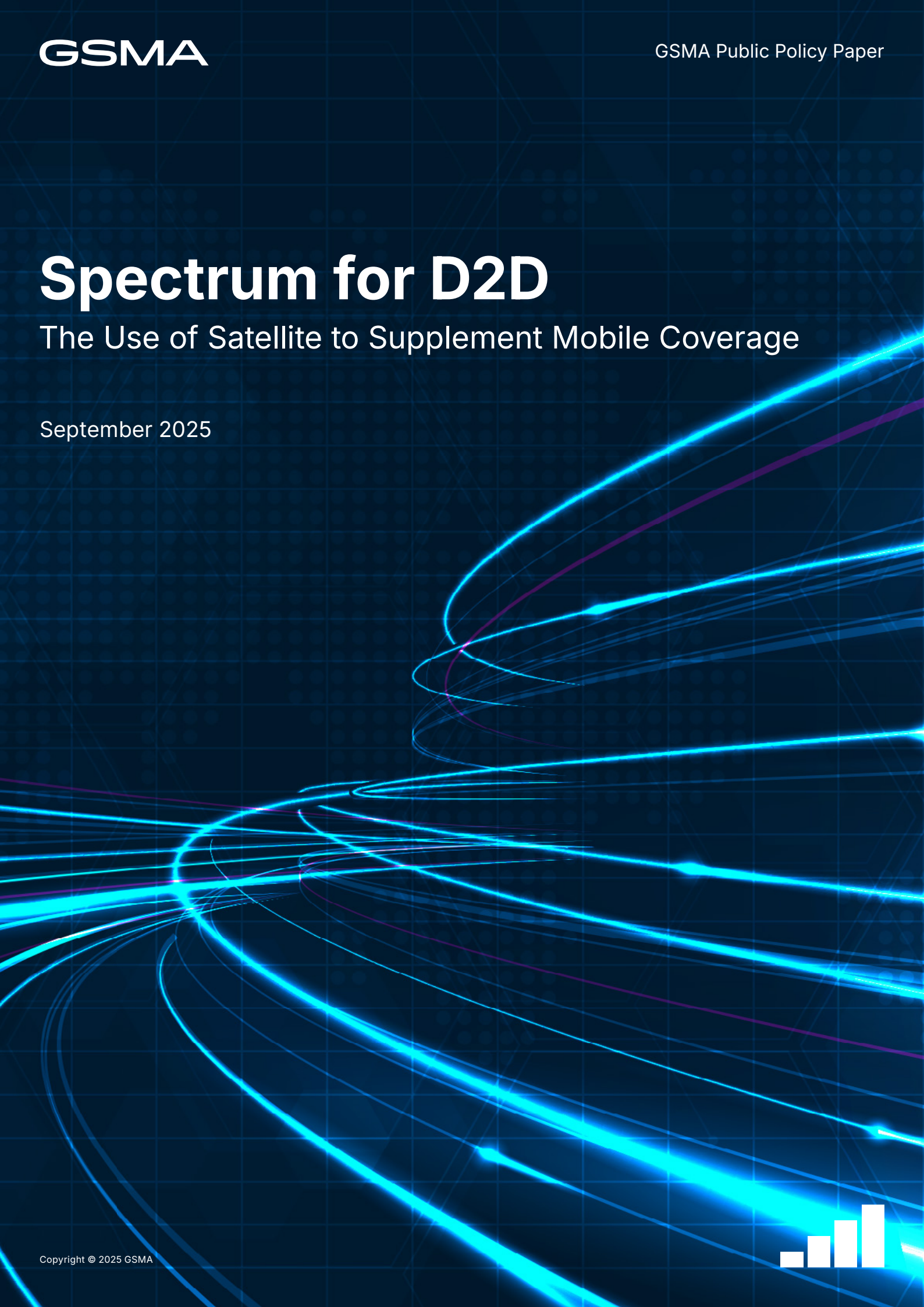
GSMA

GSMA Public Policy Paper

Spectrum for D2D

The Use of Satellite to Supplement Mobile Coverage

September 2025



GSMA™

The GSMA is a global organisation unifying the mobile ecosystem to discover, develop and deliver innovation foundational to positive business environments and societal change. Our vision is to unlock the full power of connectivity so that people, industry and society thrive. Representing mobile operators and organisations across the mobile ecosystem and adjacent industries, the GSMA delivers for its members across three broad pillars: Connectivity for Good, Industry Services and Solutions, and Outreach. This activity includes advancing policy, tackling today's biggest societal challenges, underpinning the technology and interoperability that make mobile work, and providing the world's largest platform to convene the mobile ecosystem at the MWC and M360 series of events.

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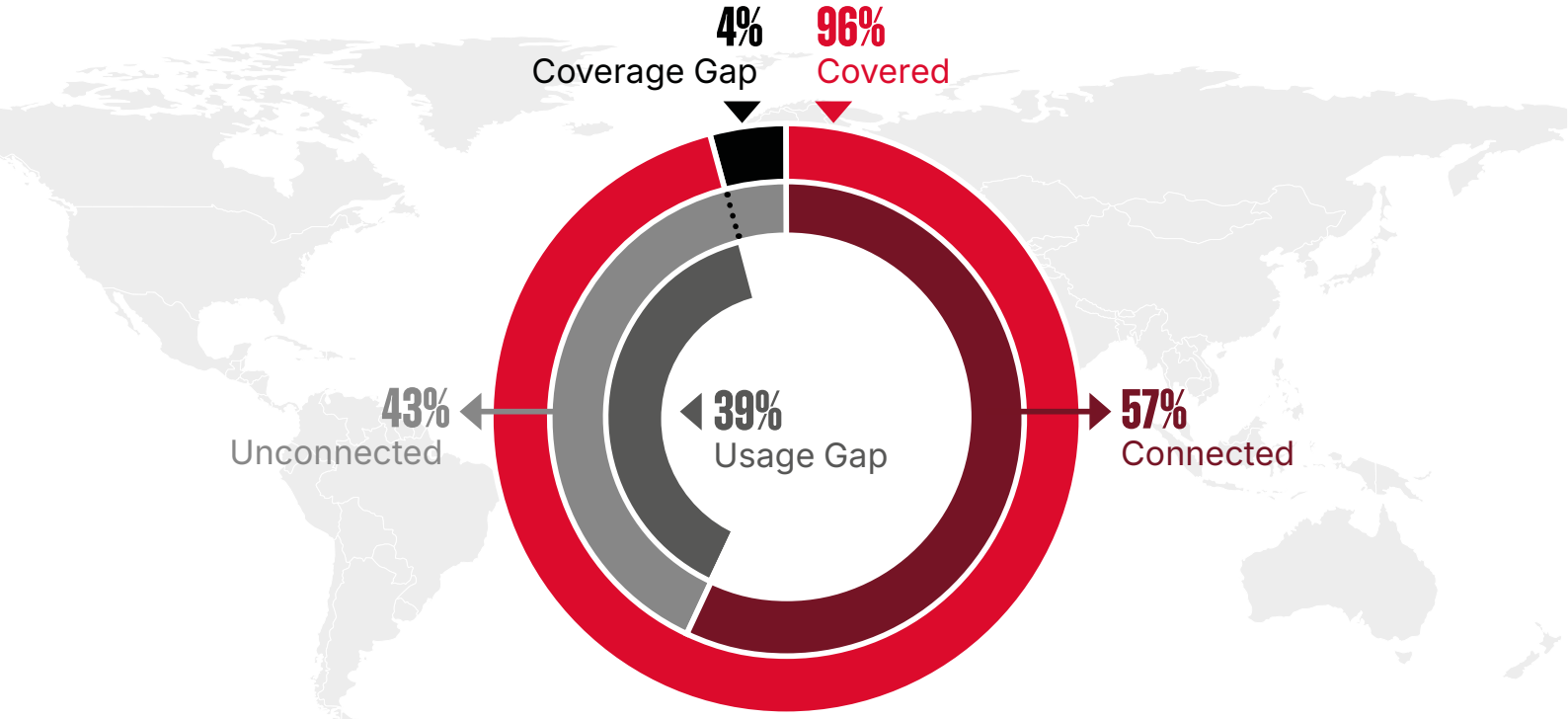
Direct-to-Device (D2D) describes connectivity between satellites and mobile handsets. The use of satellite connectivity as part of a mobile network can supplement a terrestrial operator's network coverage. Providing this broader coverage layer can help mobile to reach further into sparsely populated or inaccessible locations. D2D infrastructure can also provide an added layer of network resilience: signals from satellites can still be received in the event of terrestrial network outage, including support for emergency services where terrestrial networks fail. D2D can provide connectivity after natural disasters and it can digitally empower crisis-affected communities during times of humanitarian intervention.

Today, 57%[1] of the world population is connected to mobile broadband and D2D can add resilience and also supplement their services when they travel to areas with no connectivity, such as deserts, oceans, mountains or national parks. It can also help connect part of the unconnected who live outside coverage of mobile broadband networks (the coverage gap), estimated at 4% of the global population. However, policies on supplemental satellite services should go hand in hand with other policy reforms to connect the 39% of the global population that live within the mobile footprint and are not connected (the usage gap). The usage gap is caused by lack of affordability and digital literacy, among other things. Regulation which focuses on both issues can deliver the industry vision of connecting everyone.

D2D can provide a valuable supplemental technology for the mobile industry, new business for the satellite and mobile sectors, improve resilience and extend access to services for end-users. Governments should allow mobile operators to deploy D2D services in partnership with satellite operators.

Usage / coverage gap globally



1 The State of Mobile Internet Connectivity Report, GSMA, 2024

D2D spectrum and services

D2D operations can use two spectrum categories: frequency bands identified for IMT and allocated to the mobile service, and bands already allocated to the mobile satellite service (MSS). Both types of D2D operations are available today. They currently both provide SOS and SMS capabilities, while D2D using IMT spectrum also offers data. D2D is a new and rapidly evolving technology and, with the correct regulation, has the potential to offer improved services in the future.

The larger footprint of satellite beams compared to terrestrial cells limits the amount of data that can be delivered in any area. As such, outside areas of very low population density, D2D use will be limited.

Although to the consumer D2D services may be similar using both types of spectrum, they are different in terms of regulatory framework.

Spectrum	Benefit	Challenge
Mobile satellite spectrum	No cross-border issues as harmonised spectrum is used. Local regulatory frameworks often exist and may allow D2D.	Handsets require specific hardware for satellite bands that are currently only available in few high-end devices. Reaching global economies of scale is not guaranteed.
IMT spectrum	Standard handsets used. Some countries have developed national frameworks.	Technical coexistence and international regulations are still under consideration as part of the WRC-27 process.

GSMA positions on spectrum for D2D

D2D in IMT spectrum

01. D2D using mobile spectrum should be provided through mobile network operator (MNO) licences

D2D operating in IMT spectrum bands provides a supplemental service to terrestrial networks and enables MNOs to collaborate, under commercial arrangements with satellite network operators (SNO), to extend the MNO's coverage. With the regulator's permission, this should be done through the spectrum licence of the MNO; i.e., the rights of use by satellite for any given terrestrial band should derive from the exclusive rights on MNO licences, through lease agreements or other authorisation tools as applicable in each country.

Authorising the utilisation of an MNO's licensed spectrum with a D2D satellite provider may mean the MNO remains responsible for ensuring the mitigation and management of interference under the terms of its original licence, depending on how the authorisation of satellite use of the mobile spectrum is framed. In this case, the MNO may also remain responsible for compliance with other regulations.

This approach will allow MNOs to decide how best to use their licensed mobile spectrum bands to enable satellite connectivity for subscribers. Such market-led choices will support the most efficient and optimal use of mobile licensed spectrum as MNOs are best-positioned to determine how to leverage spectrum to better-support customers in remote, rural, suburban or urban settings. This includes determining which licences or portions of licences might be best used to extend their network coverage via satellite.

02. When using IMT spectrum, D2D must protect IMT networks in accordance with the Radio Regulations

In some countries, D2D regulations are in place and there is enthusiasm from a number of regulators to authorise D2D services using mobile spectrum. The US, Canada, and Australia are examples of this, and have all adopted the approach of authorising the MNO to utilise its spectrum under a commercial agreement with a D2D satellite provider. In the US, FCC regulation stipulates that D2D operations are on a secondary (no interference / no protection) basis.

In Australia, a mobile phone used with D2D in mobile bands can be operated within the geographic area of the spectrum licence, provided it operates in accordance with the conditions of the licence.

In the UK, Ofcom consulted on a regulatory framework that would enable D2D services in IMT bands to be provided by MNOs and D2D satellite providers working in partnership. The proposal also included limits to protect IMT networks in neighbouring countries licensed to operate in the same band, and with users licensed to operate in adjacent frequencies in the band.

Regulators' interest is increasing due to D2D using mobile spectrum successfully being trialled throughout the world, as well as plans announced for more satellite capacity being launched for D2D.

Furthermore, the ITU World Radiocommunication Conference 2027 (WRC-27) is looking at establishing an international framework to facilitate the development of D2D services.

Where regulators plan to introduce D2D services soon, they may need to define cautious national regulatory frameworks for D2D in IMT spectrum. As such, regulators could create a regulatory framework based on one of the following options.

A. D2D operations should protect existing services in accordance with the Radio Regulations. As there is no satellite allocation in the some of the mobile bands being used at present, D2D should thus operate on a no interference / no protection basis.

B. Create secondary allocations in certain mobile bands along with some conditions, in order to make sure that D2D operations do not cause harmful interference to the services it is designed to supplement.

D2D must protect mobile networks, which are used by 5.8 billion unique mobile subscribers. Any approach to D2D introduction should be based on regulatory and technical conditions which ensure coexistence with mobile terrestrial networks.

This means managing the risk of harmful interference with an operator's own terrestrial network, with mobile operators licensed to operate in the same band in adjacent areas (including neighbouring countries), and with users licensed to operate in adjacent frequency bands.

03. Standard handsets may be used for D2D using IMT spectrum

As D2D services using IMT mobile bands share the frequencies already licensed to MNOs for terrestrial mobile services, standard mobile handsets should be able to work seamlessly between both systems, and no tailoring should be required.

Economies of scale through the use of mobile handsets benefit both forms of D2D to some extent, but while D2D using MSS spectrum requires either proprietary standards or 3GPP Release 17+ handsets that are also designed to tune to specific satellite bands, D2D using mobile spectrum can use standard handsets. This will allow for D2D using IMT spectrum to become available both in recycled and second-hand handsets, as well as all new handsets including the most affordable ones.

04. Agreement with MNOs must be in place to use their licensed spectrum in the licensed area

Regulators should not grant separate licences to D2D operators for the same frequencies and areas as existing terrestrial licences. This would undermine the regulatory ecosystem currently supporting mobile terrestrial infrastructure investment and services for billions of consumers. Access to MNO spectrum for D2D should derive from the MNO licence rights, not any separate licence from the regulator.

As mentioned in Position 1. above, the MNO licensee must provide consent to the satellite operator via a lease agreement or similar commercial transaction. The D2D satellite entity will need satellite authorisations to operate their constellations but its rights of use of terrestrial MNO spectrum licences should derive from the rights of the MNO.

05. Ahead of WRC-27, interference needs to be addressed through domestic regulations

WRC-27 will endeavour to agree internationally harmonised parameters to ensure coexistence between terrestrial mobile and D2D services when using adjacent frequencies or using the same frequencies in adjacent areas. Where regulators plan to introduce D2D services soon, they may need to define specific national arrangements to authorise MNOs to share their spectrum with D2D satellite providers. Various schemes are available for authorising use of mobile devices to transmit to the satellites, including a licence exemption option, but authorisation of transmissions from satellite space stations to user devices may not currently be in scope of some national regulatory frameworks.

Where countries wish to provide a framework, regulations should ensure both the compatible operation of D2D in one spectrum block next to terrestrial mobile in the adjacent spectrum block, and that terrestrial mobile operating in one licensed geographic location is protected from D2D in a neighbouring licensed geographic location.

06. Any new MSS allocations at WRC-27 must protect IMT networks

WRC-27 aims to define internationally harmonised technical and regulatory provisions for D2D services operating in IMT bands under Agenda Item 1.13. Any new allocations to MSS that come about in bands identified for IMT must be on a secondary basis, so that MSS does not cause harmful interference to IMT networks, nor claim protection from them, in accordance with the Radio Regulations.

Local regulations developed ahead of WRC-27 may be revised in order to ensure that D2D services using mobile spectrum are harmonised as widely as possible.

D2D in mobile satellite (MSS) spectrum

07. Existing MSS regulations may allow D2D using MSS spectrum

Where in-country regulations allow the operation of D2D using MSS spectrum, technical and regulatory provisions to address possible interference already exist in the ITU Radio Regulations. In this case, satellite service providers must meet all eligibility and any other legal requirements of the national legislation of a given country. Some regulation may require updating (e.g. to include low-earth orbit satellite constellations) and same services, same rules regulation must always apply.

When using MSS spectrum, the licence holder will typically be an entity separate from the MNO (e.g. a specialised MSS satellite network operator (SNO)). The service will then operate under the technical requirements of the MSS spectrum licence.

As a result of this separate licensing regime, it may not be necessary for the SNO to enter into any partnership with the MNO. However, users may adopt services more seamlessly where SNOs enter into commercial partnerships with MNOs at a wholesale level rather than trying to compete with them in the retail market.

08. 3GPP specification is in place but handset availability remains low

3GPP completed the standardisation of several mobile satellite bands including the 1610-1626.5 × 2483-2500 MHz as band n254, 1626.5-1660.5 × 1525-1559 MHz band as n255, and 1980-2010 × 2170-2200 MHz as n256. 3GPP standardisation of the MSS bands was an important step forwards but does not guarantee that they will be included in mobile handsets (over 60 terrestrial 5G bands have been standardised by 3GPP, only a portion of which are commonly used in handsets).

As D2D develops, handsets may increasingly make use of n254, n255 and n256 in the future. As of today, these are limited to a small number of high-end models and handset availability is one of the issues that D2D using MSS spectrum needs to overcome before it is successful.

09. Any new MSS allocations at WRC-27 must protect IMT networks

WRC-27 will assess other bands for MSS. It contains two Agenda Items (1.12 and 1.14) that will consider additional allocations of spectrum to the mobile satellite service. The bands being considered under these two Agenda Items are:

- **1427-1432 MHz**
- 1645.5-1646.5 MHz
- **1880-1920 MHz**
- **2010-2025 MHz**
- **2120-2170 MHz**

All these bands except the 1645.5-1646.5 MHz band (i.e. all bands in bold) hold an IMT identification. As such any introduction of new mobile satellite services including D2D must protect the existing IMT identification in accordance with the Radio Regulations.

International coordination and the ITU

WRC-27 will look at various spectrum bands which are relevant to the provision of D2D services. IMT bands in the range 694 MHz to 2.7 GHz are being discussed under Agenda Item 1.13 with regard to a possible additional mobile satellite (MSS) allocation, along with technical measures to ensure coexistence with existing services when they are used to provide D2D services.

Meanwhile, Agenda Item 1.12 considers additional MSS spectrum in bands which overlap with IMT, and Agenda Item 1.14 also considers MSS in bands overlapping with IMT.

The band overlaps with Agenda Items 1.12, 1.13 and 1.14 will lead to complex work at WRC-27 to develop the best way to bring more flexible use options into this spectrum while ensuring interference is not caused to IMT use. These three Agenda Items cannot be considered in isolation and must be resolved in a complementary way.

It is important to coordinate among all these AIs for IMT protection and, subsequent to any WRC decision, impact assessments should be carried out at a national level before the introduction of new services in existing IMT bands.

Agenda Item	Intent	Spectrum
1.12	To find new spectrum for low data rate satellite IoT	— 1427-1432 MHz — 1645.5-1646.5 MHz — 1880-1920 MHz — 2010-2025 MHz
1.13	To harmonise conditions for use of D2D in mobile / IMT bands	— 694 MHz-2.7 GHz
1.14	To extend mobile satellite spectrum in bands which are currently identified for terrestrial mobile / IMT	Regions 1 and 3 — 2010-2025 MHz (Earth-to-space) — 2160-2170 MHz (space-to-Earth) All Regions — 2120-2160 MHz (space-to-Earth)

Agenda Item 1.12

Agenda Item 1.12 seeks to provide additional capacity for low-power satellite through additional MSS spectrum allocations. However, it seeks to do so largely in bands that are already widely used for mobile including the 1500 MHz, 1800 MHz and 2.1 GHz IMT bands.

1427-1432 MHz is globally identified for IMT as part of the wider 1500 MHz band (1427-1518 MHz). The bottom 5 MHz of the band that are being considered under Agenda Item 1.12 is less commonly used than the spectrum above 1432 MHz. However, equipment is in use that covers the whole band and there is an increasing number of countries using this spectrum for IMT. Adjacent-band compatibility issues also remain. These are both with mobile in the band above and other services, including sensitive Earth Exploration satellites that may be used for environmental monitoring, which exist immediately below 1427 MHz.

1645.5-1646.5 MHz is not a mobile band but the other spectrum being considered under Agenda Item 1.12 falls into the mobile 1800 MHz and 2.1 GHz bands which are heavily used for mobile globally.

Agenda Item 1.13

This Agenda Item considers spectrum which is allocated to the mobile service and has an IMT identification between 694 MHz and 2.7 GHz. The ITU is studying what technical and regulatory conditions are required to introduce connectivity from satellites directly to mobile handsets in those bands, alongside its existing terrestrial mobile use.

If this Agenda Item is successfully concluded, it can help facilitate the development of the D2D market by ensuring coexistence between terrestrial and satellite networks. It will give globally harmonised conditions for D2D using IMT spectrum to leverage the broad proliferation of existing IMT enabled devices. However, protection of existing IMT networks must be ensured by making any allocation to MSS secondary, ensuring it does not interfere with nor claim protection from primary services, coupled with technical limits and operational measures to protect IMT networks. These will be important factors in enabling consensus at WRC-27 and subsequently to rolling out large scale D2D services.

Agenda Item 1.14

Agenda Item 1.14 may provide more capacity for mobile satellite spectrum and considers bands which overlap with both AI 1.12 and AI 1.13. This represents a risk of regulatory fragmentation, where there is potential for conflicting or contradictory regulations, given that the bands are under consideration in three separate Agenda Items.

The frequency band 2010-2025 MHz is used for mobile in some countries in EMEA and APAC. The frequency bands 1920-1980 MHz / 2110-2170 MHz and 1710-1780 MHz / 2110-2180 MHz are widely used for mobile with extensive deployments globally. This spectrum is heavily used for mobile throughout the world. In some countries, portions of these bands are also used for critical railway safety.

GSMA Head Office
One Angel Lane
London, U.K.
EC4R 3AB
United Kingdom
gsma.com