MOBILE SATELLITE SERVICE DIRECT-TO-DEVICE AND INTERNET OF THINGS CASE STUDIES IN THE INTERNATIONAL TELECOMMUNICATION UNION GLOBALLY HARMONIZED MSS L- AND S-BANDS

(Item on the Agenda: 3.4)

(Information document submitted by the Mobile Satellite Services Association (MSSA))

Impact on the sector:

Direct-to-Device (D2D) and Internet of Things (IoT) services in the International Telecommunication Union (ITU) globally harmonized mobile satellite service (MSS) L- and S-bands enable standards-based connectivity across rural and underserved areas in the Americas, helping bridge the digital divide and supplement terrestrial networks by providing communications in hard-to-reach areas. These solutions directly support CITEL's mission of fostering universal, equitable, and sustainable telecommunications development, while advancing its vision of regional digital integration through resilient, innovative ICTs that drive inclusive social, economic, and environmental progress.

Executive Summary:

The rapid advancement of D2D and IoT services, enabled by harmonized MSS spectrum in the L- and S-bands, marks a major step forward in global connectivity. Utilizing 3GPP Release 17 non-terrestrial network (NTN) frequency bands, including n255 and n256, these solutions deliver direct, standards-compliant satellite links to smartphones, sensors, and IoT devices—without the need for specialized infrastructure. This allows continuous, resilient service across terrestrial and satellite networks, especially in remote or underserved areas.

From tracking ghost fishing gear in Mexico, combating illegal fishing in Antarctica, enabling text messaging and voice over NBIoT to showcasing D2D in the automotive sector in remote areas of Brazil, Mobile Satellite Service Association (MSSA)[1] member companies are providing interference-free and commercially viable services that support digital inclusion, environmental sustainability, disaster

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[1] For more information about the Mobile Satellite Services Association, please see here: https://www.mss-association.org/about-mssa/#about-purpose

resilience and smart industry growth. This contribution shares MSSA members' D2D and IoT L and S-band use cases as examples of how industry is contributing to CITEL's PCC.II objectives for inclusive, sustainable, and resilient digital transformation. Such examples in globally and regionally harmonized MSS spectrum represent a low-barrier, high-impact solution for enhancing connectivity, and innovation across the region.

In the Americas, where vast regions lack reliable connectivity, standards-based MSS D2D/IoT helps bridge digital gaps without requiring unnecessary infrastructure. Governments and regulators can leverage this to advance national connectivity goals and provide essential services like emergency response, environmental monitoring, ocean conservation and rural education.

Introduction:

The rapid advancement of Direct-to-Device (D2D) and Internet of Things (IoT) services, enabled by International Telecommunication Union (ITU) globally harmonized mobile satellite service (MSS) spectrum, particularly in the L- and S-bands, is transforming numerous sectors and represents significant technical, operational and regulatory progress in global connectivity.

The mobile satellite industry has worked diligently over the last several years to develop a robust technological ecosystem that enables the emergence of innovative, interoperable D2D solutions. A major milestone was achieved in 2022 with the 3rd Generation Partnership Project (3GPP) Release 17, which established a strong foundation for direct communication between satellites, smartphones and other mass-market user equipment. This breakthrough has driven significant advancements in both terrestrial and non-terrestrial satellite networking technology.

3GPP Release 17 enhances key features of the 5G Core Architecture to support Non-Terrestrial Networks (NTNs) for various use cases, including coverage extension, Internet of Things (IoT), disaster communications, global roaming and broadcasting. 3GPP Release 18 identifies three specific MSS frequency bands under 6 GHz -recognized across all ITU Regions- for 5G New Radio (NR) and narrowband IoT (NB-IoT) to enable satellite-based connectivity, following the duplex mode defined by the ITU table of frequency allocations. Additional MSS frequency bands are under consideration in Release 19. Table 1 summarizes the MSS bands in FR1-NTN.

Table 1: NTN satellite bands in FR1-NTN[2]

NTN satellite operating band	Uplink (UL) operating band Satellite Access Node receive / UE transmit FUL,low – FUL,high	Downlink (DL) operating band Satellite Access Node transmit / UE receive FDL,low – FDL,high	Duplex mode
n256	1980 MHz – 2010 MHz	2170 MHz – 2200 MHz	FDD
n255	1626.5 MHz – 1660.5 MHz	1525 MHz – 1559 MHz	FDD
n254	1610 – 1626.5 MHz	2483.5 – 2500 MHz	FDD
*NOTE: NTN satellite bands are numbered in descending order from n256. Note band n252 which is 2000-2020 MHz (uplink) paired with 2180-2200 MHz (downlink) is in the final stages of approval and is expected to be finalized in June 2025.			

The benefits of using globally harmonized and 3GPP standardized MSS frequencies for D2D/IoT include leveraging spectrum already allocated for MSS services under applicable regulatory frameworks, including the ITU's longstanding MSS framework (defined in the ITU Radio Regulations and Recommendations) which effectively manages potential interference risks and enables the effective use of these bands for D2D. At the same time, using MSS spectrum minimizes interference risk in the first instance by avoiding any need to repurpose spectrum for satellite communications or operate on a co-frequency basis with terrestrial networks (as is the case where MNO spectrum is utilized).

Moreover, D2D services using MSS spectrum can provide nearly 100% outdoor coverage, except in the most densely packed urban areas. This can help provide critical connectivity for underserved populations, delivering important social and economic development gains. It can also expand connectivity across multiple large and diverse segments, including industrial, government, agriculture, automotive, public

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[2] See: 3GPP 38.101-5, NR; User Equipment (UE) radio transmission and reception; Part 5: Satellite access Radio Frequency (RF) and performance requirements,
https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=3982

safety, and others. Many operators and equipment manufacturers are embracing 3GPP Non-Terrestrial Networks (NTN) standards for emerging D2D handsets such as the Google Pixel and Samsung Galaxy.

Below are different case studies of innovative MSS D2D and IoT applications of MSSA member companies utilizing the globally harmonized L- and S-bands in line with CITEL's vision of enabling and accelerating social, economic, cultural, and environmentally sustainable development for all the region's inhabitants through the development of telecommunications and information and communication technologies (ICTs).

MSSA Member Case Studies:

ERICSSON: Integration of traditional mobile networks with satellite mobile networks

In March 2025, Ericsson, Qualcomm Technologies, and Thales Alenia Space combined expertise in a French test laboratory to successfully connect a 5G standards-based non-terrestrial network call with a simulated low earth orbit (LEO) satellite channel.[3]

The trial proved that an NR-NTN capable device would never be without mobile coverage where areas are served by either terrestrial or non-terrestrial networks. In other words, if NTN covers an area in the middle of an ocean or deep forest - currently impossible to cover with terrestrial networks - then a device would be able to connect, via mobile connectivity alone, with any other device or service on the mobile network without the need for additional satellite signal receiving equipment, such as a dish. Support applications could include high-definition voice calls and real-time video streaming services.

The achievement is a significant milestone on the way to non-terrestrial networks becoming a commercial reality. The collaboration launched in 2022 was, at the time, the world's first publicly announced collaboration for 5G NTN based on 3GPP standards.

OMNISPACE: Utilizing D2D and IoT to address ghost fishing in Punta Lobos, México

Omnispace, in partnership with Buoy Fish, the Global Ghost Gear Initiative (GGGI), and Fedecoop, is using MSS to address "ghost fishing"—specifically through ghost gear maritime recovery—which enhances efforts to monitor and safeguard aquatic biodiversity. Ghost gear—also known as abandoned or lost fishing equipment—is a leading source of marine pollution, threatening biodiversity and fisheries worldwide. This gear can entangle, trap, and kill marine animals, damage habitats, and pose navigation hazards. This practice severely diminishes fish population and poses significant threats to non-target species, including lobsters, dolphins, turtles, and seabirds.

To address this urgent challenge, Omnispace and its partners launched one of the largest single deployments of trackable buoys in Punta Lobos, Mexico, targeting the spiny lobster fishery. This initiative showcased a pioneering use of D2D and IoT satellite services, demonstrating how low-cost, GPS-enabled buoys connected via Omnispace's MSS network can transform ghost gear recovery. The solution integrates real-time tracking, automatic recovery alerts, and cloud-based analytics, enabling fishers and authorities to prevent equipment loss, enhance sustainability, and protect marine life. With ghost gear making up as much as 10% of all marine debris (sources: FAO, UNEP), scalable MSS satellite-based solutions using the globally harmonized MSS S-band is crucial to reducing unwanted catches, strengthening regulatory compliance, and safeguarding ecosystems. This use case is a replicable model for global fisheries, showing how innovative D2D/IOT mobile-satellite services can power a new era of ocean conservation and policy innovation.

QUALCOMM: Enabling D2D connectivity and IoT expansion in MSS bands globally

In 2023, Qualcomm Technologies introduced two next-generation modem chipsets designed to bring satellite-enabled connectivity to Internet of Things (IoT) devices—even in the most remote and infrastructure-poor regions. Compliant with 3GPP Release 17 standards for satellite communications, these

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[3] See: https://www.ericsson.com/en/press-releases/3/2025/ericsson-qualcomm-thales-achieve-space-connectivity-milestone

chipsets support GEO and GSO satellites operating in L- and S-bands (n255 and n256). By removing the need for directional alignment, they simplify device deployment while delivering reliable, low-power connectivity for a range of industrial and commercial applications. One of the modems targets stationary use cases, with ultra-low power consumption and a streamlined design optimized for fixed installations. Applications include remote monitoring of water tanks, utility infrastructure, and environmental sensors. The modem integrates with Qualcomm's processing solutions to support one-way data uplinks and time-critical two-way messaging. These features extend device lifespan and enable real-time alerts from hard-to-reach locations, making the modem well-suited for long-term field deployments. The other modem is tailored for mobile and hybrid terrestrial-satellite IoT applications. It includes GNSS support and is ideal for global asset tracking, transoceanic shipping, livestock monitoring, and logistics management. Its architecture allows developers to integrate satellite connectivity with minimal design changes while maintaining compatibility with terrestrial networks.

On the handset side, Qualcomm has introduced support for NB-NTN connectivity in the X80 5G Modem-RF system.[4] This modem is available in commercial smartphone devices, providing SMS and emergency messages to users in the absence of terrestrial coverage.[5] In a collaborative showcase, Qualcomm, Deutsche Telekom and Skylo successfully enabled SMS communication over satellite directly from standard smartphones using the same 3GPP NTN standards.[6] This breakthrough illustrates how MSS spectrum and D2D satellite infrastructure can offer seamless continuity between terrestrial and satellite networks, supporting both consumer messaging and mission-critical IoT data flows without the need for specialized hardware. Together, these developments highlight how Qualcomm is driving a new wave of connectivity—making MSS D2D and terrestrial networks more accessible, resilient, and integrated, even in regions with little or no cellular infrastructure.

TERRESTAR: Voice over NB-IOT in Canada

In January 2025, Terrestar Solutions Inc., Canada's premier mobile satellite operator, partnered with Mavenir, a leading cloud-native network infrastructure provider, to complete an industry first Voice over NB-IoT (Narrowband Internet of Things) call in NTN (Non-Terrestrial Networks) mode.[7] This groundbreaking achievement took place over 3GPP-standardized NTN S-band spectrum, avoiding interference common in terrestrial networks. In a parallel development, in February 2025, Terrestar, in collaboration with Bittium, TTP, and Qualcomm, introduced the Sat Companion, a next-gen device that enables direct-to-mobile satellite communications on any smartphone, anywhere. With its easy snap-on feature, patent-pending high-gain antenna, and powered by a Qualcomm 9205S modem, the Sat Companion ensures seamless connectivity, providing users with uninterrupted SMS, chat, voice, and email services even in the most challenging and remote areas.[8] Together, these initiatives hold great promise for helping bridge the connectivity gap in Canada, where 75% of the landmass is still not served by terrestrial wireless networks

VIASAT: Combating illegal fishing in Antarctica

Non-profit marine conservation organization Sea Shepherd Global relies on the reliability, speed, and global coverage of Fleet Xpress to report destructive and illegal fishing practices and ultimately effect positive

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[4] See: https://www.qualcomm.com/products/technology/modems/snapdragon-x80-5g-modem-rf-system

[5] See: https://www.skylo.tech/newsroom/skylo-certifies-the-samsung-galaxy-s25-series-on-verizon

[6] See: https://www.skylo.tech/newsroom/deutsche-telekom-skylo-and-qualcomm-demonstrate-sms-over-satellite-directly-from-smartphones

[7] See: https://terrestarsolutions.ca/en/news/mavenir-and-terrestar-achieve-industry-first-satellite-voice-over-nb-iot-call-in-ntn-mode

[8] See: https://terrestarsolutions.ca/en/news/terrestar-solutions-bittium-ttp-and-qualcomm-showcase-the-sat-companion

change.[9] Crucial to Sea Shepherd's mission is reliable, high-speed mobile satellite connectivity with global coverage in the globally harmonized L-band. The organization is a long-standing partner of Inmarsat Maritime, a Viasat business, with four of its nine current vessels subscribed to Fleet Xpress. This includes Allankay, a 55-metre-long former toothfish longliner deployed to Sea Shepherd's latest campaign, Operation Antarctica Defense. In Operation Antarctica Defense, as in other campaigns, the camera is Sea Shepherd's weapon. Whether drawing attention to legal yet destructive activities or exposing illegal fishing practices that justify arrests, the ability to "catch vessels in the act" and quickly share photographic evidence is key. Sea Shepherd requires the capabilities to communicate with law enforcement in different jurisdictions and send out media releases as soon as possible to keep the public informed. Also, it is needed to track vessels in real time and quickly adopt tactics to catch them in the act, because without showing the world what's happening or sending evidence to the relevant authorities, Sea Shepherd wouldn't be able to effect positive change. The maritime connectivity service delivers the speed and reliability the organization requires to report harmful and/or illegal practices from the scene. With Fleet Xpress's global coverage, powered by Viasat and including ELERA L-band networks, Sea Shepherd maintains mission-critical connectivity even in remote and inhospitable locations like the Southern Ocean.

VIASAT: Demonstrating the power of D2D for the automotive sector in Brazil

Viasat has partnered with GuardianSat, Quectel, Acceleronix, and Skylo to help open the door for widescale adoption of satellite connectivity for automotive use cases, with the first-of-its-kind demonstration of direct-to-device (D2D) connectivity for the automotive sector.[10] The trials took place over four months in a 250 km highway between Curitiba and Blumenau that connects the populous Southern Brazilian states of Santa Catarina and Paraná. This highway crosses a diverse and rugged landscape, which often suffers from cellular black spots, so GuardianSat developed a device, incorporating Quectel's chipset technology, that can be easily line-fitted or retro-fitted in vehicles to share telemetry data using 3GPP's Release 17 open-standard D2D connectivity for the globally harmonized L-band. The chipsets within the Quectel module enable the device to connect to both cellular and satellite networks, and to seamlessly switch between the two. The antenna hardware is placed on the roof of the vehicle, and the module is connected to the vehicle's electronic control unit (ECU) via the controller area network (CAN) bus protocol, without requiring any cutting of wires. Integrating the device into a vehicle is simple, as is finding connectivity via satellite or cellular. The device can connect to cellular towers in areas where there is coverage and connects directly to Viasat's highly reliable L-band satellites to provide narrowband tracking, monitoring and messaging capabilities in areas with no cell coverage.

The devices both sent and received data from the headquarters in Blumenau, and the system achieved excellent performance, even in difficult weather conditions. The vehicles successfully transmitted data to the headquarters in 3 to 5 seconds on average, and on average received data back from headquarters within 18 seconds of the message being sent.

The solution can collect a vast array of data about the vehicle and can enable a variety of telemetry deployments. It can be used to track the vehicle's precise location, to understand its acceleration, to read the temperature of the exhaust – there are over 1,000 parameters that can be monitored and visualized using an Acceleronix dashboard.

Conclusion:

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[9] See: https://www.viasat.com/perspectives/maritime/2024/sea-shepherd-combat-illegal-fishing/

[10] See: https://investors.viasat.com/news-releases/news-release-details/viasat-and-partners-deliver-first-its-kind-direct-device

The rapid advancement of D2D and IoT services, enabled by globally harmonized Mobile Satellite Service (MSS) spectrum particularly in the L- and S-bands, is transforming numerous sectors and represent significant technological, operational and regulatory advancements in global connectivity.

These services provide direct, standards-compliant satellite communication to smartphones, sensors, and other unique devices without the need for specialized infrastructure or proprietary networks. Enabled by 3GPP Release 17 standards and operated over spectrum bands such as n255 and n256, MSS D2D/IoT connectivity ensures resilient, reliable communication across diverse applications such as tracking ghost fishing gear in coastal waters to managing critical infrastructure in remote areas. This paradigm shift allows for seamless integration between terrestrial and satellite networks, enabling continuous service even in coverage black spots. Industry leaders such as MSSA member companies are driving innovation, proving that D2D/IOT MSS solutions are not only technically viable but scalable and commercially deployable. The result is a new wave of global connectivity that directly supports digital equity, environmental sustainability, public safety, and smart industry innovation across both developed and developing markets.

The implementation of MSS-based D2D and IoT services in the harmonized L- and S-bands brings substantial socioeconomic and regulatory benefits. Across the Americas -especially in vast rural territories, mountainous regions, dense forests, and maritime zones- MSS D2D/IOT solutions have the capability to bridge terrestrial coverage gaps, empowering governments, regulators, and private stakeholders to extend essential digital services like emergency communications, environmental monitoring, agricultural data collection, maritime conservation, and remote education.

The MSSA encourages CITEL administrations to support operators in the use of the harmonized MSS L- and S-band spectrum for innovative D2D and IoT applications as they aligns with CITEL's mission of enabling and accelerating social, economic, cultural, and environmentally sustainable development for all the region's inhabitants through the development of telecommunications and ICTs.