provide that by integrating our module to smart farming devices, which gives you access to our data platform for meagre cost and within record time. In the oil and gas industry devices can detect hazardous gases or leaks in oil pipes that need to be communicated quickly. OQ is close to signing a memorandum of understanding with an esteemed research institute to collaborate on a 5G satellite constellation and innovative telecommunication services in Middle East and Africa that could be a first step in that direction.

A third sector benefitting from satellite-based 5G IoT is the logistics sector for tracking of shipments and containers. Utilities and smart metering are a big market for us with a huge potential. Also, there's the financial sector, where our services can be used for ATM machines in MEA countries without fibre to communicate with a satellite. While incumbent satellite providers have a solution in VSAT, it's very expensive and similar to using a big pipe to pass through small amounts of water. With our technology we can be much cheaper and more efficient.

Question: What's your assessment of the current 5G IoT market? What do you expect from it in the near future?

Omar Qaise: 5G wireless networks are crucial for IoT because they allow communication service providers and large enterprises to connect mobile and IoT devices, data centres and public or private cloud platforms. IoT is a very fragmented and very new market though. Many organisations aren't fully aware yet how this can help them. Besides

technology provision, there is also a need to really work with customers and educate them about the value of IoT.

Today, 5G is capable of supporting a large number of static and mobile IoT devices with varying speeds, bandwidth, and quality of service needs. To deliver best results however, 5G has to be transformative rather than a faster version of existing networks.

Adoption of 5G IoT ensures new process efficiencies and technological developments, resulting in increased profitability and productivity. And while the need for industry is clear, factors such as cost, spectrum availability, government regulations, and the availability of 5G-capable IoT devices may slow down the adoption of 5G IoT technology. The lack of standardisation in IoT protocols could also limit demand and market growth.

The key aspect that drives the faster adoption of 5G IoT technologies includes the unprecedented speed, large bandwidth, massive scalability and high reliability of 5G network applications. For upcoming applications like drone control, vehicle telematics and infotainment and artificial intelligence (AI) latency, currently at below 10ms, is a very critical factor, especially with 5G. Traditional satellites may take more than 250ms and cannot match requirements. With our nanosatellites in LEO, we can address this gap for latency critical applications and provide high data density, quality of service and rapid response time.

Another future avenue is a hybrid satellite-cellular device, a concentrator for applications where users might only be using sensors that connect via Bluetooth, Wi-Fi or other means. The concentrator collects data from the numerous sensors, encapsulates it and sends information to the satellite using a narrowband (NB)-IoT link. We call this product the 'OQ ONE Gateway.'

Selling excess capacity to mobile operators, mobile virtual

network operator (MVNOs) and solutions providers is another potential option. Instead of several roaming partners or adding infrastructure in difficult to reach areas, service providers could tap our satellite network for IoT connectivity where there are gaps in terrestrial network coverage.

Question: With experts heralding an automation boom as part of the fourth industrial revolution we're living through, are networks equipped for the mass digitization of industry?

Omar Qaise: Connected sensors and actuators enable companies to automatically pick up on inefficiencies and problems sooner, saving time and money.

One of the most compelling use cases for 5G in manufacturing are automated guided vehicles. These vehicles are typically enabled by Wi-Fi and rely on software loaded on the machine to manage routing and task execution. 5G would provide for significantly better connectivity for sharing data between vehicles and coordinating fleets in real time. Alternatively, take a look at oil companies that have a fleet of autonomous aircraft used to gain visual and thermal images to detect potential problems in pipelines enabling predictive maintenance.

To achieve the same high throughput and low latency for these cases without 5G would require available private networks with high-speed connectivity. However, private networks need the deployment of infrastructure, which can cause an issue for mobility when assets are spread out.

Through our services, we can help or augment existing private networks at a global scale. And by using our 5G



OQ Tiger assembly. Photo courtesy OQ ●●●

satellite testing centre and the recently opened LEO Constellation Control Centre, mobile and terrestrial operators can test and validate how their existing network would integrate with OQ's 5G stack.

Question: How is OQ Technology's Hybrid Satellite-Cellular Terminal equipped for the challenges and rewards the expansion of IoT will bring?

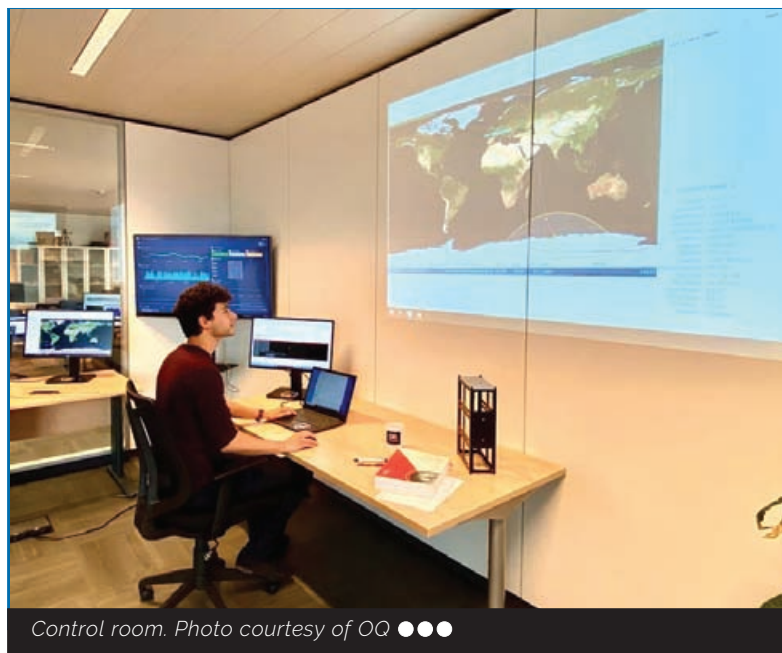
Omar Qaise: There are three challenges in providing 5G satellite connectivity: Speed, distance, cost. On the ground, the next cell is typically around 20-30km away. Satellites in LEO are about 500km away, travelling fast, at about 7km/s, which destroys the waveform of NB-IoT. OQ Technology developed algorithms and add-on software following 3GPP-based cellular standards for NB-IoT, to make sure IoT devices can seamlessly switch between terrestrial and satellite connectivity to overcome these issues without modifying the cellular standards.

This allows users to connect with the satellite and receive data on the same existing frequencies. In 2019, we successfully tested a prototype supporting NB-IoT waveforms in low Earth orbit with uplink and downlink, showing success for NB-IoT via satellite even in harsh conditions. We also have six pending patent applications in the USA and in Europe that will improve satellite based IoT and M2M communications in remote locations. Our Tiger-2 nanosatellite performed well during the launch and early orbit phase (LEOP) and is now reaching the final stages of the commissioning phase.

Cost is another huge challenge. Getting satellite connectivity is typically expensive. While mobile chips are cheap (US\$5) and easy to buy and install for use within existing terrestrial networks, when you leave those networks, you have to use a satellite chip which easily costs around US\$100. With our technology you can use the same standard US\$5 chip to connect to a satellite. This unrivalled combination of seamless connectivity in otherwise unconnected locations and at a fraction of the cost is ideal for IoT service providers.



5G OQ sat. Photo courtesy of OQ ●●●



Control room. Photo courtesy of OQ ●●●

Matching the same or as-close-as cellular price, will provide a lot of use cases and open a big market for us. We are already in talks with potential cellular chip partners to scale up the satellite access capability to existing cellular IoT chips globally.

Question: What NewSpace market solutions do you predict making a stir in the next decade?

Omar Qaise: One has to bear in mind that right now NewSpace is not a destination but an enabler for a variety of business verticals to solve existing or future problems or improve the situation on Earth. It also follows the innovation cycles we have seen in other industries like standardised manufacturing in automotive or miniaturisation in IT.

Take networking for example. Just like the terrestrial networking world, I expect a digital transformation to enable ground systems to become more dynamic and unlock the value of these newer and more innovative satellite architectures. Virtualization and orchestrating operations to support a highly dynamic and automated service environment would provide massive low-cost scalability and enable distributed architectures.

This could include leveraging the same digital technologies such as software defined networking (SDN), virtualization, the cloud, and electronically steerable antennas. Interestingly, OQ Technology won this year a competitive ESA tender towards the development of agile 5G core network concepts and test bed over satellite.

AI is also finding its way into NewSpace. This technology will bring great advances in the use of small satellites where automatic diagnostics could anticipate future issues with a spacecraft. It could also help to reduce the amount of data that needs to be downloaded in order to process the information provided by the satellites. Automated satellite collision avoidance and optimizing constellation control, where a learning system could help to reduce the number of tasks needed for constellation management, are other examples.

Overall, we are very well positioned to disrupt the traditional satellite communication market and bring a compelling new product into the world combining both satellite and cellular capabilities. ■



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Satellite 2021 drew smaller but enthusiastic crowds of attendees emerging from the pandemic. Photo courtesy Paul Sims ●●●

An industry determined to lead and innovate emerges amid a pandemic at Satellite 2021

With trade shows and conferences once more kicking off again in the satcom sector, albeit with limited international participants, the opportunity for business and innovation is ripe after such a long absence.

Paul Sims, Contributor, Satellite Evolution Group

Attendance may have been down at Satellite 2021, but enthusiasm and innovation was never stronger. While the pandemic kept many international participants away, it's clear that COVID-19 did little to slow promising advancements and unprecedented partnerships in satellite's growing role in global connectivity.

"Everywhere on Earth speaks to what I think is the superpower of satellite, which is reach. We have the ability to connect the edge of a network as efficiently as we can in

the center, and that's obviously not the case for terrestrial networks," noted SES CEO Steve Collar, who participated virtually from Luxembourg during the highly anticipated general session *'The Future of Global Satellite Connectivity.'*

Collar shared the stage with Facebook, SpaceX, and ST Engineering iDirect, reflective of the new collaborative landscape required to elevate the connected experience anywhere. "Our job is to make our services carrier grade, as reliable and easy to use as terrestrial in parts of the world where terrestrial doesn't and will never exist," Collar said. "Whether that's planes in the air, ships at sea, or extending telco networks where it would otherwise be economically unviable."

"It's a long runway to solve that problem, and it really revolves around not being as proprietary and closed as we have been historically as an industry," said Kevin Steen, ST Engineering iDirect CEO, noting that a telco-satellite collaboration will truly unleash 5G and open the door to an unprecedented, connected experience.

OneWeb Executive Chair Sunil Bharti Mittal announced such a partnership during his Satellite 2021 keynote address, revealing that AT&T will use OneWeb's LEO satellites to provide broadband services to 'poorly connected' communities across the US that are outside its fibre footprint.

"I am pleased to share with you today that the US market now has a huge distributor in the form of AT&T," Mittal announced. "We expect to sign at least one telecom operator in every country of the world," he said, noting OneWeb has already more than a dozen telco partnerships in place.

"You can't solve the global connectivity problem without satellite. It's absolutely vital," according to Facebook Connectivity's Brian Barritt. "Availability of 4G is estimated to grow from 40 percent to 55 percent by 2025, so it's happening but just too slow," Barritt told the session audience, pointing out satellite is well positioned as a much-needed accelerator



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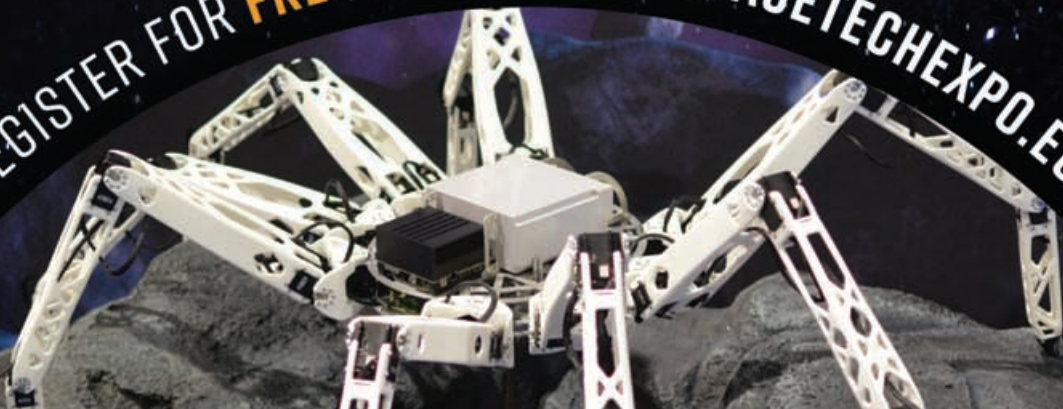
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once barriers such as proprietary solutions and networks are removed between telecom and satellite networks.

"Satellite has been on an island far too long," claims Collar, pointing to SES' plans to "allow telcos to essentially use our space-based architecture as an extension of their own terrestrial networks."

"Satellite networks and ground game should be part of the 6G standards development," noted Steen. "Let's figure out how we can drive and optimize that process as an industry."

Jonathan Hofeller, Vice President of Starlink Commercial Sales for SpaceX noted the company is serving 100,000 broadband customers in 15 countries across the globe. "People are coming out of the woodwork with a need for connectivity," he said. "We are working with telcos (to make that happen)." SpaceX's goal, according to Hofeller is to provide "so much capacity it will open up so many more use cases."

Innovations across the value chain are proof positive that satellite was busy upping its game amid the pandemic. Advancements in everything from ultra-high-powered military-tough modems and satellite security software to spacecraft propulsion systems are among the dozens of announcements



that were the talk of a conference and an industry that hasn't missed a beat.

Innovations at Satellite 2021

Advantech Wireless Technologies unveiled a new solid state super-powered amplifier system that is already drawing strong interest from the Space Force and the NASA Artemis program, a US-led international human spaceflight program.

Artemis was launched in 2017 with the primary goal of returning humans to the Moon by 2024. Advantech cut its teeth on DTH amplifiers that allow system operators running 200 to 250 television channels to deliver more content more efficiently, using far less satellite bandwidth.

Knowing Advantech's Summit II amplifier with the equivalent of 16,000W of "phase combined power" is bound to play an integral role in lunar missions has Tony Radford, VP Global Sales and his team imagining just what out of this world applications the government has in mind for the new innovation.

"It's a hush-hush program at this point, and we're thrilled to be a part," said Radford. "The beauty is they need big horsepower, and Advantech is one of the few companies on earth who can deliver it."

Propulsion systems

Propulsion will enable the future space economy and Benchmark Space Systems is well on its way to being a leading provider of in-space mobility solutions. Benchmark CEO Ryan McDevitt shared his vision of an ecosystem of interconnected on-orbit services and capabilities during the first day 'Advances in Spacecraft Propulsion Systems' panel discussion.

"The biggest advances on the horizon involve not only on-orbit servicing and refuelling capabilities that will extend mission life, but propulsion innovations that will help accelerate ROI of on-orbit assets," McDevitt said after the popular session.

Benchmark has its workhorse Halcyon thruster aboard a trio of government and commercial satellite missions in space,

The background of the poster is a composite image. The top half shows a view of Earth from space, with a bright horizon line. Overlaid on this is a network of white dots connected by thin white lines, resembling a satellite or data network. A bright blue beam of light descends from the top center, passing through the network. The bottom half of the poster is a solid purple band containing white text and logos.

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following the successful SpaceX Falcon 9 Transporter 2 mission this summer. Gas station in space operator Orbit Fab is using Benchmark's non-toxic, hydrogen-peroxide fuelled Halcyon thruster to power its prototype tanker in low Earth orbit.

In-space inspection and situational awareness provider SCOUT and Orbit Fab are among the first to sign mobility as a service (MaaS) agreements with Benchmark to virtually eliminate upfront propulsion equipment costs and speed up strategic roadmaps to boost OSAM mission revenues.

Walton De-Ice

The name Walton De-Ice implies antenna protection against extremely cold conditions, but the company just patented its new tent-like portable radome that also guards against destructive heat, 85mph winds, and sand.

"We just received our patent for the radome," explained Ray Powers, Director of Sales and Marketing, Walton De-Ice. "This new radome has really resonated with the government and military because of the reliable protection it provides even in the harshest environments."

Mudbox

The armed forces are a big fan of Comtech's new 'mudbox' – an ultra-high-speed modem that's built like a tank and offers the durability of an 8x8 inch brick.

"The mudbox offers encryption, spreading, and a broad range of waveforms compatible with the US DOD sector," explained Louis Dubin, Senior Vice President, Comtech Satellite Network Technologies. "It's back-packable, fly away capable, and ready to take on the toughest conditions."

Security software solution

TriSept is in the process of putting its new Linux-based

"Everywhere on Earth speaks to what I think is the superpower of satellite, which is reach. We have the ability to connect the edge of a network as efficiently as we can in the center, and that's obviously not the case for terrestrial networks," noted SES CEO Steve Collar.



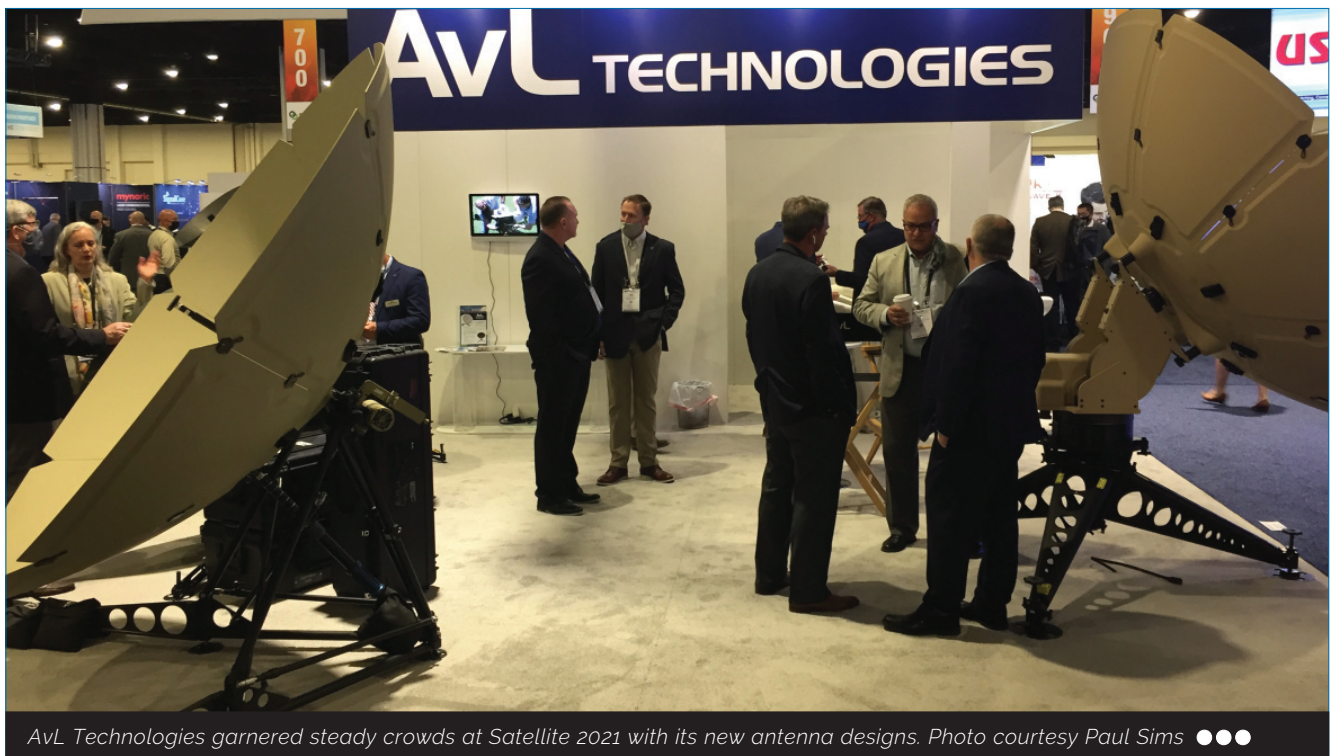
satellite security software solution through advanced lab and suborbital tests. The TriSept Secure Embedded Linux (TSEL) operating system (OS) is capable of detecting, tracking, and eliminating known and emerging vulnerabilities on conventional and small satellites.

"TriSept is closing the security gap aboard an unprecedented number of small satellite missions bound for space," said Rob Spicer, TriSept CEO. "Our teams are integrally involved in conceptualizing, integrating and managing a broad range of missions headed for space, and we're providing TSEL to keep them safe and secure."

TSEL is undergoing a series of advanced lab tests with Old Dominion University and suborbital trial runs aboard RocketStar's launch vehicle set to lift off from Cape Canaveral this fall. On track for commercial rollout by December, TSEL is set to earn full flight heritage in the spring of 2022 aboard a Lunasonde earth-scanning radar satellite scheduled to launch to low Earth orbit on a Rocket Lab Electron rocket.

On the horizon

Satellite 2021 marked a milestone 40th anniversary for the annual satellite conference and exhibition. And while it was a smaller gathering of industry professionals, it will be remembered as the event that reinvigorated in-person collaboration amid a lingering pandemic.



AvL Technologies garnered steady crowds at Satellite 2021 with its new antenna designs. Photo courtesy Paul Sims ●●●

It may start with one person's vision...

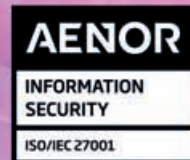
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