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Perspective

Satellite direct-to-device: a new differentiator and growth engine for mobile operators

February 2023

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1. Executive summary

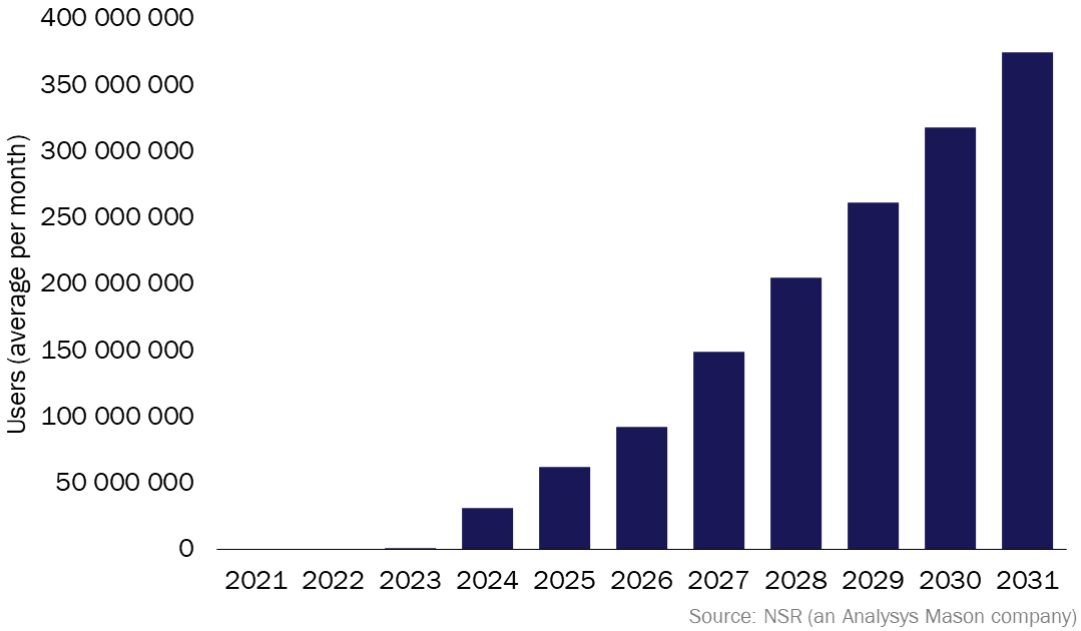
Mobile network operators (MNOs) that provide mobile services beyond those that are terrestrial-based have the opportunity to boost subscriber engagement, enable new IoT and enterprise services or secure critical links. MNOs' capacity to generate economic and social value is currently limited by the reach of their network coverage. The emergence of satellite direct-to-device services will make mobile services truly ubiquitous. Satellite direct-to-device services are still in their infancy, but their capabilities are evolving dramatically and rapidly. MNOs need to act quickly to implement their satellite direct-to-device service strategy to differentiate themselves from their competitors and to capture a piece of this opportunity that will be worth a cumulative USD93.1 billion in the next 10 years.

2. Creating opportunities beyond the network's reach

MNOs need to look for new sources of differentiation and new growth areas as their core telecoms revenue stagnates. As such, satellite direct-to-device services must be part of MNOs' network transformation strategy:

- to improve customer experience by offering safety-critical services and eventually ubiquitous broadband coverage
- as an enabler for new revenue streams allowing new beyond-network IoT and enterprise use cases (agriculture, transportation, smart grids, etc.); capturing subscribers beyond their current footprint; and offering critical connectivity services such as first responders
- as a tool to optimize investments and opex by cutting exposure to ultra-rural deployments while continuing to meet regulators' coverage obligations.

Figure 1: Satellite direct-to-device users, average per month, worldwide, 2021–2031



The reach of terrestrial coverage is, contrary to what one would believe, surprisingly limited. For example, in the USA, over 94% of the population lives in areas with at least three providers of 4G LTE coverage, but **this accounts for just 40% of the territory**. (FCC 2022 Communications Marketplace Report). There is vast economic and social value to be materialized in the uncovered areas. For example, 37% of road miles remain outside the covered areas with the consequent opportunities in connected vehicles, asset tracking or safety services to be tapped. One could build similar analysis for verticals such as agriculture, forestry, fishing, smart grids or pipelines to name a few.

NSR has identified the following three main types of users of satellite direct-to-device services.

- MNO subscribers that temporarily roam outside of terrestrial coverage but want to keep connectivity on, form the largest opportunity. These users may spend most of their time under terrestrial coverage, but coverage in some countries is so deficient that users spend as much as 6% of the time without network connectivity.

- IoT use cases, enterprises, first responders and the government/military also offer extraordinary opportunities as demonstrated by the combined work by Omnispace and U.S. Navy or Lynk's partnership with Aliv to develop maritime services. Furthermore, the satellite overlay will trigger uncountable opportunities in the IoT space for tracking, agriculture, smart grids, and many others.

- Finally, users living outside of terrestrial coverage could subscribe to mobile services once satellite connectivity is available, sometimes with support from digital divide programs.

3. The different technology paths to market

The desire for ubiquitous connectivity has always existed. In fact, satellite direct-to-device has existed for decades (with specialized equipment and services). The key novelty is to empower mainstream devices with this satellite capability.

The early vision for 5G was that it would become the framework for integrating all other communications technologies and become a '5G network of networks', including satellite. The inclusion of non-terrestrial networks in the 3GPP scope has been the key trigger for this market with major groups forming and developing the base technologies (MediaTek–Inmarsat; Ericsson, Qualcomm and Thales, etc.). However, it was not until the recently published 3GPP Release 17 that the support for satellite connectivity was defined in 5G specifications. While fully implementing the standard will still take a few months, any future 5G devices incorporating these specifications will be able to directly communicate with satellites. There are, as well, several actors following non-standard solutions to accelerate the go-to-market (Apple/Globalstar) or offer backward compatibility (Lynk, AST SpaceMobile, Starlink).

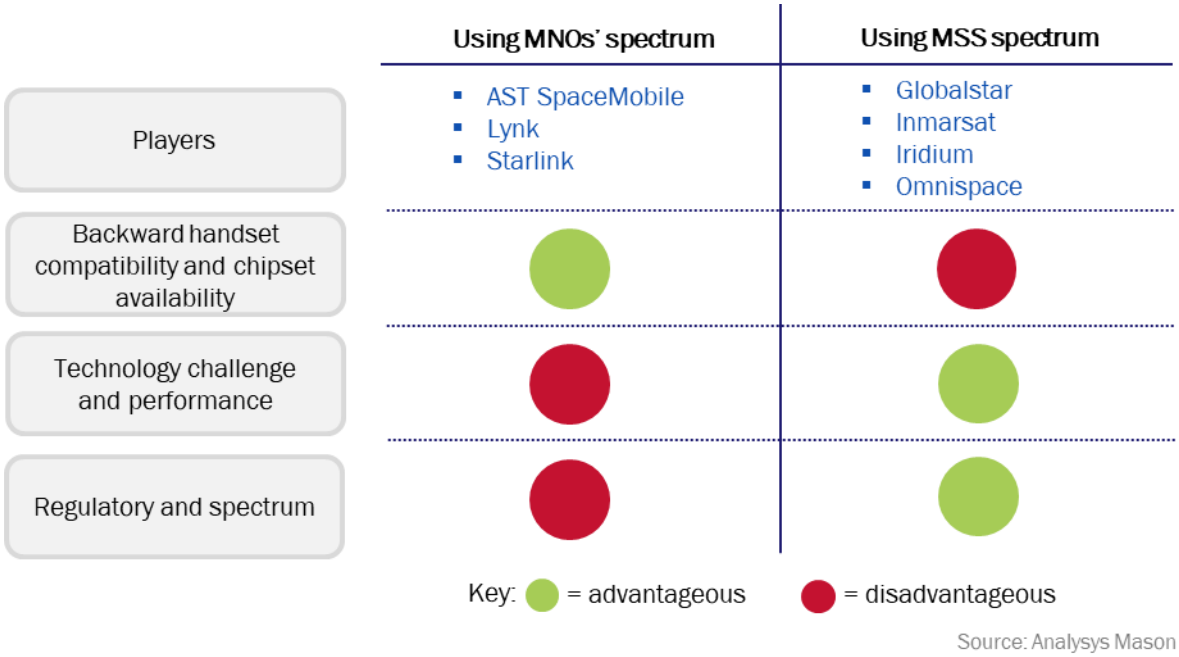
The spectrum selected to enable the services will also have the following performance and strategic implications.

- **Using MNOs' existing spectrum (AST SpaceMobile, Lynk and SpaceX).** This has the advantage of offering the possibility to be backward compatible (any existing device today would be able to communicate with a satellite) but it presents technological challenges. The phone would need to believe that it is communicating with a regular base station so complex traffic manipulation is required on the back end of the network (doppler, latency and jitter compensation, etc.). Performance levels would also be affected because the transmitting power will be limited by the risk of interfering with terrestrial base transceiver stations (BTSs).

  Coordinating the spectrum and the regulatory aspects are the biggest barriers because satellites would use spectrum that is assigned to terrestrial uses, requiring a special waiver of the rules. This coordination would probably need to happen at national levels; the soonest ITU's World Radio Conference at which this could be considered is in 2027. Furthermore, cross-border coordination or even cross-partial economic areas spectrum allocations (as in the case of the USA) could be also difficult because spectrum used by one MNO in an area might conflict with the spectrum that is allocated to another MNO in a nearby area, keeping in mind the large coverage area of satellites.

- **Using spectrum that is assigned to mobile satellite services (MSS).** With the inclusion of non-terrestrial networks in the 3GPP Release 17, a mainstream 5G device will have the potential to directly communicate with a satellite if chipsets incorporate this capability. So, the main challenge for these satellite operators with approved spectrum rights across the globe is to convince MediaTek, Qualcomm and the other 5G chipset manufacturers to incorporate those capabilities (spectrum, waveform modification, etc.) into their future designs. This approach would not be backwards compatible but would probably offer better performance capabilities and certainly more regulatory certainty.

Figure 2: Implications for the different selection of spectrum options



Using MNOs' spectrum might bring the services earlier to market and user demand will increase rapidly because of the backward compatibility of the service. However, the regulatory certainty and the capacity to offer higher performance levels would offer a long-term advantage for operators with MSS spectrum.

4. Are satellite constellations friends or foes?

The expectations in terms of performance are clear: satellite direct-to-device solutions will not be able to match terrestrial performance or even traditional satellite links. The focus for these services is coverage, not throughput density. Limitations in signal power will cap the speed of the link, but low data-rates are fine for many use cases such as voice, messaging or IoT. In this sense, satellites will not be a substitute for terrestrial solutions, but these constellations can extend MNOs' network infrastructure, offering ubiquitous coverage and unlocking new growth drivers.

The current solutions are just the beginning of the journey. There is extensive work going on in this segment. As constellations densify and technologies progress, performances will rapidly improve eventually unlocking new possibilities, specifically broadband services. In this sense, it is expected that 3GPP Release 18 will incorporate a big step forward in capabilities, but always as a complement to, not a substitute for, terrestrial networks.

5. The bottom line

Satellite direct-to-device services are a reality today. The possibilities will expand at an extraordinary pace in the coming months. MNOs need to define their strategy imminently to stay differentiated from the competition and capture some of the growth that the possibilities of ubiquitous connectivity can offer.

MNOs need to decide how to best use these technologies, while prioritizing some use cases (such as an enhanced customer experience, IoT, enterprise, first responders, etc.) and optimizing infrastructure investments, particularly for reduced capex and opex for ultra-rural deployments.

6. About the author

Lluc Palerm (Principal Analyst) began consulting for NSR in 2015. His areas of expertise include satellite–telco integration, 5G and capacity supply. He is the lead author of NSR's 5G Via Satellite (5GvS) report, Wireless Backhaul via Satellite (WBS) report, Commercial Satellite Ground Segment (CSGS) report, and co-authors the Global Satellite Capacity Supply and Demand (GSCSD) report. Lluc regularly participates in consulting projects related to supply and demand forecast for new satellite systems; planning and evaluation of satellite services for telcos; or market entry strategy for emerging opportunities among others.

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