Cloud-based Satellite Ground Platforms in the Age of 5G NTN

APSCC, Ground Segment, Issue 2, 2025

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Introduction and Scope

The satellite communications industry is in the midst of transformation with the impending shift to 5G Non-Terrestrial Networks (NTN). This evolution promises standard ubiquitous connectivity across terrestrial and non-terrestrial networks, a multi-vendor open ecosystem for the satcom industry, new revenue streams from new use cases, and reduced TCO for satellite operators and MNOs. In this paper we will expand on the motivation for 5G NTN and the key strategic evolution steps to make the 5G NTN justified from business perspective to the market players.

Why 5G NTN?

5G NTN brings forth a wide range of advantages that contribute to the progression and enhancement of global satellite communication systems. Some of these advantages include:

Ubiquitous Connectivity:

5G NTN can provide ubiquitous connectivity, extending text, voice, video, and broadband 5G services to remote and underserved areas globally. This contributes to bridging the digital divide and ensuring that people in diverse geographical locations have access to advanced communication services.

Service Monetization:

Satellite Operators and MNOs can leverage 5G terrestrial network monetization systems that allow them to onboard new customers and provide new services quickly and easily, as well as expand to new use-cases and revenue streams.

Operational Efficiency:

Satellite Operators and MNOs can adapt 5G terrestrial network functions and operations systems that allow them to reduce their current OpEx and CapEx, as well as increase customer experience.

Standard Interoperability

Historically, satellite networks have been characterized by proprietary interfaces and protocols, hindering system interoperability and limiting the development of standardized solutions. The adoption of 5G NTN, a globally recognized standard, promises to break down these silos, fostering greater competition and innovation. A large ecosystem will also benefit from economies of scale.

Flexibility for Diverse Use Cases:

5G NTN is designed to accommodate diverse use cases, ranging from Direct-to-Device and IoT to Air, Ground and Maritime Mobility, Cellular Backhaul, Private Networks, and Military services. This flexibility makes it suitable for a wide array of applications, driving innovation across industries.

Future-Proof Design:

5G NTN standards are developed with a forward-looking approach, allowing for easy integration of future technologies and evolved standards. This ensures that the network remains relevant and adaptable to emerging trends and requirements.

5G NTN Advantages

Seamless Evolution Strategy to 5G NTN

As we embark on this exciting journey, it's crucial to focus on efficiency, adaptability, and strategic evolution. **We have analyzed the key considerations for a seamless evolution to 5G NTN, ensuring harmonious integration without sacrificing current investments and business continuity.**

Transitioning to a Virtualized All-Software Platform:

The foundation of a successful transition to 5G NTN is the adoption of a virtualized all-software platform that operates efficiently on standard, off-the-shelf hardware. This shift towards Virtualization and Cloud technologies empowers network operators with flexibility, scalability, and cost-effectiveness. By decoupling software from dedicated hardware, operators can harness the power of commodity hardware, significantly reducing capital expenditures and operational costs.

A virtualized platform facilitates the efficient allocation of resources, ensuring optimal performance based on demand. This approach not only enhances operational efficiency but also paves the way for a dynamic, software-defined network architecture that can easily adapt to evolving requirements and new technologies.

Virtualization and Cloud have revolutionized terrestrial networks, offering unprecedented

flexibility, cost-efficiency, and on-demand resource allocation. The satellite industry recognizes these benefits and is eager to leverage cloud platforms for network management, data processing, and service delivery. This move allows satellite operators and MNOs to scale their infrastructure dynamically, reduce capital expenditure, and access a rich ecosystem of cloud-based applications and services.

The integration of cloud technology into satellite network operations offers numerous compelling benefits:

Scalability and Elasticity:

Cloud environments provide virtually limitless scalability, allowing satellite operators to easily scale their resources up or down based on demand. This elasticity is crucial for handling fluctuating traffic patterns and supporting new services without requiring massive upfront investments in infrastructure.

Agility and Faster Time to Market:

Cloud platforms enable faster deployment of new services and applications. The agility of the cloud allows operators to respond quickly to changing market demands and launch innovative offerings, gaining a competitive edge.

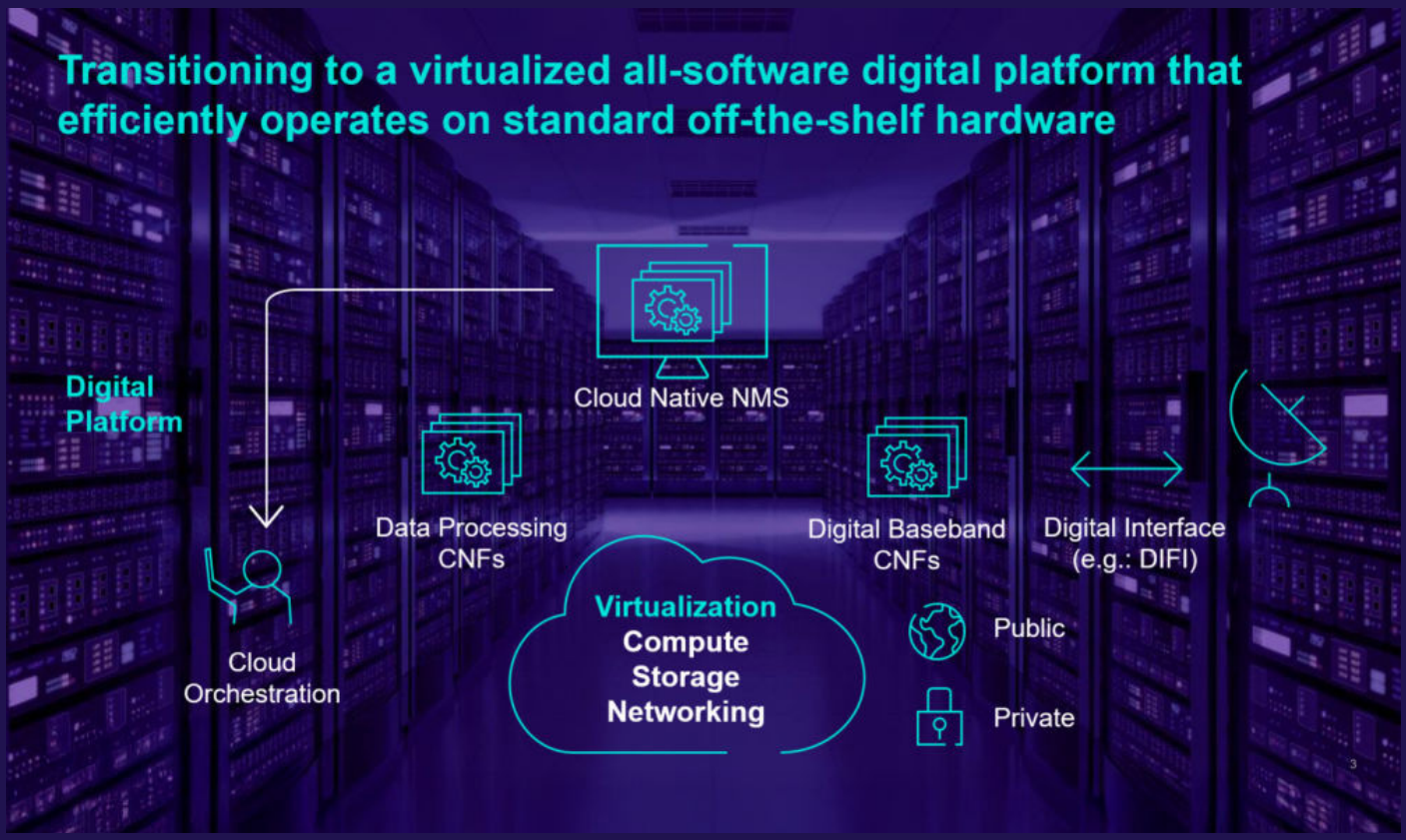
High Availability and Redundancy:

Cloud platforms offer robust infrastructure with built-in redundancy and disaster recovery capabilities. This enhances the reliability and availability of satellite network services, ensuring business continuity even in the face of unforeseen events.

Innovation and New Service Enablement:

Cloud platforms provide access to a wide range of cutting-edge technologies, such as AI, machine learning, and big data analytics. These technologies can be leveraged to develop new services, optimize network performance, and gain valuable insights into customer behaviour.

Transitioning to a virtualized all-software digital platform running on Private, Public or Hybrid Cloud contains 3 main parts: cloud-native NMS application, Data Processing cloud-native network functions (CNFs) and Digital Baseband CNFs connected via Digital Interface (e.g., DIFI) to the antenna. Satellite Operators will run the Data Processing and Digital Baseband cloud-native functions On-Premises, Private Cloud or Edge Cloud for enhanced Performance, Security and Control.



Future-Ready Platform:

To future-proof your infrastructure it's essential to choose a platform designed to apply future standards, ensuring adaptability and integration across multiple waveforms. The 5G NTN landscape is dynamic and characterized by new standards and technologies, that are evolving along 3GPP Releases and technology maturity. A forward-thinking platform should be capable of seamlessly incorporating these changes without necessitating extensive hardware upgrades.

Flexibility is paramount, and a platform that supports multi-waveforms ensures compatibility with diverse satellite communication technologies. This adaptability is crucial as industry continues to explore different frequency bands, modulation schemes, and satellite constellations to meet the growing demand for ubiquitous connectivity.

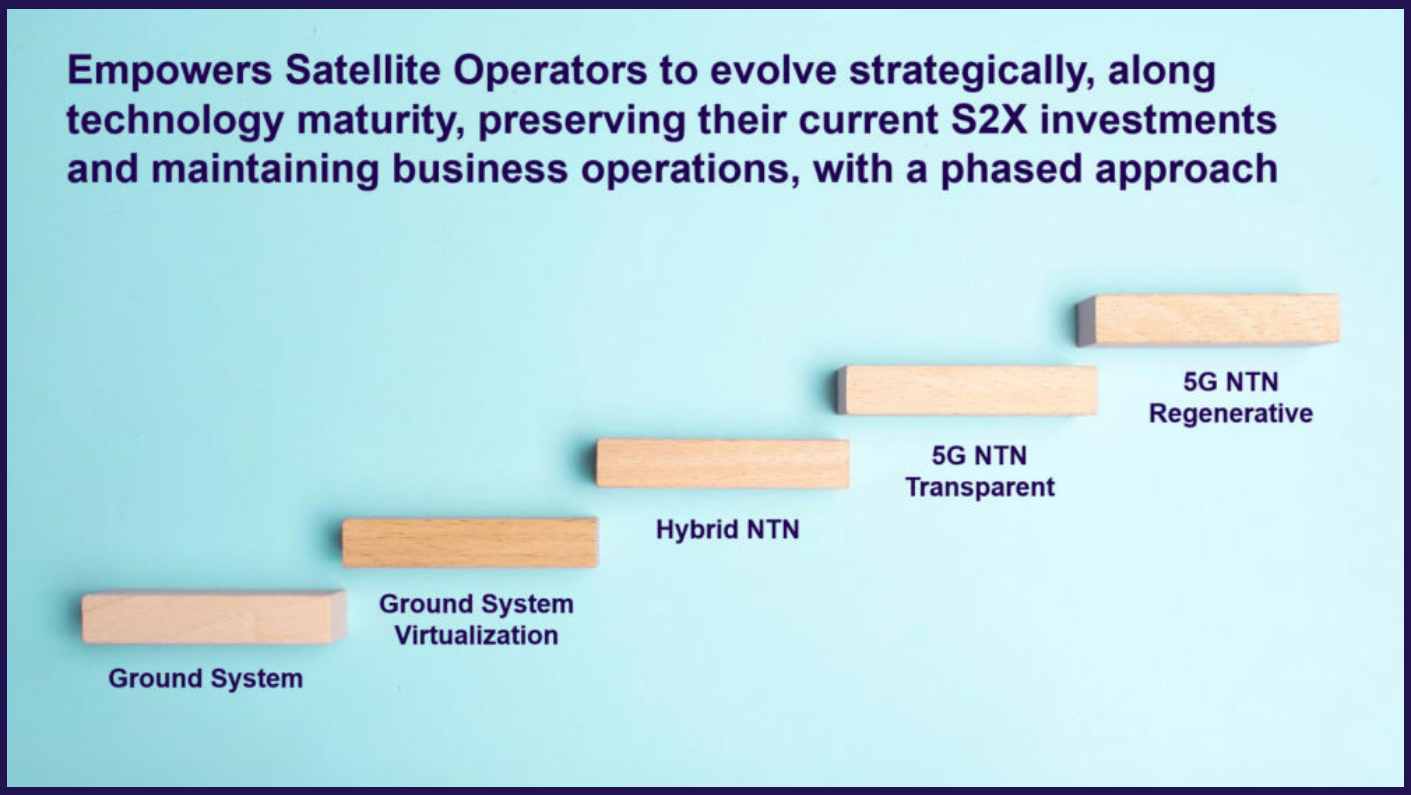
Strategic Evolution and Phased Approach:

Evolution should be strategic, preserving current investments in technologies like DVB-S2X while maintaining smooth business evolution. The transition to 5G NTN is not a one-size-fits-all process, as some SNOs will aim for building 5G NTN Transparent solution while others will aim for 5G NTN Regenerative solution. A phased approach allows operators to incrementally upgrade their infrastructure, mitigating risks and ensuring a smooth transition without disrupting ongoing operations.

Preserving investments in current technologies like DVB-S2X is essential for a cost-effective transition. By integrating current DVB-S2X technologies with standard 5G Core (aka Hybrid NTN mode), and using standard OSS and BSS systems and processes, SNOs can use 5G Core's standard management and control for users and services. Furthermore, SNOs can monetize and automate their operations and use advanced standard capabilities like Charging, Roaming,

Analytics and Lawful Interception. By integrating DVB-based networks into 5G Core, SNOs enjoy the benefits of 5G Core without losing their past investments. As such they can reduce risk, validate and use 5G Core even prior to market availability of 5G NTN satellites, hubs and terminals.

By strategically integrating 5G NTN elements – 5G Core, 5G NTN gNBs and 5G NTN Terminals – alongside existing systems, operators can leverage the benefits of both technologies while minimizing disruptions to ongoing operations. This phased approach also allows for thorough testing and validation, ensuring that each stage of the transition is successful before moving to the next.



Multi-Orbit Platform:

For next-generation 5G NTN platforms, the ability to seamlessly operate across multiple satellite orbits – Low Earth Orbit (LEO), Medium Earth Orbit (MEO), and Geostationary Earth Orbit (GEO) – is paramount. Each orbit offers distinct advantages in terms of latency, coverage, and capacity. LEO constellations excel in low latency and high data rates, ideal for real-time applications and dense urban areas. GEO satellites provide vast, consistent coverage, crucial for broadcasting and serving remote and fixed locations. MEO offers a balance between the two.

A multi-orbit capable platform enables dynamic service provisioning, allowing operators to select the optimal orbit based on specific application requirements, user location, and service level agreements. This flexibility enhances network resilience, optimizes resource utilization, and facilitates the delivery of a wider range of services, from low-latency mobile broadband in urban centers to ubiquitous IoT connectivity across vast rural landscapes and reliable backhaul for remote terrestrial networks.

Network Management System (NMS) for Both Current DVB-S2X and 5G NTN Platforms:

The cloud-native NMS application serves as the central nervous system of your network, providing real-time monitoring, configuration, and optimization capabilities. It is wise to invest in a robust NMS designed to handle the intricacies of both current DVB-S2X and 5G NTN platforms.

A unified NMS that seamlessly integrates with both legacy and future platforms, as well as with Service, Resource & Cloud Management and Orchestration systems, simplifies operations and reduces the learning curve for network administrators. This unified approach enhances overall efficiency, allowing operators to manage and monitor their entire hybrid network ecosystem from a single interface.

Conclusion

The transition to 5G NTN and Cloud represents a significant leap forward for the satellite communications industry. Operators can ensure a smooth and future-ready transition by following these guidelines: **a)** embracing a virtualized all-software platform. **b)** incorporating future standards. **c)** adopting a phased evolution strategy. **d)** supporting multi-orbit platform. **e)** investing in versatile NMS.

As we navigate the complexities of this transformation, it's imperative to keep in mind that the journey to 5G NTN is not just about embracing the latest technologies but also about leveraging them strategically to enhance connectivity, efficiency, and business continuity. With careful planning and a forward-thinking approach, the industry is poised to unlock new possibilities and redefine the landscape of satellite communications. The successful implementation of these tips will not only position operators as leaders in the 5G NTN era but also ensure that they are well-prepared for the evolving demands of the digital age.

Since the invention of cellular networks, their focus has been only on terrestrial infrastructures. For the first time in history, 5G technology is about to expand to non-terrestrial networks, allowing the creation of true ubiquitous connectivity and coverage around the world.

Read the full article **here**

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