

# Satellites and 5G

by **Bernardo Schneiderman**

**S**atellite communication will play a significant role in 5G and beyond as a complementary solution for ubiquitous coverage, broadcast/multicast provision, aeronautical & maritime communications, emergency/disaster recovery, and remote rural area coverage.

There are several use cases where standard terrestrial coverage is either not present or possible, making satellite systems uniquely positioned to provide a solution to bridge this gap. By 2020-2025 there will be more than 100 High Throughput Satellite (HTS) systems using Geostationary (GEO) orbits but also mega-constellations of Low Earth Orbit (LEO) satellites, delivering Terabit per second (Tbps) of capacity across the world.

New cost-effective system architectures as Starlink (SpaceX), LightSpeed (Telesat), OneWeb, O3B (SES) systems should be considered as a major impact in the 5G infrastructure. Beside these ones during the 1Q21 Lockheed Martin's space division announced a strategic interest agreement with satellite start-up Omnispace "to explore jointly developing 5G capability from space."

5G wireless technology promises to deliver performance upgrades across the entire telecommunications industry. The purpose of the 5G network is to deliver faster speed and sustain a highly concentrated number of devices. This new infrastructure will transform the entire telecom industry.

The current 5G implementation process is ongoing, but in its early stages. Major mobile carriers already are rolling out the 5G network, although there will be a gradual transition from the 4G LTE. With the early stages of implementation of 5G beginning in 2019 and 2020, there will be several opportunities for transformation over the next decade.

Another goal of 5G is to support the expansion of devices comprising the Internet of Things (IoT) more devices will be able to transmit data without causing performance issues.

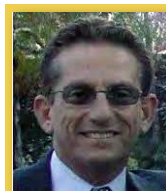
Driverless cars and autonomous vehicles are a related technological category that stand to benefit from 5G, as the demand for an interconnected transportation system rises. Maintaining fast software downloads such as GPS mapping routes will be critical for a system of connected cars.



Image courtesy of ESA

DriveNSR's report entitled "5G via satellite: Impacts, Demand and Revenue potential to 2029," forecasts deep 5G impact in the satellite ecosystem with close to 10 million active units by 2029. Beyond the obvious use cases, like Cellular Backhaul and Trunking, a wide spectrum of applications will experience accelerated demand from 5G, including IoT, Private 5G for Corporate Networks, Mobility or even more conservative users like Gov/Mil.

"While 5G use cases generate a lot of hype, one must not underestimate the transformative power of 5G in how satellite networks are designed," states Luc Palerm, NSR Senior Analyst and report author. "Incorporating and standardizing technologies like SDN/NFV or Cloud, 5G Network Management System will be at the core of how future satellite networks are built, offering the scale and flexibility to optimally operate future VHTS, constellations and software defined satellites under standardized service orchestration."



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## EXECUTIVE ROUNDTABLE

To shed light on the market for 5G services via satellite, Satellite Executive Briefing (SEB) invited major companies to participate in a virtual roundtable. We received feedback from following executives: **Richard Swardh**, SVP, Premium Enterprise & Mobile Operators-**Comtech EF Data**; **Bhanu Durvasala**, VP International Division-**Hughes Network Systems**; **Jaume Sanpera Izoard**, CEO-**Sateliot**; Semir Hassanal, Head of Cellular Backhaul and Trunking-**ST Engineering iDirect**; **Manik Vinnakota**, Director, Commercial and Product Development-**Telesat**; and **Kyle Griffin**, VP for space advanced program development, Lockheed Martin.

Follows are excerpts of the discussion:

**Satellite Executive Briefing (SEB): Please provide a summary of products or services that you currently offer or are planning to provide for the 5G market.**

**Comtech EF Data:** Comtech EF Data is a leading provider of innovative and optimized satellite communications solutions, and a subsidiary of Comtech Telecommunications Corp. We provide the highest performing satellite platforms and modems in the market that serve the needs of all generations of wireless technologies. Our link optimization solutions help provide a similar look and feel for end users connected to 5G over a long delay link as they would experience over a fiber or microwave connected base station.

**Hughes:** The 5G network is often called a “network of networks” because it is, effectively, a patchwork of various transport types enabling connectivity, and this includes, of course, satellite transport. In fact, satellite will be a critical element of 5G globally. There will always be places where terrestrial fiber/microwave backhaul is not available and where satellite provides the most cost-effective – if not the only – backhaul connectivity path. To support this application, the Hughes JUPITER™ System is already 5G ready utilizing non-standalone (NSA) mode, with functionality for Layer 2 transport support and

the ability to support 16,000 simultaneous TCP sessions per terminal. The JUPITER System currently supports what we believe is the largest Layer 2 implementation in the world – in Indonesia. The Hughes integrated 4G/LTE acceleration with NSA 5G implementations enables operators to enhance the user experience while also conserving bandwidth and is in use in places like India with Reliance Jio and Latin America with Telefonica

**Sateliot:** We are going to have a direct to sensor LEO constellation for 5G IoT (NB-IoT).

**ST Engineering iDirect:** The 5G standard promises to totally transform overall network capabilities. However, to successfully deploy the full potential of 5G, mobile network operators (MNOs) need satellite to supply connectivity hand in hand with the terrestrial network, in hard-to-reach areas, for mobile terminals, to offload network congestion, to enhance user experience i.e., by using multicasting, rerouting non-latency sensitive services and backhauling 5G traffic from remote areas, among other use cases. That’s why the satellite industry, including ST Engineering iDirect, is transforming the fabric of our network to better align with 5G standards, making it easier for MNOs to adopt and sell satellite services in the 5G future. In order to facilitate the integra-

tion of satellite into 5G networks, we have been involved with many initiatives and testbeds to prepare for the future.

Our 5G-enabled Intelligent Gateway (iGW) satellite ground infrastructure helped enable the successful integration of a commercially available 5G core network into a live satellite network – the aim of the SaT5G project. The integrated 5G Non-Terrestrial-Network (NTN), consisted of a remote terminal which connected over a live satellite to the 5G-enabled ST Engineering iDirect hub. The satellite connection continued to use the native satellite radio at the physical layer. The 5G-enabled Intelligent Hub gateway included physical network functions for terminating the native satellite connection, along with a satellite RAN and a standard and unmodified commercially available 5G core network, both of which were virtualized.

We have also been involved with proof-of-concept testing for 5G content distribution leveraging edge computing where video content distribution technology is designed to operate over a satellite network with 4G/5G and Multi-access Edge Computing (MEC) integration. The technology transforms multimedia streaming on mobile devices by leveraging efficiencies of a tightly integrated hybrid cellular and satellite network, enhancing user streaming experience and reduc-

ing network operation costs.

Our Mx-DMA return technology also fully addresses 5G use cases for very high throughput but also IoT/Machine to machine MTC and optimized latency. The technology abides to Self-Organizing Networks (SON) rules with automatic configuration, optimization, and diagnostic functionality.

We are ultimately working towards end-to-end service orchestration and seamless integration of satellite into the 5G telco infrastructure which will also enable edge computing. This will ensure a great user experience when accessing popular content at the edge thanks to content edge storage, but also reduce latency for applications which will be able to leverage this edge capability.

**Telesat:** Telesat is one of the largest and most successful global satellite operators and today serves the wireless backhaul needs of mobile network operators through our fleet of geostationary (GEO) satellites. While GEO can support a wide range of applications and is particularly well suited for distributing broadcast video, our telecom customers require very high throughput, Secure, low latency connectivity to meet their 5G network requirements.

For this reason, Telesat is building its next-generation Low Earth Orbit (LEO) network, Telesat Lightspeed, that is specifically engineered to deliver fiber-quality, high-speed, low latency broadband for enterprise and telecom customers. Telesat Lightspeed satellites are 35 times closer to Earth, which results in low-latency (<50 ms) everywhere on the planet.

Telesat has demonstrated the ability of serving 5G requirements with the world's first 5G backhaul demo over its LEO satellite, in partnership with the Vodafone Group and the University of Surrey's 5G Innovation Centre. Test results confirmed round-trip latency of 18-40 milliseconds and the ability to deliver throughput to meet the demand of live transmissions of 4K and 8K video, along with simultaneous encrypted video calls and web browsing.

Telesat Lightspeed is a non-GEO network that has international Ka-band priority spectrum rights. The Telesat Lightspeed network has over 15 Tbps of capacity and covers every point on Earth. It is the most technologically capable satellite communications network in history and exploits the latest advances in space-based data processing, laser communications, digital antenna technology and machine learning."

**Lockheed Martin:** Lockheed Martin is interested in two primary areas using the speed of today's 5G and building resilient, adaptable architectures in space for ubiquitous global communications.

First, we want military users operating in communications-contested and denied environments to have ready and reliable access to data so they can perform their missions anywhere in the world when terrestrial systems are unavailable or compromised.

Second, we are developing these military-grade capabilities in space that use commercially deployed 5G features like high-bandwidth, low latency and prioritized connections but secur-

ing them to reduce the possibility of detection or interception. This is the next step in resilient, global communications and networks that are expanded in both capability and access.

Ubiquitous global communications from space provides tremendous opportunity to deliver direct access and roaming to disconnected users. Based on the 3GPP standards, Non-Terrestrial Networks (NTN) can support voice over IP, text, IOT device data and government command and control solutions. These services can be quickly delivered worldwide, and user equipment as small as a smartphone can be used to close the links.

**SM: Considering the expansion of 5G penetration globally, how are you planning to increase your market share in the short, medium and long term?**

**Comtech EF Data:** 5G brings some very interesting innovations to market and will allow satellite to play a greater role in delivering connectivity either directly to user terminals using 5G waveforms from space or through traditional backhaul as frequently used today in 2G, 3G and 4G networks.

Comtech EF Data has been the market leader in high performance mobile backhaul for 2G/3G/4G for over 20 years. We will continue to build on that heritage and introduce additional products and features in our portfolio that meet the demands of our end users as they make the move to 5G. Initially we believe the market for 5G will develop for the higher end use cases like disaster recovery, emergency re-



# Hit Your Target



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sponse and military. Over time, we believe it will also move to more mainstream use cases and also include communities and business that are today served with mobile backhaul by previous generations.

**Hughes:** High availability of the global 5G network demands that there be redundant connectivity paths employing alternate technologies. For example, when the primary terrestrial link fails – during natural or manmade disasters – satellite backup provides the necessary resiliency. What's more, the overall 5G architecture calls for hybrid solutions of terrestrial/satellite technologies to reach the full potential of universal connectivity no matter where on the planet. The JUPITER System already enables cellular backhaul at more than 12,000 sites globally, and we continue to work with mobile network operators worldwide to help expand their network reach with satellite backhaul. In Latin America, where we have satellite capacity, we offer a vertically integrated solution for MNOs to expand their networks using the JUPITER fleet of satellites and the JUPITER System ground capabilities.

At the same time that operators implement 5G services in urban and ex-urban areas, we expect that demand for cellular network service will reach further into sparsely populated and hard to reach communities. Considering that “a rising tide lifts all boats,” we are seeing more deployments in these rural areas of 2G, 3G and 4G/LTE networks. In fact, as operators deploy 5G towers in the densely populated areas, they are able to repurpose

the 2G, 3G and 4G/LTE towers in their networks, farther out from the network core.

**Sateliot:** 5G is expanding and all the operators are willing to extend their networks coverage. The MNOs have in this moment a huge pressure in having more coverage with less investments and this is exactly what we offer. Full coverage for their 5G IoT customers without any investment and with exactly the same equipment NB-IoT their customers are using today through a single roaming agreement.

**ST Engineering iDirect:** In the short term, we will focus upon leveraging our existing solutions to enable us to establish our place in the 5G ecosystem. We ensure that our modems are 5G enabled and that we are continuously adding new capabilities to our new modems to optimize 5G processing.

In the mid to long term, we will build upon and expand our already developed solutions for multiple market verticals such as maritime, aero, private networks, emergency services, land mobility, IoT further leveraging 5G architecture, cloudification and slicing functionality.

**Telesat:** Nearly half of the world's population lives outside urban areas where affordable and high-quality Internet to the home or 4G/5G mobile networks may not be widespread. A critical gap is the lack of cost-effective and quality backhaul connecting remote areas to the urban fiber backbone. Telesat Lightspeed will be truly transformative by offering such a solution.

Telesat Lightspeed will be certified to MEF standards for

easy plug-and-play integration with their mobile networks, allowing them to take advantage of ubiquitous, high capacity and low latency connectivity, without the complexities inherent in integrating traditional satellite-based solutions.

**Lockheed Martin:** The U.S. and allies need ubiquitous global communications, and 5G is one more tool in the tool box to provide services. Adding into this a commercial market, being supported by mobile network operators and user equipment manufacturers, the scale and scope of the market is tens of billions of dollars.

**SEB: Are there any specific vertical markets that you are focusing on?**

**Comtech EF Data:** Comtech EF Data is a market leader in high performance satellite communication across many markets. With our recent addition of UHP Networks, we are expanding our reach even further. Our solution set spans from delivering multi-Gbps links of trunking in support of mobile broadband to thousands of VSATs in support of Internet of Things (IoT). We also service mobility markets with large links over GEO/MEO to cruise ships to over ten thousand fishing and shipping vessels across our platforms.

**Hughes:** The Hughes JUPITER™ System is already the de facto ground network platform of choice, operating on more than 40 satellites worldwide. Across those implementations, Hughes technology supports both backhaul and mobility applications and we will continue to partner



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with customers to support those solutions. Another important vertical market for Hughes is the Community Wi-Fi opportunity which brings crucial connectivity to villages and towns outside the reach of terrestrial services. Hughes equipment supports more than 50,000 Community Wi-Fi hotspots around the world. Throughout Latin America, Hughes works together with Facebook Connectivity to deploy Hughes Express Wi-Fi hotspots which empower local shop-owners to sell their own Wi-Fi service, bringing much needed internet access to these communities and a new revenue opportunity for the storekeepers.

**Sateliot:** Massive IoT in a wholesale model for the mobile operators.

**ST Engineering iDirect:** There are many applications that we see that will benefit from 5G. Our focus includes IoT, backhaul, maritime, aero and land mobility, enterprise and broadband, broadcast and government and defense. There are also set to be other use cases, ones that we're not even aware of yet, that will emerge as we move forward into the 5G era.

At ST Engineering iDirect, we believe that satellite within the 5G network will be about more than just backhaul — 5G presents new use cases for satellite to break out of its niche, open new markets, and participate in a fully converged, end-to-end network.

**Telesat:** Telesat Lightspeed is the only NGSO network that was designed specifically for enterprise B2B/B2G customers. We believe that there is a massive market

for global broadband connectivity. Other LEO systems were designed primarily for consumer broadband, while Telesat intends to serve enterprise applications with the ability to deliver up to 7.5 Gbps to a single terminal, or over 20 Gbps to a single 'hotspot' like an airport hub, sea port or remote community.

Telesat Lightspeed will provide backhaul connectivity for ISPs, MNOs, aggregated IoT and private LTE or 5G networks serving enterprises, remote industrial or mining facilities. In addition, we will also serve the aviation, commercial maritime, cruise ship and energy connectivity markets, as well as enterprise, government and defense customers.

**Lockheed Martin:** We're focused on delivering secure 5G benefits to users directly, without ground station intermediaries. VOIP, IOT, secure backhaul and command and control applications can all be supported through our solutions for mobile, commercial, personal, marine and infrastructure services.

**SEB: Considering the influx of Non-GEO constellations in the next few years, do you have any solutions to cover this market with hardware or services to complement 5G solutions with terrestrial 5G operators?**

**Comtech EF Data:** Comtech Telecommunications family of companies are involved in many aspects of the NGSO markets. As a corporation, we can be a one-stop shop offering a full turnkey Ground Terminal and User Terminal solution for NGSO networks. Comtech Xicom Technology is a market leader in providing high

linearity, high power Q/V and Ka amplifiers for many new NGSO platforms. We can scale our manufacturing facilities to deliver thousands of amplifiers each year that may be needed for the large size LEO satellite networks being planned by some of the larger players in this market. Comtech AHA licenses intellectual property including FPGA cores and waveforms. Comtech EF Data provides hub infrastructure, as well as SCPC modems and similar to Comtech Xicom Technology, the Comtech EF Data company can manufacture modems at very high volumes and at competitive prices to support some of the larger NGSO constellations. Finally, Comtech Mission Critical Technologies provide tracking X/Y hub antennas for MEO and LEO constellations and also help with system integration and building teleports that are trying everything together.

**Hughes:** Hughes engineers and patents are at the center of satellite ground technology innovation — whether for GEO, MEO or LEO constellations. Hughes is an investor in and a technology provider to OneWeb, developing the gateway electronics and the core module that will be used in every user terminal for this LEO system. The Hughes JUPITER™ System was central to a recent multi-orbit demonstration of aeronautical connectivity with SES and Thinkom. And Hughes continues to innovate multi-transport solutions for terrestrial/satellite connectivity using the company's proprietary Active Technologies™ that enable real-time quality of service, additional virtual capacity, automatic traffic classification and





prioritization and intelligent path control.

**Sateliot:** We are deploying our own LEO constellation with commercial service by the end 2022.

**ST Engineering iDirect:** We have already introduced our iQ LTE modem series for terrestrial interoperability which features a software-defined architecture and a satellite modem as well as an LTE modem for maximum flexibility and expansion enabling the delivery of persistent communications across a wide range of use cases. In the future we are looking into extending these capabilities for 5G use cases.

In terms of non-GEO constellations, we will provide our high-performance ground systems for O3b mPOWER, SES's next-generation Medium Earth Orbit (MEO) communications system. O3b mPOWER will enable a flexible, low-latency, high-speed, fiber-like experience for industry segments that include telecommunications/Mobile Network Operator, government,

aerospace, cruise, offshore energy, mining and commercial shipping. This opportunity allows us to reinforce our collaboration with SES and take further steps towards achieving our vision of a GSO and NGSO, multi-access platform to deliver next-generation services and applications enabled by emerging 5G standards.

We are providing a 5G capable modem portfolio and on the hub connectivity side we are enabling 5G technologies while contributing to other projects which are under development. All of these imply end-to-end orchestration and interoperability with terrestrial 5G operators.

**Telesat:** Telesat is working with a global ecosystem of hardware manufacturers to bring to market affordable user terminals and modems to access the Telesat Lightspeed network. Small, easy to use hardware for telecom providers is paramount to expanding 5G networks to areas that were previously unviable to serve.

**Lockheed Martin:** When we

look at orbital regimes, we think about what orbit will best perform the mission for our customers. We take a more holistic view that considers vehicles large and small, from LEO to GEO and beyond. That being said, we've recently expanded what we can do with ubiquitous global communications from LEO, like our development of Tranche 0 of the SDA Transport Layer.

**SEB: What trends and opportunities do you see in satellite provision of 5G services and how is your company position to meet these trends and opportunities?**

**Comtech EF Data:** Satellite systems are becoming more complex and costly to build and Comtech Telecommunications' breadth of companies servicing the industry is an important partner to our end users to meet those challenges whether it being 5G over satellite or NGSO. By being able to provide everything end to end from hub, modem, antenna and RF along with integration services and IPRs provide a lot of



value to many of our customers. Very few companies in the industry have similar capabilities today. Another trend we see is from some of the larger and new LEO satellite entrants/operators that plan to compete with terrestrial networks to provide broadband internet services globally. They plan to roll out hundreds of satellite gateways and thousands of user terminals, so they offer a tremendous growth opportunity to suppliers that can meet their stringent requirements of high performance, high volume and low cost. Comtech Telecommunications and its subsidiary companies have been planning for this market for a few years and we are already engaged with several of these large LEO operators to offer the most advanced solutions at very competitive prices. We have also made significant investments in our factories to scale production capacity to meet the demands of these large LEO networks.

Hughes: There are multiple opportunities that we are seeing for satellites in the 5G ecosystem. These include the IoT sector, connecting billions of devices for applications including precision farming, smart mining, smart cities, fleet management, disaster monitoring, smart grid, telehealth, oil and gas, shipping, aviation and many more. We are also seeing trends for using satellite for offloading of terrestrial traffic during busy hours and/or providing network resiliency during disaster events. Another trend is the use of satellites to fill voids in connectivity as users move in and out of terrestrial coverage areas on airplanes, ships and vehicles.

Hughes is well positioned for the 5G transition with our next generation smart and flexible JUPITER™ ground system, which works with very high throughput and efficient satellites that are capable of providing service when and where it is needed for both fixed and mobile applications. Our ground networks incorporate virtualized gateways and software defined networking to allow operators to significantly improve deployment time for new applications as well as for network expansion, while bringing down both operational and capital costs.

Sateliot: IoT is exploding and the 5G Standard (NB-IoT) has the best competitive offer in cities (under mobile coverage) to extend this offer in non-urban areas through the mobile operators is the winning bet.

ST Engineering iDirect: ST Engineering iDirect is well positioned to provide MNOs with a platform that extends anywhere in the world; supports 2G, 3G and 4G/LTE backhaul scenarios; and will be forward compatible with 5G standards, ready to enable partners to take part in new use cases and opening up new opportunities arising from 5G.

To explain further, in terms of 5G to premises, satellite will complement terrestrial networks such as broadband connectivity to a home or office in underserved areas or to enterprise sites as a backup. For 5G fixed backhaul, satellite will bring broadband connectivity where it is difficult to deploy terrestrial connections (e.g., in rural and remote areas or across a wide geographic region). From the perspective of mobili-

ty, satellite will bring broadband connectivity to remotes or user equipment (UEs) on the move such as airplanes, trains, vehicles, and maritime vessels.

Telesat: We designed our LEO network to enable MNOs to expand the reach of their 5G services to rural and remote populations. But in order to serve this market, telecom operators need large amounts of bandwidth at low costs. In addition, they want to know their satellite operator is their partner and not competing against them in other offerings like broadband connectivity to homes and businesses.

Telesat is ideally positioned to meet the capacity and performance requirements at disruptive economics with Telesat Lightspeed. As a B2B-focused operator, we will not compete against our customers to provide consumer services.

Lockheed Martin: Mesh networking is important for our Department of Defense customers who prioritize a JADO-centric future, and we're actively experimenting with that through our Pony Express nanosatellites. SmartSat™ with software-defined platforms also shape that future state. All this is bolstered with our experience in secure, faster data networks from space, as evidenced by our work with LTE over satellite, which is patented by Lockheed Martin and currently fielded. In the near future, these sorts of systems will be able to be upgraded in orbit not just with remote software upgrades but with hardware upgrades, and we're testing common architecture for that now.

