Satellite Executive BRIEFING
Vol. 19 No. 6 November-December 2026
SATELLITE Markets & Research
Industry Trends, News Analysis, Market Intelligence and Opportunities

From Bespoke to Batch: Industrializing Space for the NGSO Era

by Dr. Georg Heinecke

The space industry is at an inflection point. Next-generation non-geostationary orbit (NGSO) constellations demand production volumes that were unimaginable a decade ago. More than 43,000 satellites are expected to be launched between 2025 and 2034.[1] Sovereignty considerations as well as high-profile commercial successes have led to a global funding spree to build space infrastructure on an unprecedented scale. This development has made "industrialization" the talk of the industry with companies announcing factories for series production boasting rates of a few units per month, week or even day.

However, contrary to the marketing announcements, our experience shows that very few space companies can rightfully claim series production capability today because industrial machines that deliver on time and cost cannot be created overnight and rely not only on one company getting their homework done. Current production systems and organization are still build around customized, low-volume production, with a strong emphasis on engineering expertise. This is the industry's unresolved equation: technological strength without scalable industrial capability. Or as one industry leader put it to us: "Virtually everything in the world is built on assembly lines – except for satellites. Why?"

The Global Scale Challenge

Traditional satellite manufacturing involves complex organizational structures that are dominated by engineers, endless requirements and review iterations, and low volume production and supply systems build around one-off requests. These workshop systems by default optimize towards perfect technical solutions and quality but jeopardize time and cost milestones in the process – one of the reasons why the industry is notorious for its cost and schedule overruns.

A look around the industry is instructive. Launchers, small and large, come to market much later than promised or struggle to increase rates as planned. For instance, launchers could sell many more rides since the

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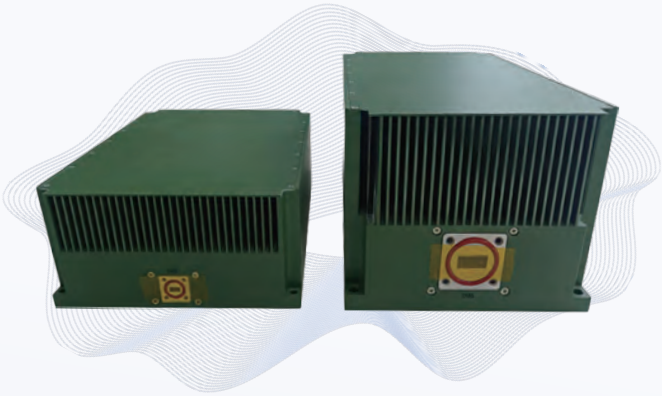
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EDITORIAL

Reaching for Space



Satellite Markets and Resaerch's parent company, Synthesis Publications LLC, is proud to announce the publication of our contributing editor Bruce Elbert's latest book "Reaching for Space." This book is part of our satellite technology series which includes "The Satellite Technology Guide for the 21st Century" written by yours truly.



Reaching For Space draws from Bruce Elbert's extensive industry and military experience, spanning over 50 years in space systems and satellite communications. Having worked for four different satellites operators and the largest manufacturer of satellites and total systems, he draws from an extensive systems engineering background with many satellite programs and architectures, including GEO, MEO and LEO. In the service side of the business, Bruce Elbert developed several service business models in the video, data and mobile satellite communications arena. Upon retirement from Hughes Space in 1999, he established his own satellite system and business development consulting firm, Application Technology Strategy LLC, and continues to assist clients in the private and public sector who provide and employ these resources for strategic advantage.

The book is now available at **Amazon** or at our website at:

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Virgil Labrador



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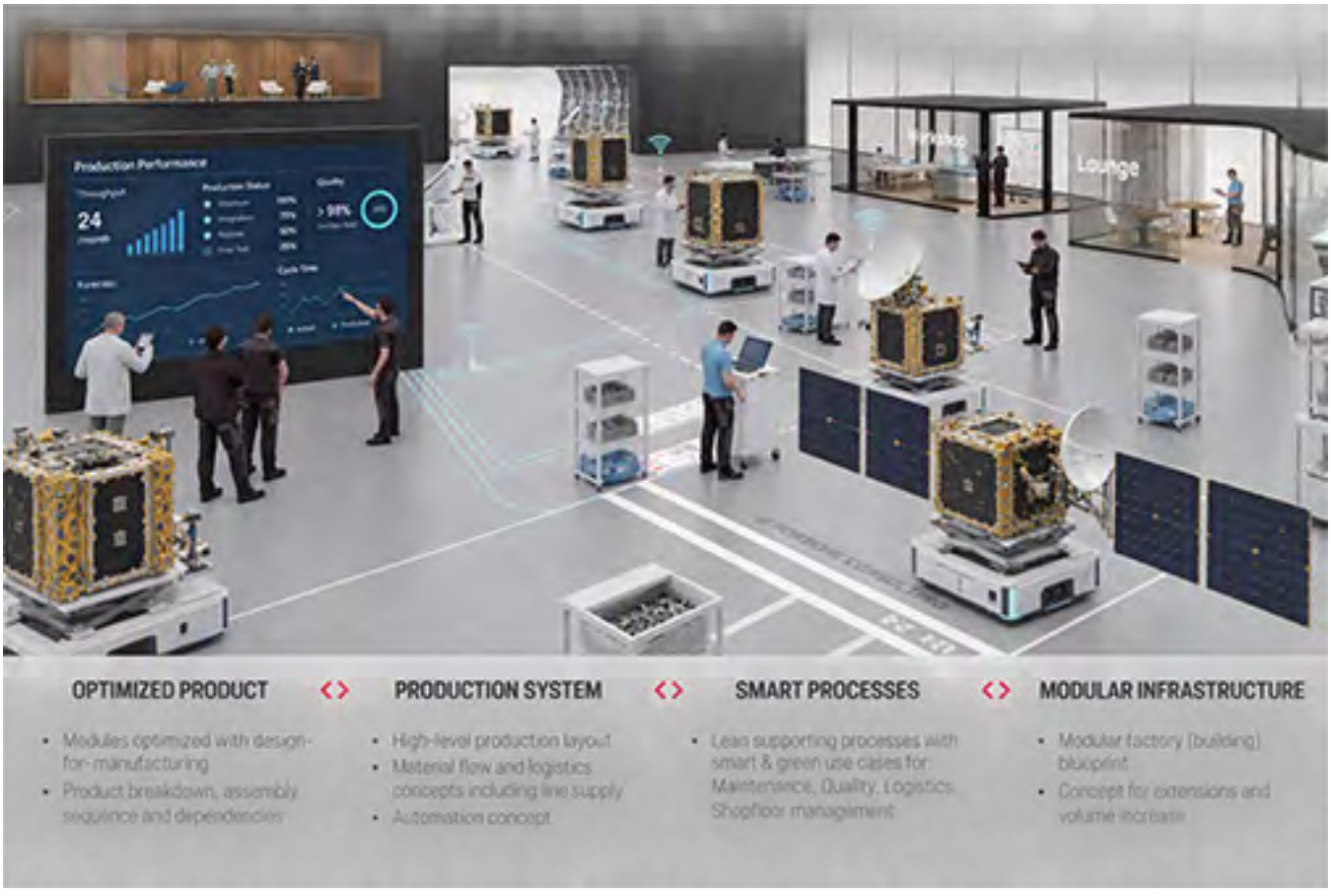
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Satellite Executive Briefing is published monthly by Synthesis Publications LLC and is available for free at www.satellitemarkets.com

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From Bespoke to Batch...
from page 1



Falcon 9 anxiety grabbed the industry but the associated production systems just cannot easily ramp up – even with several years of planning horizons. A similar story unfolds around constellation manufacturing. Scaling production systems remains a central challenge.

Europe as a Case in Point

This situation is particularly evident in Europe. The continent has world-class R&D but struggles to transition into scalable, competitive industrial production. Europe's space-industrial complex is now finally moving toward stronger sovereign capabilities and greater production scale, but largely through national rather than truly European industrial strategies. For instance, Germany unveiled the most ambitious, defense-driven space policy that places established primes firmly in the drivers seat, making it difficult for its vibrant new space ecosystem to participate. Sovereignty fosters fragmentation: it preserves national capabilities and political support, but also duplicates capacity, limits consolidation, and makes Europe-wide scale and standardization harder to achieve. IRIS² is another case in point. Calls for replicating the tranche-based tender that the SDA applies in the US are falling on deaf ears in the EU. Although this approach has the disadvantage of splitting volumes between several primes, it is an excellent way to spread execution risk: If one company fails to build the industrial machine to deliver on time and cost there are alternative suppliers ready to cover the gap.

Learning from High-Volume Industries

The automotive industry faced a similar transformation a century ago. What was once a craft industry built around bespoke engineering became the world's most sophisticated manufacturing ecosystem. The principles that enabled that shift – Platformization, standardization, modular architectures, and supply chain orchestration – are directly applicable to space.

DEVELOPMENT AND MANUFACTURE OF HIGH-FREQUENCY AND SATELLITE COMMUNICATION TECHNOLOGY



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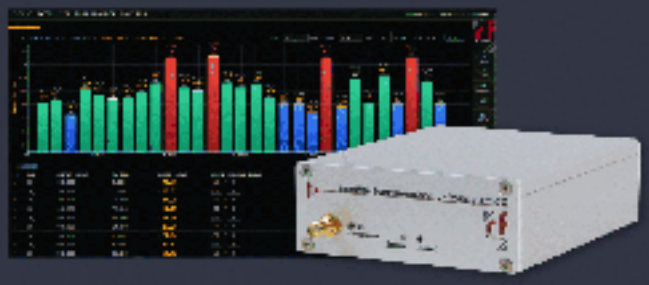
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Beyond Gravity shows how quickly this transition can happen. Working with Porsche Consulting, they introduced flow production at its U.S. facility, making payload production ready for series manufacturing. Production was restructured and scaled from just a few units per year to two units per month. Each process becomes a repeatable sequence, distributed across balanced workstations and supported by closely aligned support functions[2].

Process First, Then Production Line

Herein lies a critical lesson for the space industry: define the process before designing the production line. Too often, companies invest in facility, equipment or tooling before they have fully understood and standardized the manufacturing process. You cannot design an efficient production line without knowing the sequence of operations, the standard work content, the material flow, and the quality control points. You cannot determine floor space requirements without understanding process flow and throughput. You cannot specify workstations without defining the tasks to be performed at each station. The space industry's instinct is often to build the factory first and figure out the process later. This approach guarantees cost overruns, underutilized capacity, and production bottlenecks.

The Hybrid Model

A complete shift to product-based industrialization remains only partially realistic in the space sector. Customer-specific programs will continue to exist, particularly for institutional and scientific missions. The realistic target state is therefore a hybrid approach: platform strategies embedded within programs that remain customer-specific. This requires managing customer-specific programs and standardized platforms in parallel. Companies need modular product and process architectures as well as end-to-end digital value chains – from PLM and ERP through MES. The goal is not a "mass-produced product" but industrialization in a complex environment.

"...as one industry leader put it to us: 'Virtually everything in the world is built on assembly lines – except for satellites. Why?'.."

The Path Forward

To meet the demand of the NGSO era, the space industry must move from bespoke to batch. This requires: Platformization through modular architectures that enable standardization without sacrificing mission flexibility; industrial operating models with end-to-end digital value chains connecting engineering, manufacturing, and supply chain. Partner governance ensures that prime contractors and suppliers scale together as one production system. Most critically, it requires a fundamcess before you design the production line. Build the factory around the process, not the other way around.

The transformation must be delivered at speed, built with resilience, and designed to strengthen technological independence. Porsche Consulting supports space companies in this transition, from industrial operating models and platform strategies to scalable production and partner networks.

Notes

[1] Novaspace: Satellites to be Built and Launched (2025)

[2] Porsche Consulting – A Turbe Boost for Space (2026)



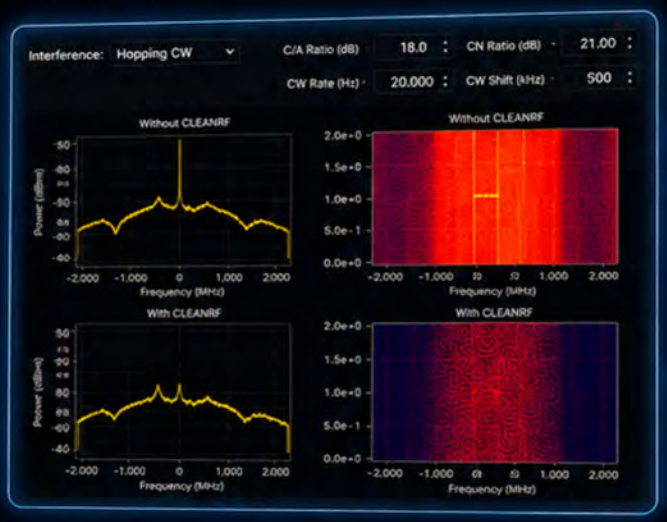
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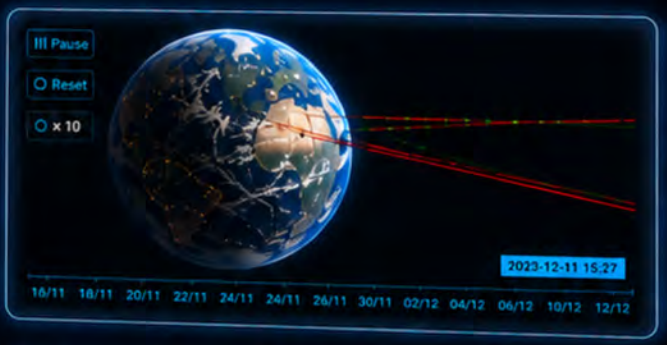
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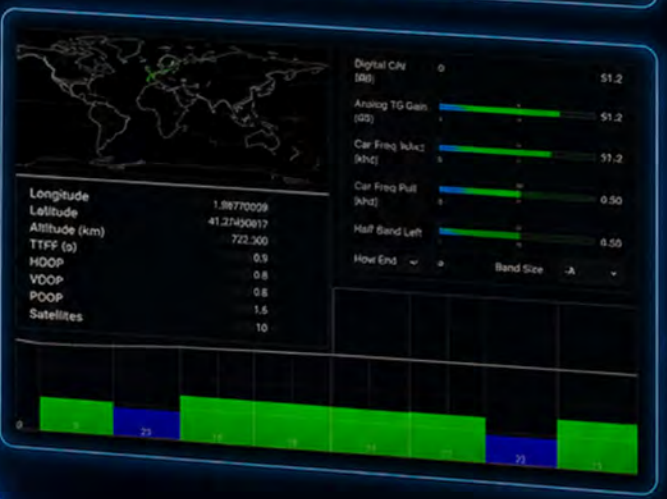
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5G NTN: State of the Industry

by Andy Walker

The satellite industry has been buzzing with the coming of New Space, mega constellations and multi-orbit capabilities, but there is another revolution that is running alongside these changes and that is the emergence of 5G non terrestrial networks (NTN). The combination of these transformations is opening up satellite technology to the wider telco industry and customer base. This opportunity could potentially have a significant impact upon satellite businesses and yet the industry is currently at very different stages of preparedness. Many new services require closer integration with terrestrial networks. Direct-to-Device (D2D) connectivity, mobile roaming, emergency coverage, IoT, sovereign networks and hybrid satellite-terrestrial services all benefit from common identity, policy and mobility mechanisms.



image courtesy of iStock credit: :VectorUp

There is a need to shift from the proprietary networks to align with 3GPP standards, and the manner in which that is done will impact the efficacy and efficiency of operations. Key players, such as AST Space Mobile and Starlink have already made moves into the D2D sphere, whilst others are assessing their routes in. However, so far the adoption of 5G NTN has been less common, with both the named players above potentially moving in that direction but not having yet deployed standards based 5G NTN.

5G NTN gives operators a route into the mobile supply chain and the 3GPP service model. It may simplify partnerships with mobile network operators, support access from standardised device classes and reduce the amount of proprietary integration needed above the satellite link.

5G NTN - The Basics

5G NTN holds the key to finding elusive seamless connectivity, everywhere. Operating across LEO, MEO, GEO, HEO and VLEO, NTNs provide a range of coverage for multiple use cases including mobility and IoT. At the moment, 5G NTN is supported mostly in GEO and LEO, but it is expected that this will expand to other orbits in the near future. Working as part of a hybrid communications system, alongside terrestrial networks, NTN connectivity allows the right form of satellite connectivity to be used for the application in hand. For example, for D2D connectivity, a satellite in LEO would be most suitable due to its low latency. However, for an application that doesn't rely upon that low latency, such as IoT, satellites in GEO may provide the best option.

Growth Potential

In a recent report by Markets and Markets it is forecast that the global 5G NTN market is set to increase from USD 11.91 billion in 2026 to USD 45.5 billion by 2031 at a compound annual growth rate of 30.8%. This forecast is being driven by demand for continuity of connectivity which cannot be met by terrestrial coverage alone, particularly for remote areas, the maritime, aviation sector and areas at risk of natural disasters.

The Connectivity Gap

As we are all aware, there are many issues with continuous coverage of terrestrial mobile networks. For indi-

vidual mobile users, these so called 'not spots' can be very frustrating but for businesses such as airlines, maritime, logistics companies and those located in remote areas, they are unacceptable and can result in lost revenue. With passengers selecting airlines, cruise ships and ferries based upon the reliability of their connectivity, continuity of connectivity whether for passengers or crew is an important consideration. This connectivity gap also negatively affects IoT operation, which is often deployed in the most remote regions of the world and affects critical industries such as agriculture.

Standards Development

For satellite network operators (SNOs) and mobile network operators (MNOs) to interwork, there are three avenues of possibility.

The first is that proprietary systems on both the MNO and SNO side work independently but interwork at the application or network level. The second avenue is that the satellite operator is in compliance with 3GPP standards - not just enabling the obvious approach of D2D functionality, but also more complex terminals for more specialist use, as outlined further below. The third avenue that can be explored is full interfacing between terrestrial networks (TNs) and NTNs through the core network.

Currently, the standard is at Release 19, which is an advanced 5G standard. Each iteration of the standard builds in new functionalities and features in system specifications. Release 20 is currently in progress, and this will further develop the existing 5G standards whilst laying the foundations for 6G.

NTN has massive potential, but at present, deployment is patchy. The industry must get to grips with the technology and the large capital investments needed to launch and operate 5G NTN compatible constellations. These are currently not fully in place.

D2D connectivity: Satellite and MNO collaboration

One of the more widely adopted NTN technologies has been D2D where MNOs and SNOs are collaborating and establishing partnerships to enable them to reach more subscribers. According to OOKLA research, these deployments are more focused on coverage rather than speed and are being well received in rural areas, outdoor environments, maritime settings and emergency communications in particular. The uptake of these new services is very dependent upon the devices, collaborations between MNOs and SNOs, the cost of the services, market conditions and a balanced evaluation of how partnerships will best evolve for mutual benefit.

"...There is a need to shift from the proprietary networks to align with 3GPP standards, and the manner in which that is done will impact the efficacy and efficiency of operations..."

OOKLA identifies Australia as one of the more mature D2D markets, the UK has also experienced growth whereas in other parts of the world such as Japan and the US and Canada D2D lower usage is recorded.

Spectrum Issues

Already a finite resource, spectrum is becoming increasingly scarce as satellite operators struggle to find the spectrum to accommodate their services. There has been a huge surge in the numbers of LEO satellites launched in recent years largely due to the deployment of the Starlink constellation. SpaceX's recent acquisition of Echostar spectrum to fuel deployment of its D2D service is a good illustration of how in-demand spectrum rights are.

There is also the risk of conflict between terrestrial and satellite spectrum. The provision of D2D services that utilise terrestrial mobile spectrum, enable compatibility with unmodified handsets but risk interference with cellular networks if not coordinated. Using mobile satellite service (MSS) avoids this interference but it also requires handset modifications that restrict device adoption.

Operation across borders is also an issue and can cause complications in terms of seamless global roaming. National and regional frameworks differ, and this requires a lot of coordination between different regulatory bodies.

Finally, interference can be caused between satellite operator beams that reuse frequencies to increase capacity where overlapping of footprints occur. Any mitigation techniques put into place inevitably reduce throughput and affect the user.

The need for stronger and/or more specialist devices

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early 2G devices that utilise a large single band antennae or an external stub, the cell phone has transformed into the smartphone that utilises multiple antennas in a very small space. This has resulted in a decline in performance because, as radios, handsets have grown weaker. This may not have affected performance on terrestrial networks, where the majority of macro cells are located close to users. However, NTN places greater demands on the network.

This means that the handsets are unable to cope with the vast distances that signals must travel for NTN. LEO satellites are typically located 500 to 1200km away and GEO satellites 35,786 km from Earth, so the free-space path loss is orders of magnitude greater. Therefore, to provide useful services on future handsets, devices with superior antenna and RF performance are required. If not, the existing weak devices will place greater demands on the NTN network resulting in increasing capital and operational costs.

This may be approached either through the modification of mass market handsets, or perhaps more likely through a segmentation of the device market to deliver more suitable D2D devices that match the specialist need of specific markets, whether, health, B2B or other specialist applications and new cases.

Recognising the Value and Complexity of more Flexible 5G NTN Implementations

Beyond D2D there is more work to do. There are many applications where 'vanilla' 5G NTN D2D handsets, whether modified or not, will not provide sufficient flexibility to implement the new services required. We need to differentiate this vanilla approach, where mass market chipsets offer very low cost over very high volumes, from needs requiring something more flexible.

A good example is in the area of military use of 5G NR-NTN terminals, where various aspects of mission suitability make a vanilla 5G NTN based approach un-workable. This includes:

-Security – where the exposure of meta data and susceptibility to jamming make use of standard 5G NTN waveforms in contested environments an issue.

-Adaptability – where the significant accumulation of long-life terminals can make the evolution of network capabilities difficult to take advantage of at the terminal level.

This same lack of adaptability can cause similar challenges in the field of commercial aviation, where long-life terminals must begin evolving today to avoid becoming obsolete as 5G NTN-based LEO networks are adopted in the future.

This more flexible approach of 'Flexible' 5G NTN offers a route to the best of both worlds – retaining hardware acceleration and cost reductions via the use of chipsets but adding software defined radio to provide advantages such as in-life terminal improvements via over the air updates.

Early Days, Massive Opportunity

5G NTN is still at an early stage, and D2D is its most visible proving ground. Current progress has not only highlighted how terrestrial and non-terrestrial services can start to converge technically but has also offered a valuable glimpse to operators as to what partnerships might look like commercially, and the benefits and indeed dangers that such partnerships may hold. These services show how satellite connectivity can extend mobile coverage, but they do not represent the full potential of NTN.

Many users will be served by standardised, mass-market devices. Others, including defence and aviation, need terminals that can meet more demanding security and service requirements and adapt as networks evolve. Flexible 5G NTN can address those needs while retaining the benefits of standardised 5G technology. This will help bring satellite connectivity into a broader range of services, including how convergence can be beneficial not just between terrestrial and non-terrestrial networks, but also between the commercial and government and military domains.



Andy Walker is the Head of Satellite and Space for **TTP plc**, a technology and product development services company based in the Cambridge (UK) technology cluster. He has 36 years of experience in disruptive technology businesses, from co-founding to IPO. He has worked in both startups and large corporate enterprises in various markets. For more information visit: https://www.ttp.com/

Rapid Field Deployment is the New Benchmark for SATCOM

by Greg Campbell

Establishing reliable connectivity in the field has never been more important - and the speed with which operators are able to connect has become the new yardstick for effective SATCOM.

Delivering uninterrupted command and control for personnel is vital in fields ranging from defense to emergency response, and ensuring this can be achieved quickly, reliably and with minimal disruption, is now the single most important issue in satellite communications.

Previously, discussions around groundbreaking SATCOM technology tended to focus on the bandwidth that could be delivered: but for operators across defense, emergency response, public safety, disaster recovery and government speed and ease of connection is now a far more important benchmark.

Operators are asking the same questions: how fast can I connect? How reliably will I stay connected? Can I move and remain connected securely? Those vital few minutes in which a connection is first established are more important than they have ever been. As a result, technology is shifting to meet the needs of operators, with new SATCOM equipment built specifically for fast connections,



photo credit: US Army

reliability and the ability to remain connected while moving. This is particularly important in contested environments, with electronic warfare now used to disrupt and jam connections or in austere environments where infrastructure such as cell towers may be absent. Connecting fast, and staying connected, is now the most important challenge faced by operators in fields as diverse as defense to emergency response.

A New Approach Is Needed

This need for rapid and reliable connections has led to a new generation of modular, lightweight and easily deployable SATCOM architectures. Today, the key concerns in designing SATCOM architecture are to balance portability and performance, to reduce size, weight and power requirements (SWaP) where possible, but also to keep systems simple and rapidly deployable. Connections need to be simple to set up and reliable even in the most difficult environments.

Delivering uninterrupted command and control is increasingly vital, so new SATCOM architectures focus on speed of deployment by ensuring tight integration across terminals and network infrastructure to boost reliability and cut complexity. This new generation of hardware sees increasing automation, with auto-acquire satellite systems, multi-band connectivity for improved flexibility, and broad compatibility with modern SATCOM architectures to ensure ease of use and rapid deployability.

A Simpler Way To Connect

Previous generations of satellite technology required high levels of technical expertise and training, which meant that fielding the technology

was time-consuming and difficult. But the new generation of SATCOM architectures is designed to remove these barriers, with tool-free assembly combined with automated satellite acquisition, meaning that even non-technical personnel can establish a secure, stable connection in minutes. Rapid assembly and materials such as lightweight carbon fiber are vital to ensuring the equipment can be moved into place quickly and deployed rapidly. In order to deliver for operators in contested and extreme environments, other vital aspects are a simplified operating system so that the number of personnel who can operate devices is not unintentionally limited, and the ability to monitor the performance of SATCOM equipment via the web in real time.

A vital part of delivering connections that are fast and reliable to set up is the move away from single-orbit architectures, and towards more ambitious and modern multi-orbit approaches.

Multi-orbit approaches, which integrate Low Earth orbit (LEO) and medium Earth orbit (MEO) along with Geostationary orbit (GEO), offer operators a way to connect reliably even in highly contested environments. Multi-orbit architectures mean that operators are freed from depending on a single network to deliver (and waiting to connect) or being cut off if that network becomes unavailable. Instead, a single reliable communications architecture integrates multiple orbits, meaning operators are not left waiting too long to connect. With multi-orbit architectures offering improved flexibility and resilience, they have become a vital part of ensuring operators can connect quickly and reliably.

Connections That Save Lives

For emergency responders dealing with hurricanes, earthquakes, or wildfires where network infrastructure is compromised, it's vital that non-technical response teams can use rapid-deployment SATCOM technology to establish connections rapidly without specialized training.

For troops in contested environments or forward operating bases, the time to set up a traditional heavy-footprint SATCOM antenna is a risk. In defense applications, today's ground vehicles are also now increasingly connected, thanks to systems ranging from command and control to ISR (Intelligence, Surveillance, and Reconnaissance) to autonomous systems. Uptime is absolutely critical in harsh and contested environments, and as a result, the speed of deployment of SATCOM technology is becoming a competitive and strategic capability in its own right, playing a vital role in supporting critical connectivity in sectors from defense to emergency response.

A New Approach

The SATCOM industry is in a period of rapid evolution, catalyzed by the arrival of LEO satellites and multi-orbit architectures - and lengthy connection delays are no longer acceptable to operators. With technology evolving at rapid pace, the way people use SATCOM equipment is changing, with lengthy installation processes and complex set-up becoming a thing of the past. Rather than the bandwidth a SATCOM system can deliver, the most useful benchmark is the time taken to connect. A new generation of hardware addresses these needs with multi-orbit architectures, simple set-up ensuring that non-technical personnel can deploy equipment and increased automation to ensure connections can be made faster and more reliably.



Greg Campbell is President of **Lite Coms,** where he oversees day-to-day operations with a focus on expanding manufacturing capacity, investing in new technologies and strengthening the company's defense SATCOM portfolio. An aerospace and defense veteran with nearly two decades of leadership experience, he previously served as President of Calspan Corporation, where he drove strategic growth across aerospace and defense programs. There, he led teams supporting global SATCOM flight testing for next-generation satellite communications, expanded optical communications testing capabilities and helped advance an autonomous flight test program. He is a recipient of the Buffalo Business First 40 Under 40 award. He can be reached at: gcampbell@litecoms.com

Technical Considerations When Combining Commercial and Military Satcom Solutions and Networks

by Helen Weedon

Military operations have evolved to become progressively multi-domain, geographically dispersed, and data heavy. While in the past, defence organisations may have been at the forefront of satcom innovation, in recent years, this has switched with commercial providers now leading that charge. As a result, defence organisations are increasingly leaning on commercial satcom providers to deliver the flexibility, scalability, and redundancy that modern missions demand.

Aside from the political challenges that combining commercial and military networks creates, a number of technical considerations also arise. Military operations require technology that is reliable, rugged, secure and flexible, so any commercial solutions installed within government networks must of course meet these key requirements.

When it comes to combining commercial and defence networks, interoperability and seamless handovers between different systems is obviously a critical factor. Consequently, orchestration clearly plays a vital role in making hybrid networks operationally viable.

Role of Commercial Solutions

The dedicated military satcom systems built to serve the military requirements in the years gone by were not designed for the sheer scale, tempo, and distribution of current missions. This has created a gap that has pushed military organisations to integrate commercial solutions and networks into their architectures.

Commercial providers have invested heavily in developing next-generation satcom technology such as multi-orbit/multi-band connectivity, virtualisation and software-defined infrastructure, and the speed of development is fast. Matching this pace of innovation is difficult for defence programmes, primarily because of the long procurement cycles and extensive validation processes. The result is an environment in which commercial networks are playing a growing role in providing capacity, mobility, and flexibility for defence organisations.

Real-world deployments show how deeply integrated commercial solutions have become in modern military networks. Perhaps the most obvious is the use of commercial LEO networks which with their low latency and ease of deployment, are now widely used by defence organisations to provide critical connectivity on the battlefield. While LEO constellations are playing an increasingly bigger role in military communications, it's also recognised that depending on a single network is a dangerous road to go down. The antidote to this is the use of hybrid networks to achieve increased redundancy and resilience. And if these networks combine multiple orbits, users can leverage the various advantages and characteristics that each orbit offers.

That said, some sovereign governments prefer not to have their sensitive information flowing over commercial third nation networks and this is driving an increase in joint procurement of commercial satellites that feature software defined payloads to allow the flexibility they require.

Yet blending all of these disparate components is no walk in the park: interoperability and effective orchestration are critical.

Technical Considerations when Installing Commercial Solutions in Military Networks

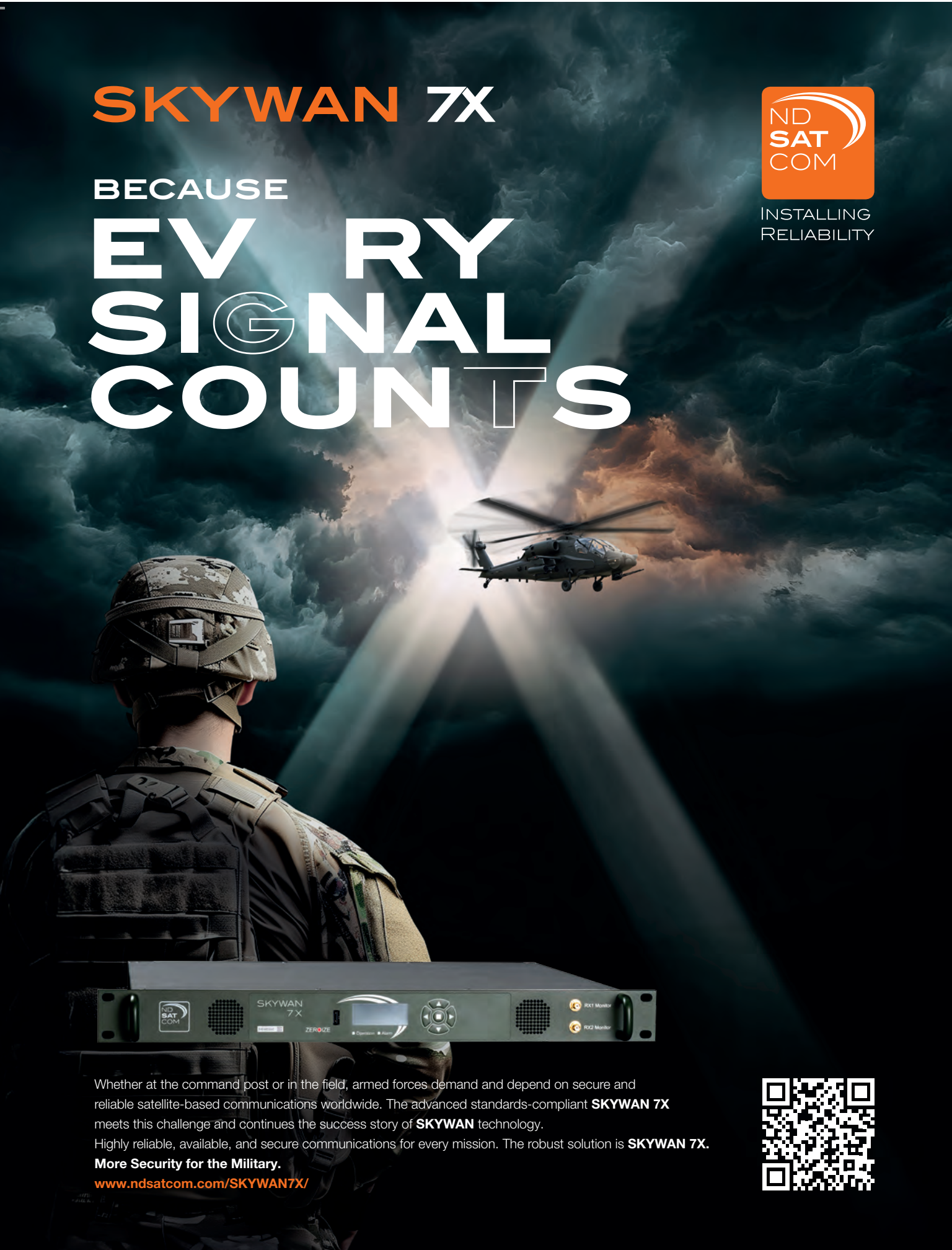
Military users assess satcom technology through a narrower lens than commercial counterparts. Reliability, deployability, ruggedness, interoperability and flexibility are all critical factors. When commercial equipment enters military environments, it must meet these criteria without losing the agility that makes it attractive.

Interoperability is of course a key consideration because data must be able to move seamlessly and reliably between sovereign GEO systems and commercial networks

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operating across orbits. Achieving that kind of seamless interoperability is technically demanding, which is why orchestration has become central to future architectures.

Networks must be able to understand the state of each available link, and route traffic accordingly without requiring users on the ground to think about which system they are using. Defence organisations require effective network virtualisation software to enable them to oversee and manage different networks from a central point.

Another major challenge is resilience in the face of deliberate interference and jamming. Military satellite links are subject to cyberattacks and electronic warfare pressure that is far more intense than in typical commercial networks. Although commercial operators naturally incorporate interference mitigation and anti-jamming features into commercial networks, for military use, there needs to be multiple layers of technology all working together to provide military-grade security.

Achieving seamless handovers between separate networks and systems is another technical challenge. Switching from a GEO satellite to a commercial constellation is a complex operation, particularly when it must be done without any loss of service. Beam patterns vary, network management systems do not always align, and terminals must coordinate across disparate architectures. For handovers to work in the field, orchestration systems need a unified view of the available networks and an understanding of mission priorities.

Procuring technology with the latest up-to-date capabilities also remains a challenge because military procurement cycles tend to be extremely long. This is one of the factors that is driving defence organisations to increasingly employ satcom as a service contracts. Not only does this grant access to the latest technology, but it also shifts operational responsibility onto commercial operators who are able to react quickly to changing requirements. The use of AI and ML could also potentially help to streamline and essentially speed up supply chains and efficiency of procurement cycles.

Where Integration is Heading

What's become crystal clear in recent years is that no single system can possibly meet all mission requirements, and military satcom can no longer remain isolated from commercial infrastructure. Hybrid networks are emerging as the only realistic way to support operations that span vast distances, involve multiple domains, and rely on rapid flows of information. Dedicated military systems will still play a vital role, but they cannot deliver the scale or adaptability needed for today's environment without commercial partners.

With this in mind, there is without a doubt, a need for greater collaboration, both on the government side, and on the commercial side, than the sectors have been used to.

Standardisation is also gaining momentum as virtualised ground systems and software defined networking become more common. Borrowing principles from terrestrial telecoms allows different systems to work together more naturally and helps create the foundation for the multi-orbit, multi-band environments that defence organisations now need.

While none of us knows what's around the corner, the direction of travel seems clear. Commercial and defence satcom networks are steadily moving towards a more integrated model where networks that were once distinctly separate, are becoming increasingly merged and connected. In this blurred landscape, commercial providers will continue to advance satcom technology and make new capabilities available for the commercial market, which can then be customised to meet specific defence needs.



Helen Weedon is Managing Director of the **Satcoms Innovation Group (SIG)** which is dedicated to promoting innovation within the satellite industry. Helen has been involved with SIG since 2011, previously supporting the group with marketing, PR, and admin activities. Helen has over 20 years' experience within the satellite and broadcast industries. She is the founder of Radical Moves, a specialist PR and Marketing agency. Helen is fluent in French, German, and Welsh, with a basic knowledge of Dutch and Spanish. Helen regularly addresses the industry on the challenges faced by the satellite industry and the innovative approaches needed to resolve them. She can be reached at: helen@satig.co.uk

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Unlocking the $1 Trillion Opportunity Means Solving the Space Industry's Supply Chain Challenge

by Peter Menham

According to industry forecasts, including the Space Foundation's The Space Report 2025 Q2, the global space economy is expected to exceed $1 Trillion over the coming decade. Investment continues to grow, new markets are emerging, and innovation across launch, satellite operations and downstream services shows no sign of slowing.

On the surface, the industry appears well positioned to reach that milestone.

Yet beneath this optimism lies a challenge that receives far less attention than launch cadence, satellite capability or funding. As the sector expands fuelled by rapidly emerging innovation, the complexity of delivering integrated space missions is increasing at an equally rapid pace.

The conversation is often framed around new technology. We discuss artificial intelligence, autonomous operations, reusable launch systems and next-generation payloads. These innovations are important and continue to push the industry forward.

However, innovation alone does not guarantee scalability.

As more organisations contribute specialist technologies and services, the industry has evolved into a highly diverse ecosystem. This diversity has been one of the sector's greatest strengths, enabling rapid innovation and encouraging competition across the supply chain.

At the same time, that diversity introduces increasing complexity, slowing growth and increasing risk.

Today's missions frequently depend on multiple suppliers, software environments, operational teams and infrastructure providers working together across organisational boundaries. Every new interface, integration point and operational dependency adds coordination effort that can ultimately influence programme cost, schedule and long-term maintainability.

The challenge, therefore, is not simply building better technology.

It is ensuring increasingly complex systems can work together efficiently.

In many industries, vertical integration has been presented as a natural response to complexity. Bringing more capability under one organisation can simplify coordination, improve consistency and reduce internal interfaces.

There are certainly circumstances where this approach delivers value in the space sector.

However, a healthy space ecosystem depends upon specialist organisations continuing to innovate within their respective fields. Attempting to consolidate every capability risks reducing flexibility, slowing growth and limiting opportunities for collaboration across the wider market.

Instead of asking how every organisation can own more of the value chain, perhaps the more important question is how the industry enables independent organisations to work together more effectively.

This shifts the discussion from ownership towards interoperability.

As constellations grow and architectures evolve into larger systems-of-systems, coordination and scaling become progressively more complex and inefficient. While limited standardisation exists in specific technical areas, there is little common infrastructure enabling systems, organisations, and services to operate coherently together.

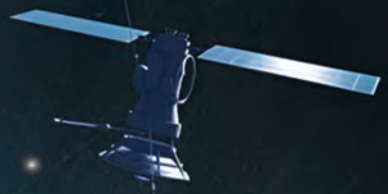
Supply chain resilience is no longer solely about sourcing hardware or new space capabilities. It increasingly relies on creating an interoperable software infrastructure, capable of connecting a highly diverse ecosystem without suppressing innovation or creating unnecessary complexity elsewhere in the system.

None of these challenges diminish the remarkable progress the sector has already made.

Quite the opposite.

They are evidence of an industry entering its next stage of maturity.

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MARKET TRENDS

The next phase of growth will not be defined solely by who develops the most advanced technology, but by who can integrate technology most effectively across increasingly connected ecosystems.

This is not a challenge for one company to solve alone.

It is a challenge for the wider industry.

Open discussion around interoperability, systems integration, operational coordination and scalable infrastructure will become increasingly important as the sector continues to grow. By recognising these issues early, the industry has an opportunity to build stronger foundations for long-term, sustainable expansion.

Reaching the $1 Trillion milestone is undoubtedly achievable.

The opportunity now is ensuring that the systems, organisations and supply chains supporting that growth are capable of scaling alongside it.



Dr Peter Menham is Co-founder and Chief Technology Officer at **Bright Ascension,** where he leads the company's technology strategy and software innovation. With extensive experience in spacecraft software engineering, mission operations and scalable space systems, Peter has worked across commercial and institutional space programmes. His interests include software architecture, systems integration and the future of interoperable space infrastructure. Connect with Peter on LinkedIn or visit Bright Ascension (https://brightascension.com) to learn more.

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The AI-Driven Teleport

by Jason Bates

Companies throughout the teleport and satellite sector have been integrating AI into their operations for several years, with initial investments delivering benefits in areas such as customer-facing services, engineering, and network operations.

While AI's hype may currently surpass capabilities, its potential continues to evolve – rapidly. There have been significant enhancements in areas such as software development, and there is measurable evidence that company investments in AI are paying off in tasks such as virtual monitoring of data, closed-loop network automation, anomaly detection, predictive maintenance, and network optimization.

The improvements in AI capabilities are coming at a beneficial time for the teleport sector, as the shift away from traditional, hardware-centric services and toward virtual platforms that operate more like data centers continues. Increased integration of more capable AI processes will enable teleport operators to manage more complex, dynamic workloads and multi-tenant operations. AI can be a catalyst, accelerating the teleport industry's transition to serving as more flexible, cost-effective, and intelligent network nodes.



Improving Network Operations

Some areas where AI's value has been clear to date is in network visibility, traffic analysis, and operational reporting. With its ability to analyze thousands of metrics in real time, AI can detect subtle changes in large technical datasets that may not be noticed and alert teleport staff. This reduces the mean time to detect and resolve incidents.

Predictive maintenance is one of the most promising applications. Teleports, gateways, and satellite ground infrastructure generate huge volumes of monitoring data, so correlation of events in a traditional way is no longer possible. AI enables identification of weak signals that may precede failures, allowing intervention before service degradation occurs. The greatest value is not necessarily in preventing catastrophic failures — which are already rare — but avoiding small degradations, reducing troubleshooting time and prioritizing maintenance activities more effectively. Over time, this translates into lower operational costs, improved infrastructure availability, and more efficient use of engineering resources.

Managing Complex Hybrid Networks

AI is transforming how teleports manage the growing complexity of multi-orbit and multi-band environments as well as the dynamic traffic flows across hybrid networks that now span satellite, terrestrial, and cloud infrastructure. Hybrid networks create a more dynamic operating environment because traffic may need to move between GEO, MEO, LEO, terrestrial, and cloud infrastructure depending on latency, availability, geography, cost, security, and customer requirements. AI has the potential to help companies navigate this environment by analyzing multiple variables


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simultaneously and recommending an appropriate route, capacity allocation or service configuration. It can also help forecast traffic demand, identify potential congestion, and detect changes in application behavior.

This level of automated decision support becomes increasingly important as the scale and speed of decisions exceed what human operators can practically perform manually. AI helps operators move from reactive management to predictive optimization. It can analyze traffic patterns, anticipate congestion, recommend routing decisions, and optimize the use of available resources across different network domains. The long-term objective is not autonomous networking, but intelligent orchestration – where AI continuously recommends the most efficient service path while operators retain overall network control.

Delivering for the Customer

The real measure of the growing impact of AI is improved customer services and satisfaction. The objective of effective AI integration is to provide customers with greater transparency and more proactive service management by transforming complex technical data into clearer customer-facing information. Potential applications include: real-time performance dashboards, automated service summaries, predictive alerts, customer-usage analysis, earlier notification of possible service degradation, and initial assessment of affected services and customers.

AI can help operators move from informing customers after a problem occurs toward identifying emerging risks earlier and recommending preventive action. For customers, the teleport sector is turning its AI gains into improved capacity planning and rapid response to changing customer needs, and customer satisfaction is improving due to faster issue resolution, remote problem-solving, and reduced service disruptions.

AI-driven security tools are also becoming a critical component of teleport cybersecurity as satellite networks grow more interconnected, software-defined, and distributed across multiple vendors, clouds, and orbit types. AI is helping security teams move beyond signature-based detection toward behavioral analysis by analyzing large volumes of network activity and identifying patterns that may indicate abnormal behavior, unauthorized access, malware, traffic anomalies, or coordinated attacks. It can help correlate events from different systems, prioritize alerts. and reduce the workload created by large numbers of low-risk notifications.

"...The real measure of the growing impact of AI is improved customer services and satisfaction. The objective of effective AI integration is to provide customers with greater transparency and more proactive service management by transforming complex technical data into clearer customer-facing information. ..."

There is also significant potential in adopting AI and machine learning for spectrum management and RF optimization. As customers look for every percentage increase possible in their network efficiency, AI enables identification, categorization, and anomaly detection of satellites via RF emissions, supporting space domain awareness, and spectrum monitoring.

There are no teleports that have fully embraced AI today, but with rapid improvements in capabilities, it is not out of the question to ask what teleport operations will look like in a few, short years. "By 2028, a truly AI-driven teleport will no longer be viewed as an isolated facility. It will operate as an intelligent node within a digital ecosystem that integrates satellites, gateways, terrestrial networks, virtualized systems, computing capabilities and cloud platforms, and customer environments," a teleport operator executive said.



Jason Bates is editor for the **World Teleport Association (www.worldteleport.org),** which conducts research into the teleport and satellite industry, provides a unified voice for teleport operators and offers Teleport Certification programs to service providers. **"The AI-Driven Teleport"** is available for free to members and for sale to non-members from WTA's online store **(www.worldteleport.org/store/).**

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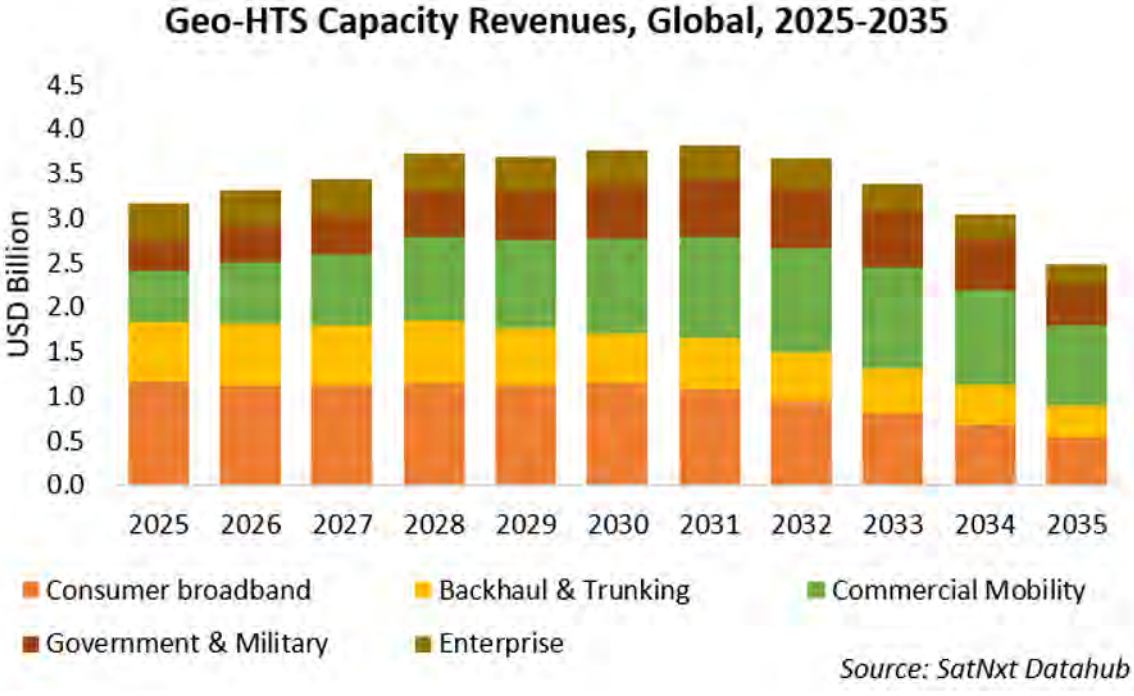
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Beyond Connectivity: GEO Satcom Incumbents Diversify into Earth Observation

by Aishwary Pachaury

The boundary between Satellite communications (Satcom) and Earth observation (EO) is narrowing as incumbents seek new revenue streams and EO providers pursue faster delivery of usable intelligence. Expansion into remote sensing and analytics is taking different forms: Space42, SKY Perfect JSAT, MEASAT and Thaicom illustrate routes through mergers, investment and partnerships. In the other direction, ICEYE is developing sovereign connectivity solutions with Nokia, while Planet and SES Space & Defense have tested satellite relays to accelerate EO data delivery. These moves share a commercial logic, not a single business model: communications operators want more value from existing customer relationships, while EO providers want their information delivered and used sooner. Customers, meanwhile, want fewer integration tasks between acquiring data and acting on it, and a clearer route to operational intelligence and turnkey solutions.

Geo incumbents are witnessing massive competition from the LEO satcom capacity. This is resulting in accelerated price erosion, customer churns and revenue decline. According to SatNxt Global Satcom market forecast, the Geo-HTS revenues decline from $3.17 billion in 2025 to $2.49 billion in 2035, down 21.3%. Mobility and government demand offer interim growth but cannot sustain the aggregate trajectory. This supports a diversification thesis, and hence the industry incumbents are looking for opportunities beyond connectivity.



EO Opens a New Route Beyond Connectivity

GEO incumbents have several responses to pressure on connectivity revenues: add LEO capacity through multi-orbit offerings, consolidate assets, or move downstream into managed services. EO offers a unique form of diversification - expanding based on their customer needs & demand growth, rather than only how they deliver

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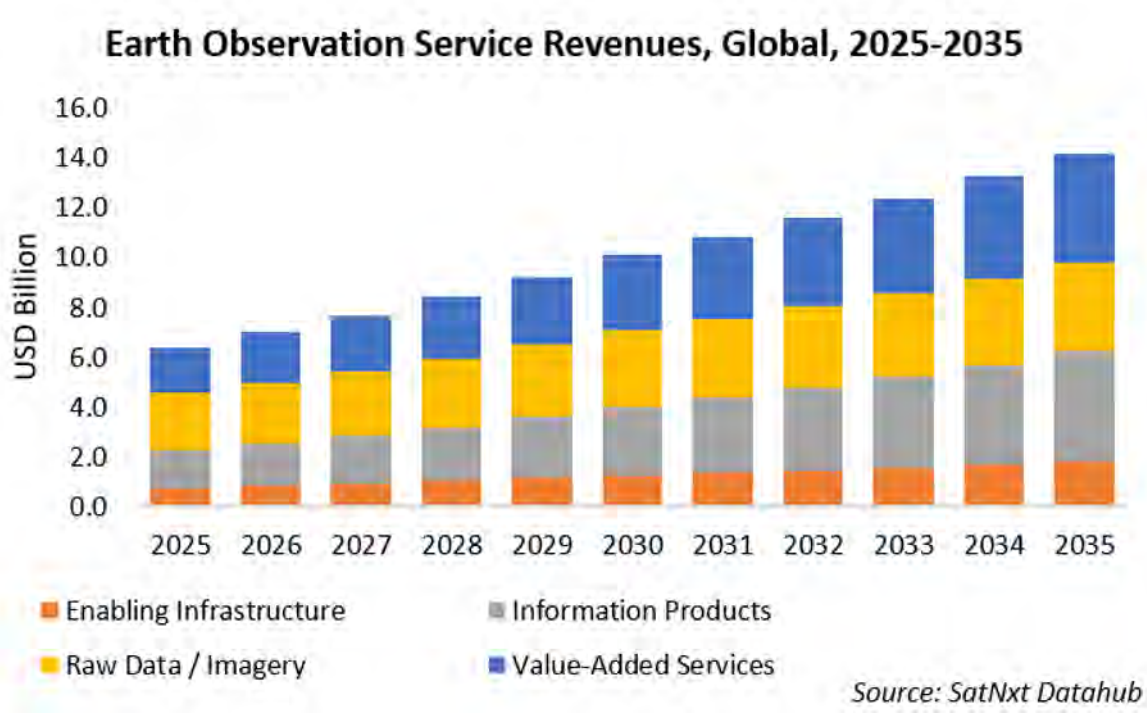


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connectivity. Combined with analytics and AI, imagery can underpin monitoring and intelligence services for customers already buying communications. The strategic fit is strongest where existing customer relationships, local support and secure delivery can be combined with specialist sensing and analytical capabilities.

SatNxt's EO market assessment reinforces that rationale: projected revenue rises from $6.42 billion in 2025 to $14.18 billion in 2035, while information products and value-added services grow from 51.9% to 62.0% of the total. The opportunity is therefore not simply to own imaging satellites or distribute raw data, but to turn observations into usable outputs and deliver them within customer workflows. Incumbents should prioritise applications where they have customer access and a credible delivery role, partnering for missing capabilities rather than assuming that market growth alone makes EO an attractive investment.

Convergence in Practice: Portfolios, Sovereignty and Speed

Portfolio expansion is proceeding through ownership and partnerships, but the commercial objective is the same: combine data acquisition with services customers can use. The Yahsat-Bayanat merger brought communications, geospatial analytics and AI together within Space42. In June 2026, the company reported Foresight-3, -4 and -5 operational, taking its SAR constellation to five satellites, with 25-centimetre imagery feeding GIQ. MEASAT's stated partner-led offering spans optical, SAR and short-wave infrared imagery and analytics; its February 2025 SPACESAIL memorandum includes potential EO cooperation alongside broadband, direct-to-device communications and satellite IoT. SKY Perfect JSAT is combining investment in LEO EO satellites with Japanese sales of constellr thermal-infrared data, launched in February 2026 for wildfire detection, infrastructure monitoring, maritime security and industrial activity. Thaicom's CarbonWatch adds application-specific analysis: in July 2024, it announced TGO certification of its satellite-and-AI tree-carbon assessment method under Thailand's voluntary emissions programme and a Mae Fah Luang Foundation partnership. Its September 2026 renaming as Gulf Space Technology signals broader data-services ambitions. These models target downstream spending, but a broader portfolio is only the starting point, the test is whether sensing, analytics and local delivery work together.

Sovereignty strengthens the case for integration where governments want control over sensing and communica-

tions rather than access alone. Japan's Tri-Sat Constellation, established by SKY Perfect JSAT, Mitsubishi Electric and Mitsui, signed a ¥283.1 billion defence imagery contract, including tax, on 19 February 2026, running through March 2031. Synspective, QPS Institute and Axelspace participate in the wider consortium; the value is Tri-Sat's contracted portion, not JSAT's standalone revenue. ICEYE and Nokia approach the same demand from the connectivity side. Their October 2026 partnership proposes sovereign broadband systems spanning satellites, ground infrastructure and terminals, extending ICEYE's sovereign SAR-intelligence model into communications. First launches are expected in 2028, while a 22 October letter of intent with Ukraine's defence ministry signals interest rather than procurement. Control and resilience underpin the strategic fit; operational delivery remains a future milestone.

Delivery speed creates a different incentive to collaborate: timely information requires both sensing and a reliable route to the customer. Planet and SES Space & Defense are testing that link. In December 2025, Planet reported an error-free, 1 Mbps Ka-band relay from a Pelican satellite at 500 kilometres through O3b mPOWER at around 8,000 kilometres to Manassas, Virginia, under NASA's Communications Services Project. Relaying data can reduce the wait for direct ground-station contact, helping EO providers accelerate disaster-response and intelligence information without building their own communications constellation. SES launched a follow-on payload aboard Pelican-12 in October 2026, equipped with a software-defined radio and tracking antenna for further testing. These milestones validate the relay approach; a guaranteed operational, near-real-time service remains to be demonstrated. Faster transport creates customer value only when processing and dissemination keep pace.

Compete on the Mission and Prove the Economics

For GEO incumbents, customer needs should determine the investment case and the capabilities required. Prioritise where customer access, local support and communications expertise provide an advantage, then acquire or partner for the missing sensing and analytics capabilities. EO providers should make collection-to-customer latency part of the product proposition, alongside solution performances. For both, pricing power and profitable growth depend on repeatable demand and disciplined management

"...Geo incumbents are witnessing massive competition from the LEO satcom capacity. This is resulting in accelerated price erosion, customer churns and revenue decline..."

of integration costs.

Advanced and integrated services sellers should translate the turnkey promise into measurable commitments on delivery time, analytical output, availability and data control, and solution economics. Industry stakeholders should distinguish operational services and contracted demand beyond demonstrations, memoranda and letters of intent. The Satcom-EO boundary is narrowing; commercial success will depend on who can integrate the chain, take responsibility for delivery and earn a return.



Aishwary Pachauri is a Contant at **SatNxt (www.satnxt.com)**. Aishwary is a strategy growth consultant with over a cade of cross-sector leadership perience spanning finance, space, education, and building terials industry. He specializes commercial strategy, corporate planning, pricing architecture, and data-driven market expansion initiatives.

His consulting portfolio includes advising clients across India, and the USA, delivering actionable insights for geographic expansion and revenue optimization. At SatNxt, he brings a global, cross-functional perspective to market intelligence and strategic advisory engagements, helping organizations translate complex insights into scalable growth strategies. He can be reached at: aishwary@satnxt.com

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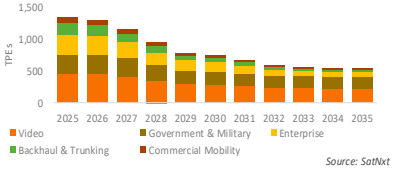
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VITAL STATS

North America SatCom Capacity Demand & Pricing, 2025-2035

Widebeam Capacity Demand (TPEs)

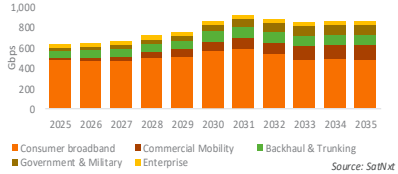
Demand will keep declining across all applications, with Video remaining the largest segment



Source: SatNxt

GEO-HTS Capacity Demand (Gbps)

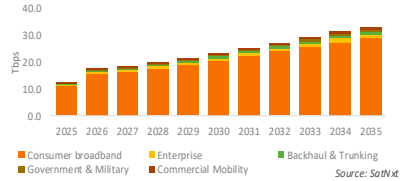
Consumer broadband will remain the anchor, while Mobility and Government demand grow fastest



Source: SatNxt

Non-GEO Capacity Demand (Tbps)

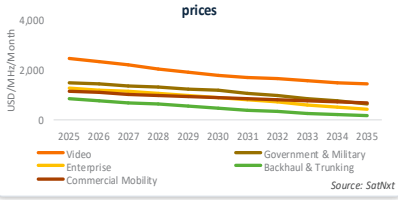
Consumer broadband will remain the major demand driver



Source: SatNxt

Widebeam Capacity Pricing (USD/MHz/Month)

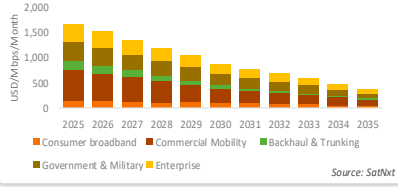
Competition from GEO & Non-GEO HTS and declining video market will continue to erode the prices



Source: SatNxt

GEO-HTS Capacity Pricing (USD/Mbps/Month)

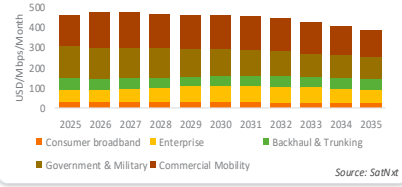
Pricing will keep falling as LEO constellations turn bandwidth into a commodity



Source: SatNxt

Non-GEO Capacity Pricing (USD/Mbps/Month)

Pricing will ease gradually, led by Government & Military, while Enterprise holds firm



Source: SatNxt

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