Satellite-Based Cellular Backhaul: Myths & Facts

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5G networks are knocking on our door. Data proliferation is accelerating. The need for ubiquitous coverage is growing. For all these reasons, backhauling requirements are expanding quickly. It is noteworthy that the Sat5G consortium of companies defined satellite communications as an integral enabler of the 5G connectivity vision. They have an inherent advantage when facilitating ubiquitous connectivity while driving network efficiencies forward.

As the mobile network continues to evolve in terms of technology, services and outreach, mobile network operators (MNOs) need to adapt their cellular backhaul solutions to these changing requirements. As data usage grows exponentially, cellular backhaul strategies must change to take into account user expectations in terms of performance and reliability. User experience is particularly critical for rich media and broadband services and has become a key differentiator with the adoption of 4G networks.

In the past, the use of satellite communications for cellular backhaul was considered a last resort because of bandwidth limitations and high costs. The satellite option for cellular backhauling was used only for hard-to-reach rural areas such as islands, mountains and deserts, where terrestrial infrastructure such as fiber, next-generation copper or microwave were either too expensive or unfeasible.

Today, with technology advancements in mobile technology and the satellite industry, traditional perceptions about satellite backhaul are quickly becoming obsolete. With Non-GEO Satellite (NGSO) constellations, abundance of capacity and ground segment innovations, there is no question about the role of satellite backhaul. Today, MNOs are required to support their subscribers, who require high-quality broadband connectivity wherever they go on land, sea and air. As a result, satellite backhaul is enabling not only an extension of connectivity to remote locations but also serves as the prime solution for use cases such emergency response, network backup and IoT applications.

While the business case for satellite backhaul has never been stronger, there still remains one major barrier to widespread deployment: perception. Common negative misperceptions of satellite backhaul revolve around three persistent myths: satellite's inadequate performance, high costs and unmanageable complexity. One of the main reasons for these misperceptions is a lack of familiarity with satellite technology. Often, decision makers are unaware of the recent innovations in satellite technology, which leads to apprehension about its suitability for cellular backhaul.

The best way to alleviate these false impressions is to examine the common myths one by one.

Myth: 4G/5G Performance Cannot be Met with Satellite Backhaul

With the large amounts of required data communication, MNOs raise concerns that VSATs are not able to deliver the required LTE performance to the handset. They are concerned these satellites will not be able to support the high throughput required for the 5G network architecture. In addition, as satellite communication has an inherent delay, a concern persists that this delay will result in poor backhaul performance and, consequentially, a poor user experience.

These concerns are unfounded, as today's satellite technology can provide true LTE speeds for the required user experience. Further, VSAT performance of over 1Gbps

has been demonstrated, satisfying the requirements for 5G networks.

Fact: Acceleration Technologies Mitigate Latency Effects

Application acceleration is especially critical when high bandwidth is required, as in 4G/5G deployments. The inherent satellite delay can be overcome by using acceleration technology that mitigates the latency effects. It is possible to achieve high throughput that requires high performance modems to accommodate the traffic and provide the required quality of experience.

Jointly patented by Gilat and SoftBank, innovative technology enables true high speeds through acceleration of traffic inside the GTP tunnel. This acceleration technique is being used to achieve the required high performance in LTE deployments of Tier-1 mobile networks worldwide, such as Softbank, NTT Docomo and KDDI in Japan; Sprint and T-Mobile in the US; Telstra and Optus in Australia; EE/BT in the UK; and Globe in the Philippines.

Figure 1 below demonstrates the significant benefit of accelerated throughput by showing the actual throughput to the handset achieved over satellite with and without acceleration.

The inherent GEO satellite delay, typically a round-trip of 600ms, causes a severe degradation in performance reversely correlated to the handset window size. The smaller the window size, the lower the throughput. The chart below illustrates how the patented acceleration provides full utilization of the 150Mbps bandwidth for any window-size handset-device. It is important to note that typical handset devices have varying small window sizes and therefore non-accelerated satellite performance would be lower than 10Mbps.

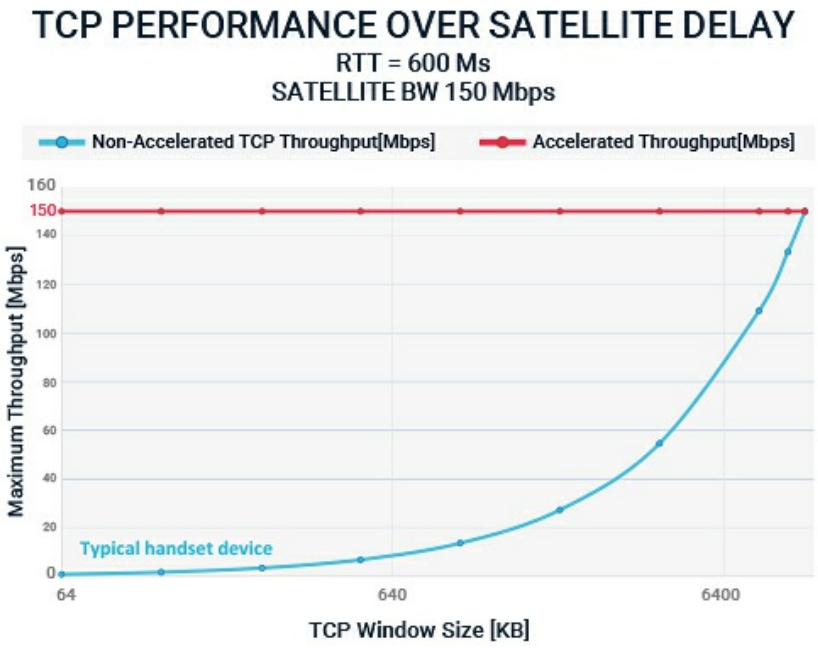

Figure 1 - TCP Performance over Satellite Delay

As the satellite industry evolves to Non-Geostationary Satellite (NGSO) constellations, the satellite latency concern is further mitigated with medium and low orbit satellite (MEO/LEO) due to significantly reducing the satellite distance from the earth.

Myth: Satellite Connectivity is Expensive

In the past, the cost of satellite bandwidth capacity and management of the satellite backhaul often rendered satellite-based communications prohibitively expensive for providers of broadband services.

Fact: Satellite Capacity Pricing Rivals Terrestrial Bandwidth Costs

According to industry analysis and forecasts (see Figure 2), HTS global supply is expected to grow by a factor of 16 by 2025, as many new high throughput satellites,

including GEO, LEO and MEO satellites, are launched. At the same time, one can see that the GEO HTS Global demand is significantly less than the supply. In the past few years, bandwidth prices were in freefall. This drop is expected to continue in the future, with the abundance of satellite capacity propelling satellite solutions into the mainstream. Based on these trends, it is expected that the cost for satellite backhaul networks will match those of terrestrial backhaul networks for many use cases. In fact, in a recent report, research firm NSR singled out cellular backhaul as the key vertical expected to drive growth in the satellite communications market.

In addition, significant savings in cost can be achieved by regarding satellite backhaul as a managed service. The MNO specifies the requirements, the service level agreement and key performance indicators, as well as the required site locations and the schedule. Considering the managed service as a black box and giving end-to-end responsibility to the satellite backhaul provider will enable the MNO to focus on its core competency and promote its business.

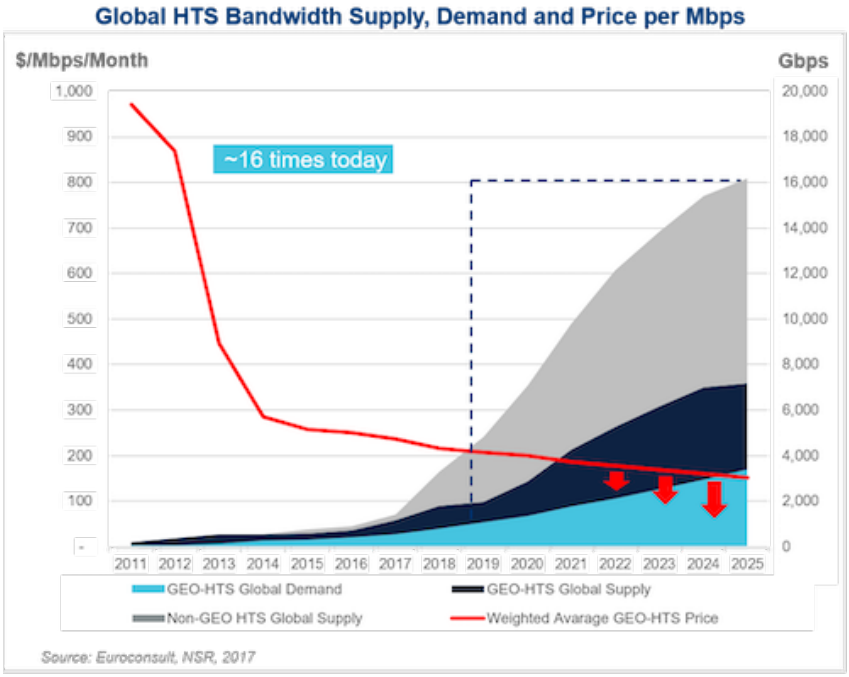

Figure 2 - Global HTS Bandwidth Supply, Demand and Price per Mbps

Myth: Satellite Connectivity is Too Complex

A third common misperception is that satellite technology is too complex for cellular backhaul networks. MNOs already have their hands full with their rapidly evolving mobile networks, and the last thing they want is added complexity for backhaul.

Fact: Accelerated Layer 2 Support Facilitates Satellite Network Integration

Another factor contributing to satellite backhaul complexity relates to the OSI network layer, where the integration of the satellite and terrestrial cellular networks takes place. Satellite networks traditionally operate at Layer 3 (the network layer) to be able to accelerate the user data, while MNO networks in some cases operate at Layer 2 (the data link layer). Accordingly, satellite networks that can operate at a carrier-grade Layer 2 while enabling acceleration can simplify the extension of existing terrestrial infrastructure to include satellite while increasing operational efficiency.

The proven benefits of carrier-grade Layer 2 support over satellite include:

- **Simplified operations:**
  Layer 2 connectivity allows the MNO to work in the same standard way with satellite as it does with any other transport method
- **More connectivity options:**
  Accommodates the use of existing MPLS/PPPoE protocols over satellite
- **Transparent Layer 3:**
  MNOs can keep the same IP network design and operational procedures

Another way to reduce satellite backhaul complexity is to use a sophisticated global network management system (NMS). Such centralized management enables full provisioning, configuration, control and monitoring of all satellite hub elements, as well as remote terminals, regardless of their physical location. This is crucial for streamlining the management of large distributed satellite networks.

A universal NMS lets MNOs easily and cost-effectively scale to support any network size, enabling them to start small and add sites as needed. With the ability to be part of an orchestrated network, integration with the Operational and Business Support System (OSS/BSS) further reduces complexity.

Dispelling Myths

The fact is that the adoption of satellite backhauling is growing significantly as an economically viable solution answering the strictest SLAs. Already, satellite backhaul is no longer a niche play for many MNOs.

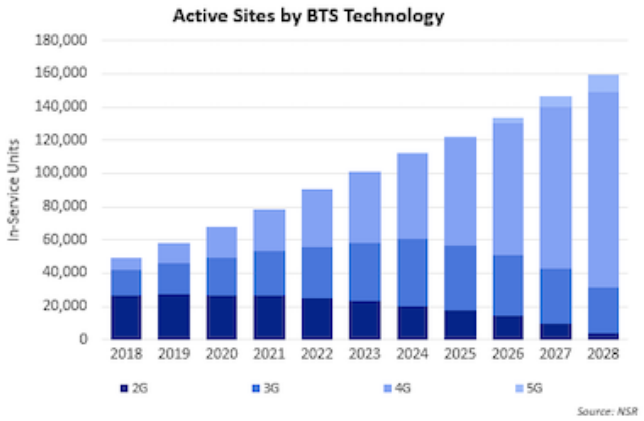

Figure 3 - Active Sites by BTS Technology

On the contrary, there are deployments of large networks worldwide consisting of thousands of sites that are being connected with satellite backhaul. These sites are a major source of revenue generation to the MNOs, indicating that indeed satellite backhaul has moved into the mainstream. Two such examples are Softbank in Japan and AMN in Africa.

With this, satellite backhaul is increasingly recognized as not only capable of answering the requirements but is actually rapidly transitioning into the preferred choice of leading MNOs worldwide across diverse use cases, particularly as the industry moves to 5G.