Introduction

The Mobile Satellite Services Association (MSSA) is a non-profit industry association, founded in 2024, that seeks to promote and advance the emerging ecosystem for advanced Non-Terrestrial Network (NTN) services, including direct-to-device (D2D). MSSA supports the efforts of advanced NTN solutions providers, including terrestrial mobile and satellite operators, original equipment manufacturers, infrastructure providers, chip vendors, and others. MSSA is focused on facilitating a global ecosystem utilizing spectrum already allocated and licensed for mobile satellite services (MSS) and well-suited for integration into a broad range of mobile devices. More specifically, MSSA seeks to facilitate global mobile connectivity via satellite through open, standards-based solutions. More information about MSSA is available at www.MSS-Association.org

MSSA appreciates the opportunity to respond to the Communications, Space and Technology Commission's (CST) consultation on D2D services in the Kingdom of Saudi Arabia (KSA) and looks forward to continued collaboration on this important topic.

Responses to Consultation Questions

Overview of D2D Services

Question 1: Does the above definition of D2D adequately capture the full potential of D2D services? If not, please suggest any additional D2D services or aspects should be considered in the current review cycle.

MSSA believes that CST's definition broadly captures the scope of D2D services by correctly recognizing that D2D enables connectivity to off-the-shelf mobile devices via satellites without requiring additional equipment or modifications and encompasses both MSS and International Mobile Telecommunications (IMT)/mobile service (MS) spectrum approaches with various technology standards, including 3GPP and proprietary solutions.

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However, MSSA also believes that CST should ensure that its regulatory framework accommodates and facilitates the provision of D2D and other advanced NTN services using MSS spectrum. Such services should include applications beyond basic voice and messaging, such as mobile broadband, coverage extension, disaster communication, global roaming, broadcasting, advanced Internet of Things (IoT), asset tracking, environmental monitoring, smart infrastructure, and countless other applications, in addition to advanced NTN safety services.

Question 2: Are there specific frequency bands within MSS spectrum that should be prioritized for D2D services? If so, please share your recommendation along with supporting justifications.

MSSA strongly supports prioritizing D2D and other advanced NTN services using MSS spectrum that is already allocated internationally and incorporated into 3GPP standards. Specifically, we recommend prioritizing:

Table 1: MSS Frequency Assignments

Frequency Band (MHz)	Direction
1518-1525	Space-to-Earth
1525-1530	Space-to-Earth
1530-1535	Space-to-Earth
1535-1559	Space-to-Earth
1610-1626.5	Earth-to-Space
1626.5-1660.5	Earth-to-Space
1668-1675	Earth-to-Space
1980-2010	Earth-to-Space
2170-2200	Space-to-Earth
2483.5-2500	Space-to-Earth

These MSS frequency bands align with existing ITU allocations and enable D2D and other advanced NTN services within established regulatory frameworks. They have been incorporated into 3GPP Release 18 for NTN implementation, ensuring compatibility with global standards and mass-market device ecosystems. Additionally, these bands benefit from established interference management mechanisms through ITU Radio Regulations, providing proven coordination procedures that have been successfully applied for decades across multiple satellite operators and services.

Question 3: Are there specific frequency bands within IMT spectrum that should be prioritized for D2D services? If so, please share your recommendation along with supporting justifications.

The potential provision of D2D services in MS spectrum bands (sometimes referred to as international mobile telecommunications or IMT bands) poses complex technical issues that do not arise where D2D services are provided in MSS spectrum. Among other things, D2D services provided in MS/IMT spectrum pose potential interference risks to mobile network operators (MNOs) and other terrestrial users of that same spectrum, as well as to MSS systems operating in nearby frequency bands. Critically, these interference risks have not yet been fully evaluated in KSA.

Indeed, detailed interference and coexistence studies (among other types of technical analysis) are needed before CST can understand the risks posed by such D2D operations in MS/IMT spectrum or make informed decisions as to whether such operations should be authorized and, if so, on what terms. D2D operations in MS/IMT spectrum may also pose interference risks to MSS services in nearby spectrum, which must be studied carefully before such D2D operations can be responsibly authorized. These studies have not been completed to date, and potential interference mitigation measures taken in IMT spectrum, such as guard bands and power limits, have not been agreed upon.

Consequently, MSSA recommends that CST initially authorize D2D and other advanced NTN services using MSS spectrum only, where existing international frameworks effectively manage interference risks. Authorization for D2D in MS/IMT spectrum should be deferred until relevant technical and coexistence issues are better understood through WRC-27 preparatory work and appropriate national coexistence studies.

Question 4: Are there any additional standardized or emerging proprietary solutions that should be considered for D2D services? If so, please describe them, highlighting their distinguishing features and potential advantages.

MSSA members are primarily utilizing 3GPP standards-based technologies to support the provision of D2D services using MSS spectrum. 3GPP Release 17 enhances features in the 5G Core Architecture to support NTNs for several use cases, including coverage extension, IoT, disaster communication, global roaming, and broadcasting. Building on this foundation, 3GPP Release 18 identifies three specific MSS frequency band ranges under 3 GHz (recognized across all ITU Regions) for NTN implementation.

This approach leverages established 3GPP standards to integrate satellite capability into mass-market mobile devices, supporting the global 5G ecosystem without requiring fundamental regulatory changes.

D2D Demand

Question 5: Are you interested in offering D2D services in Saudi Arabia using MSS bands? If so, which customer segments, devices, and use cases would you target?

As an industry association, MSSA does not directly offer services. However, our members have demonstrated strong interest in providing D2D and other advanced NTN services using MSS spectrum bands in KSA and the broader MENA region. An MSSA member recently and successfully demonstrated proof-of-concept for messaging and emergency communications using standard, unmodified smartphones in both KSA and the United Arab Emirates.

Question 6: Are you interested in offering D2D services in Saudi Arabia using IMT/MS bands? If so, which customer segments, devices, and use cases would you target?

MSSA members recognize the potential future opportunity that IMT/MS bands may represent for D2D services. However, given the current state of technical understanding and regulatory development, MSSA members are focusing their near-term deployment plans on MSS spectrum.

Question 7: Considering your responses to Questions 1 and 2, what benefits do you expect to deliver through these services? Please specify the benefits while distinguishing between MSS and IMT bands.

D2D and other advanced NTN services using MSS spectrum have the potential to deliver ubiquitous coverage across KSA's diverse geography, including remote desert regions and extensive territorial waters in the Red Sea and Arabian Gulf. This coverage would extend connectivity to areas where terrestrial infrastructure deployment is economically challenging or physically impractical, ensuring that all parts of KSA can access essential communication services.

MSSA believes that MSS spectrum will provide the foundation for innovative D2D and other advanced NTN solutions that will position KSA at the forefront of satellite-terrestrial network integration and create opportunities for continued service innovation as technology evolves.

Question 8: Considering your responses to Questions 1 and 2, would these D2D services complement or compete with existing mobile network services? Please specify the services while distinguishing between MSS and IMT/MS bands.

D2D and other advanced NTN services using MSS spectrum will complement existing mobile network services rather than compete with them. They present opportunities to extend coverage to areas where terrestrial infrastructure deployment is economically challenging, provide backup connectivity during

network outages or disasters, and enable advanced NTN applications that terrestrial networks cannot efficiently support. Additionally, D2D services can support MNOs in meeting universal service obligations by complementing their terrestrial networks with satellite-based connectivity that reaches underserved populations and remote areas. Many D2D and other advanced NTN services will be offered in partnership with existing MNOs, with satellite connectivity integrated into terrestrial service offerings.

As outlined in our response to Question 3, the relationship between D2D and terrestrial services in IMT/MS bands is more complex and requires careful regulatory design to ensure complementary operation and prevent harmful interference to existing terrestrial users.

Question 9: What is your view on the market opportunity for D2D services in Saudi Arabia? And in the Middle East region? And globally? Please specify which customer segments, devices and use cases are part of your market view.

See response to Question 5, above.

Question 10: What benefits do you expect D2D services to deliver in Saudi Arabia, and what is their estimated scale? Please specify economic benefits for individuals and businesses, as well as any broader societal benefits.

D2D and other advanced NTN services represent a transformative opportunity for KSA, delivering substantial benefits to individuals, businesses, and as well as to society. Such services will fundamentally enhance connectivity and safety for individuals across KSA. People living in or traveling through remote desert regions, maritime areas, and underserved areas will have reliable, ubiquitous connectivity through their existing smartphones without specialized equipment. Additionally, MSS-based D2D services provide the foundation for advanced and entirely new advanced NTN applications, whilst enhancing existing aeronautical and maritime safety services.

Beyond safety, D2D and other advanced NTN services will expand economic opportunities for individuals in remote regions by enabling remote work, e-commerce, online education, telemedicine, and digital financial services, ensuring all Saudi citizens can participate in KSA's digital transformation, regardless of their location.

For MNOs, D2D represents new revenue opportunities through partnerships with satellite operators, enabling differentiated connectivity packages combining terrestrial and satellite capabilities. This would enhance customer value propositions while extending effective coverage without the capital intensity of building terrestrial infrastructure in economically challenging areas.

D2D and other advanced NTN services will also deliver transformative operational capabilities for businesses in KSA. Logistics companies gain real-time visibility across KSA's vast distances. Energy sector operations in remote fields benefit from reliable connectivity for monitoring and control. Agricultural operations can deploy IoT sensors for precision agriculture across large remote areas. These capabilities translate into improved efficiency, reduced costs, and more informed decision-making.

At the national level, D2D will lay the foundation for future integrated terrestrial-satellite networks in 5G evolution and 6G development, positioning KSA at the forefront of next-generation telecommunications.

Question 11: Do you anticipate any market failures in delivering the expected D2D benefits? If so, please specify the benefits at risk and the potential reasons for failure (e.g., challenges in enhancing emergency service availability in Saudi Arabia.

MSSA anticipates that D2D and other advanced NTN services will be successfully deployed in KSA using MSS spectrum with appropriate regulatory support.

D2D Supply

Business Model

Question 12: What business model are you considering for providing D2D services in Saudi Arabia? Please specify all the business models you are considering while distinguishing between MSS and IMT spectrum bands, if needed.

Not applicable. As noted above, MSSA is not itself a service provider.

Question 13: What volume assumptions for Saudi Arabia (e.g. number of active devices, monthly calls, or data usage per device) are you using in your business planning? Please distinguish between MSS and IMT/MS spectrum bands, if needed.

Not applicable. As noted above, MSSA is not itself a service provider.

Technical Aspects & Service Performance

Question 14: Based on the D2D services you plan to offer, what are the key technical characteristics such as capacity (Mbit/s/km^2/MHz) and latency (ms) that you expect to deliver? Please specify the underlying assumptions (e.g. direct line of sight or not, outdoor or indoor, antenna elevation angle) and distinguish between MSS and IMT/MS spectrum bands, if needed.

As noted above, MSSA is not itself a service provider. That said, MSSA expects a variety of D2D solutions will emerge to address different customer needs and use cases, with associated technical characteristics varying accordingly.

Question 15: Do you expect to cover the entire territory of Saudi Arabia, including indoor availability? Please specify the percentage or total landmass covered and whether indoor service will be available. Can the coverage/service area be restricted to specific locations (for example: cities, villages, roads)? If the answer is yes, please clarify the geographic capability to define coverage areas (minimum satellite spot beam size on ground).

As noted above, MSSA is not itself a service provider. That said, MSSA notes that D2D and other advanced NTN services are generally capable of providing ubiquitous outdoor coverage across KSA's entire territory, including urban and suburban areas, remote desert regions, territorial waters in the Red Sea and Arabian Gulf, and border regions. This comprehensive coverage represents a key advantage of satellite-based operations, complementing terrestrial networks by serving areas where infrastructure deployment is challenging and ensuring connectivity across KSA's diverse and expansive geography.

Question 16: Which spectrum band do you intend to use and how much bandwidth would be required to provide for the D2D services? If different bands and bandwidths are needed for different services, please specify accordingly while distinguishing between MSS and IMT spectrum bands.

See response to Question 2, above.

Network Architecture

Question 17: Could you please detail the technology and network architecture you plan to use for delivering D2D services? Specify as many details as possible, distinguishing between MSS and IMT/MS spectrum bands (e.g. altitude, number of satellites required for service provision).

As noted above, MSSA is not itself a service provider. That said, MSSA encourages CST to allow flexibility for operators to deploy optimal architectures while ensuring compliance with regulatory requirements. For reference, MSSA also provides its "Reference Architecture Whitepaper", which briefly outlines key MSS/NTN architectural models and the associated trade-offs. (https://www.mss-association.org/mssa-reference-architecture)

Question 18: Do you see any advantages or trade-offs between using MSS and IMT spectrum bands (e.g. cost differences, performance, or spectrum efficiency)?

As discussed above, MSS spectrum provides a clear, lower-risk path for D2D deployment with established regulatory frameworks and minimal interference concerns. In contrast, IMT/MS spectrum requires resolution of significant technical and regulatory challenges. For these reasons, MSSA strongly recommends prioritizing D2D deployment in MSS spectrum initially.

For additional context, MSSA also provides its "Spectrum Management Whitepaper", which outlines the trade-offs between using MSS and IMT spectrum for D2D services. (https://www.mss-association.org/spectrum-management-considerations-for-d2d-services)

Question 19: What additional infrastructure and/or spectrum would be needed to enhance your network to accommodate anticipated future growth, and when would these enhancements be required? Please distinguish between MSS and IMT spectrum bands, if needed.

Not applicable. As noted above, MSSA is not itself a service provider.

Question 20: What is your deployment strategy and expected timeline for the technology and network architecture you plan to use for delivering D2D services? Please provide as many details as possible, distinguishing between MSS and IMT/MS spectrum bands if applicable.

As noted above, MSSA is not itself a service provider. That said, MSSA expects a variety of D2D solutions will emerge to address different customer needs and use cases, with associated technical characteristics and expected timelines varying accordingly.

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Technology Standards

Question 21: What technology are you planning to use to provide D2D services? Please provide as many details as possible while distinguishing between MSS and IMT/MS spectrum bands.

See response to Question 5, above.

Question 22: Could you please specify whether you will use standardised 3GPP technology or a proprietary solution, along with the reasoning behind your approach? Please distinguish between MSS and IMT/MS spectrum bands, if needed.

See response to Question 5, above.

Interference

Question 23: Considering your proposed D2D services, do you believe they could coexist with other user services operating on the same frequencies within the MSS spectrum bands, especially existing users? Please specify the reasons why coexistence would or would not be possible.

As noted above, MSSA is not itself a service provider. That said, MSSA believes coexistence issues in MSS bands would be well-managed through established international frameworks. The ITU Radio Regulations and Recommendations provide comprehensive mechanisms for managing interference risks in MSS spectrum, with decades of proven effectiveness across multiple satellite operators and services. Existing coordination procedures used for traditional MSS services, including satellite-to-satellite coordination, apply equally to D2D operations without requiring new regulatory frameworks or novel technical approaches.

Satellite operators already coordinate routinely among themselves under these international frameworks, ensuring compatible operations across multiple systems sharing the same spectrum bands and geographical areas.

This mature, proven coordination environment stands in stark contrast to the unresolved challenges posed by D2D operations in IMT/MS spectrum, where co-frequency operation between satellite systems and intensive terrestrial mobile networks presents unprecedented technical and regulatory complexities requiring extensive studies and new coordination mechanisms.

Question 24: Considering your proposed D2D services, do you believe they could coexist with other user services operating on the same frequencies within the IMT/MS spectrum bands, especially existing users? Please specify the reasons why coexistence would or would not be possible.

As noted above, MSSA is not itself a service provider. That said, and as noted in our response to Question 3, the provision of D2D services in IMT/MS spectrum bands poses complex technical issues that do not arise where D2D services are provided in MSS spectrum.
For additional reference, MSSA also provides its "Spectrum Management Whitepaper", which outlines the trade-offs between using MSS and IMT spectrum for D2D services.
(https://www.mss-association.org/spectrum-management-considerations-for-d2d-services)

MSSA urges CST to view with caution any suggestion that D2D uses of IMT/MS spectrum can or should be allowed to proceed on a "non-interference, non-protection" basis under No. 4.4 of the ITU Radio Regulations. As noted by the Radio Regulations Board (RRB) in its report to WRC-23, the use of this provision (which permits certain uses on a non-interference, non-protection basis) in the case of satellite networks should be approached with caution—including because of the high risk that interference that necessarily results from the operation of tens of thousands of satellites in increasingly congested spectrum bands and orbits.

Question 25: Could you indicate whether existing systems could be at an increased risk of harmful interference from the introduction of satellite-based D2D services using IMT bands? If so, please specify which IMT bands should be avoided to minimise this risk.

See response to Question 25, above.

Question 26: Do you foresee any potential border interference with neighbouring countries using IMT spectrum bands? If so, please elaborate.

MSSA believes that the potential for cross-border interference caused by or to D2D, as well as other advanced NTN services using MSS spectrum, can be effectively managed by utilizing the same mechanisms currently employed to address such interference in the case of other MSS services.

In the case of D2D operations in IMT/MS spectrum, the potential for cross-border interference is one of many concerns that has not yet been properly understood, and that requires further study, followed by the development and implementation of appropriate mitigation mechanisms.

User Equipment

Question 27: CST is considering various approaches to devices which use MSS spectrum that is not licensed in the Kingdom, including limiting the clearance of such devices from entering the Kingdom. Please share your views on suitable approaches for such devices.

MSSA strongly supports CST's existing type approval framework, which requires all terminals entering KSA to receive Type Approval from CST. This approach provides CST with appropriate oversight of device technical characteristics, ensuring equipment operating in KSA meets safety standards, complies with spectrum regulations, and protects against harmful interference.

By building upon existing procedures rather than developing entirely new frameworks, CST can facilitate timely market entry for MSS D2D and other advanced NTN operations, while maintaining robust technical oversight and consumer protection.

Question 28: Could you please indicate whether user devices require certification for using MSS or IMT spectrum? If so, kindly specify for which spectrum should be certified and provide the reasoning behind it.

See response to Questions 2 and 27, above.

Potential Future Regulation of D2D Services

MSS Spectrum

Question 29: Do you think the existing NTN regulations are suitable for D2D services using MSS spectrum bands? Please specify the reasons why the existing NTN regulations are or not suitable and suggest potential changes if not currently suitable.

MSSA believes that CST's existing NTN regulations are fundamentally suitable for MSS-based D2D services, although minor clarifications and updates would provide additional certainty for operators and facilitate deployment while maintaining robust regulatory oversight.

Critically, D2D as well as other advanced NTN services can be implemented in MSS spectrum without the need for new allocations or the adoption of new regulations at the national or international level, as they can leverage existing ITU allocations and national MSS licensing frameworks, including the CST's NTN regulations.

Question 30: What are your views on licensing of MSS spectrum bands for D2D services factoring in the existing licences in Saudi Arabia?

See response to Question 29, above.

Question 31: What modifications, if any, should be made to CST's existing equipment approval regulations and technical specifications to accommodate D2D technologies using MSS spectrum bands?

See response to Question 27, above.

Question 32: How can MSS providers collaborate with national MNOs to extend D2D services?

MSS providers can collaborate with national MNOs through a variety of commercial and technical models. D2D and other advanced NTN systems can complement MNO coverage in underserved areas by enabling direct satellite-to-device communication where terrestrial networks are limited or unavailable. Regulatory frameworks — including those developed by CST — should remain flexible to support innovative hybrid models, ranging from roaming-like agreements to integrated network architectures that ensure continuity of service for end users.

Question 33: What would be the main requirements for obtaining a service licence, and what conditions and obligations regarding coverage and quality of service should be included in the regulatory document? Please provide as many details as possible and the reasoning behind it.

As outlined in our response to Question 29, CST's existing NTN regulatory framework provides an appropriate foundation for authorizing D2D as well as other NTN services using MSS spectrum. Therefore, the same application processes should apply, with clarifications explicitly recognizing D2D as a permitted MSS service category. Service licensing requirements should ensure operator capability, spectrum coordination, consumer protection, and service quality while maintaining sufficient flexibility to encourage investment and accommodate various business models. This approach would enable rapid

D2D deployment in KSA, leveraging a proven regulatory framework while ensuring appropriate oversight.

Question 34: Is it recommended to establish a minimum level of quality of service (QoS) to be provided? If yes, please specify the technical standards for these minimum thresholds.

MSSA expects that a variety of D2D solutions will emerge in response to varying customer needs and use cases. Associated QoS parameters are likely to vary in kind.

Question 35: What is the proposed measurement mechanism (including data, procedures, and parameters) to monitor the provision of the required technical standards for coverage and quality of service (QoS)?

MSSA expects that a variety of D2D solutions will emerge in response to varying customer needs and use cases. Associated QoS parameters and KPIs are likely to vary in kind.

IMT/MS Spectrum

Question 36: Do you expect D2D services using IMT spectrum bands to be available in Saudi Arabia before WRC-27?

See response to Question 3, above.

Question 37: What services would need to be regulated prior to WRC-27? What benefits do you think such a regulation could bring to consumers and businesses in Saudi Arabia?

See response to Question 3, above.

Question 38: Do you think the existing NTN regulations are suitable for D2D services using IMT spectrum bands? Please specify the reasons why the existing NTN regulations are or not suitable and suggest potential changes if not currently suitable.

MSSA members believe that existing NTN regulations are *not* suitable for D2D services using MS/IMT spectrum bands. The complexity of MS/IMT spectrum sharing for D2D require comprehensive new regulatory provisions that should only be developed after WRC-27 conclusions, the completion of relevant technical studies, the establishment of international precedents, and the performance of national coexistence analysis.

This approach protects existing terrestrial infrastructure investments and avoids premature regulatory commitments that may prove problematic or incompatible with emerging international frameworks.

Question 39: What are your views on licensing of IMT spectrum bands for D2D services factoring in the existing licences in Saudi Arabia?

See response to Question 3, above.

Question 40: What modifications, if any, should be made to CST's existing equipment approval regulations and technical specifications to accommodate D2D technologies using IMT spectrum bands?

See response to Question 38, above.

Question 41: How would satellite operators capable of providing D2D services using IMT bands collaborate with national MNOs to provide their services?

MSSA believes that such collaboration frameworks should only be developed and implemented after the conclusion of WRC-27, the completion of relevant technical studies, the establishment of international precedents, and the performance of national coexistence analysis. Following this sequenced approach, will help to ensure that any regulatory frameworks that are developed will be based on comprehensive technical understanding and informed by international consensus.

Question 42: What are the essential requirements for obtaining a service licence, and what coverage and quality of service (QoS) conditions and

obligations should be included in the regulatory document? Please provide as much detail as possible, explaining the reasons.

MSSA expects that a variety of D2D solutions will emerge in response to varying customer needs and use cases. Associated licenses, QoS parameters, and coverage conditions are likely to vary in kind.

Question 43: Is it recommended to establish a minimum level of quality of service (QoS) to be provided? If yes, please specify the technical standards for these minimum thresholds.

See response to Question 42, above.

Question 44: What is the proposed measurement mechanism (including data, procedures, and parameters) for monitoring the provision of the required technical standards for coverage and quality of service (QoS)?

See response to Question 42, above.

Additional Considerations

Question 45: Are there any other points that stakeholders believe would be useful for our consideration? Please provide as much supporting information as possible.

MSSA commends CST for its proactive efforts to enable D2D services in KSA. Our submission demonstrates that authorizing D2D services using MSS spectrum under the current NTN licensing regime offers an optimal regulatory approach, one that promotes innovative service deployment while ensuring effective spectrum interference management and safeguarding incumbent licensed operations.

MSSA looks forward to continued collaboration with CST and other stakeholders to ensure the successful deployment of D2D as well as other NTN services using MSS spectrum that will benefit users across KSA.