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Satellite Connectivity and the Promise of Standards-Based Integration

By: Greg Pelton

Satellite and terrestrial networks have traditionally occupied distinct domains, each with their own technical standards, business models, and user communities. Yet, as digital transformation accelerates and the demand for ubiquitous connectivity grows, the boundaries between these worlds are blurring. The emerging vision is one where standards-based, interoperable technologies enable seamless integration between satellite and cellular networks, unlocking new opportunities for both markets.

Today, there are strategic, technical, and commercial drivers behind this convergence, and thus, mobile network operators (MNO) and chipset makers must embrace a standards-led approach poised to reimagine the future of global connectivity. This convergence will also serve as the foundation for a new strategic imperative with significant implications for expanding coverage, enhancing service offerings, and tapping into previously underserved markets.

The Strategic Need for Convergence

Historically, satellite communications have relied on proprietary hardware and protocols, often tailored to specific mission-critical or remote applications. While these solutions have delivered robust performance in niche markets—such as maritime, aviation, and Internet of Things (IoT)—they have struggled to achieve the scale and cost efficiencies of the global cellular ecosystem. The cellular industry, by contrast, has thrived on open standards and massive economies of scale, with billions of devices and users worldwide.

The strategic rationale for satellite-cellular convergence is clear: by embracing standards-based technologies, satellite operators can dramatically lower barriers to entry for new customers. While proprietary satellite transceivers remain a reliable and preferred choice for certain applications, standardized transceivers open the door to innovation and broader adoption across diverse network environments.

However, leveraging widely adopted cellular chipsets—already optimized for cost, power, and interoperability—can unlock access to vast new markets, particularly in IoT and direct-to-device (D2D)

communications markets. This shift not only benefits satellite operators by expanding their reach but also offers a compelling opportunity for MNOs and chipset makers.

For MNOs, the value proposition is clear. Satellite integration allows operators to extend their coverage beyond the reach of cell towers, eliminating "dead zones" and enabling critical services like emergency messaging and IoT connectivity in areas where terrestrial infrastructure is impractical or cost-prohibitive. This not only enhances customer retention but also opens new revenue streams through subscription bundles and value-added services. The ability to offer truly global coverage as part of their core service portfolio, rather than a premium or niche offering, transforms their market position.

Meanwhile, chipmakers are seizing the opportunity to embed satellite capabilities directly into their hardware. By supporting 3rd Generation Partnership Project (3GPP) Release 19 standards, companies like Nordic Semiconductor enable devices to transition easily between terrestrial and satellite networks. This unlocks a new era of always-on connectivity for smartphones, wearables, and IoT devices—without requiring user intervention. It will also result in a broader addressable market and faster time-to-market for OEMs, especially in industries like logistics, agriculture, transportation, and emergency services.

The Role of 3GPP and Industry Standards

At the heart of this transformation is 3GPP, the global body responsible for defining cellular standards. Over the past few years, 3GPP has progressively expanded its scope to include satellite access, recognizing the need to integrate non-terrestrial networks (NTN) into the broader mobile ecosystem. Initial efforts focused on satellite backhaul for terrestrial towers, but recent technical releases have begun to address direct device-to-satellite connectivity.

Iridium NTN Direct℠, a 3GPP 5G standards-based narrow-band IoT (NB-IoT) service operating on Iridium's proven Low-Earth Orbit (LEO) satellite constellation, is leading this modernization. With the company's globally licensed L-band spectrum and regulatory approvals already in place, MNOs can deploy services quickly and with minimal compliance risk. This demonstrates the tangible benefits of a standards-led approach, offering a clear path for MNOs to extend their reach into previously inaccessible areas and support global business customers.

Technical Challenges and Solutions

Satellite networks are expensive to build and launch and must operate for many years to repay the cost of capital. Historically, that has meant that satellite services rarely change unless a new generation of satellites is being launched. This introduces challenges with 3GPP standards since they are updated every couple of years and may change dramatically during the lifespan of a satellite constellation.

Most satellites capture signals from user devices and relay them to a ground station, where they are processed. This allows some standard updates to be implemented terrestrially but reduces the flexibility in how satellites use scarce spectrum resources. More modern satellites rely on regenerative payloads that are software-defined and can be updated with new capabilities over the satellite's life. These software-defined payloads provide more efficient use of the radio spectrum and can support new 3GPP features and even new radio interfaces from cellular chips over time.

Satellite LEO architecture offers distinct advantages over geostationary alternatives: lower latency, stronger signal penetration, and true global coverage—including polar regions and oceans. These

features make it ideal for mission-critical applications and low-power IoT devices. Moreover, mature constellations and operational readiness provide MNOs with a reliable and proven platform for extending their services.

Business Opportunities and Market Expansion

Standards-based integration with satellite communications opens up a wealth of new business opportunities. In the IoT sector, many potential customers are currently underserved, either because existing satellite solutions are too expensive or because their devices primarily operate within terrestrial coverage but require occasional satellite connectivity. By leveraging advanced cellular chipsets, satellite operators can offer cost-effective, dual-mode solutions that easily switch between terrestrial and satellite networks. This capability is particularly compelling for MNOs, who can now provide global coverage to their IoT customers without needing expensive add-ons or specialized hardware.

As satellite and terrestrial networks converge, the next frontier lies in how operators leverage this integration to differentiate services and drive innovation. Rather than simply extending coverage, MNOs can now reimagine service tiers, bundling satellite connectivity into mainstream offerings and enabling new applications in mobility, logistics, and public safety. This shift reframes satellite not as a fallback but as a strategic enabler of resilient, global-first connectivity—especially as demand grows for uninterrupted service across increasingly mobile and distributed use cases.

The Greenfield Opportunity in D2D and NB- IoT

Perhaps the most exciting frontier is the direct-to-device (D2D) market, particularly for connected IoT sensors, vehicles, and remote assets of all kinds. This is a greenfield space with no dominant incumbents and immense growth potential. Integrating satellite support into cellular chipsets empowers device manufacturers to participate in a broader connectivity ecosystem, enabling differentiated services and accelerating innovation across sectors that demand continuous, intelligent communication. This is especially relevant for safety, asset tracking, and emergency communications, where reliable connectivity can be a matter of life and death.

Architectural Evolution and Cloud-Native Solutions

The shift to standards-based integration also demands a rethinking of network architecture. Traditional satellite gateways have relied on proprietary hardware and custom software, resulting in high maintenance costs and slow innovation cycles. By adopting standards-based core network elements—similar to those used in 5G networks—satellite operators can leverage commercial off-the-shelf products and cloud-native solutions.

Cloud-based gateways offer several advantages: they reduce dependency on specialized hardware, accelerate service deployment, and enable simple integration with terrestrial networks. Leading mobile operators are already migrating their core networks to the cloud, and satellite providers can follow suit, building scalable, flexible, and future-proof infrastructure. This also simplifies interoperability with other operators, as standardized interfaces and protocols become the norm rather than the exception. The architectural evolution benefits MNOs by streamlining integration and reducing operational complexities.

The journey toward full satellite-cellular integration is still in its early stages, and purpose-built satellite systems will continue to play a vital role in specialized, high-reliability, or mission-critical applications where tailored performance is essential. However, the direction is clear. Standards-based

approaches are unlocking new markets, driving down costs, and enabling innovative services that were previously out of reach. The technical and commercial challenges are significant, but so too are the rewards: a more connected world where reliable communications are available to everyone, everywhere. The convergence of satellite and terrestrial networks is not just a technological evolution—it's a business revolution.

For MNOs, this means expanding their footprint and service offerings. For chipset makers, it means enabling the next generation of globally connected devices. The convergence of satellite and cellular networks through standards-based integration represents a paradigm shift in global communications. By becoming part of standards, satellite operators can deliver global, innovative, cost-effective services to new and existing markets.

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