GSOA
GLOBAL SATELLITE OPERATORS ASSOCIATION

Satellite Direct-to-Device Connectivity

Bringing Connectivity to Everyone, Everywhere, Anytime

In today's always-connected world, satellite communications are key to enable access to fast, flexible and secure connectivity whilst on the move, anytime, anywhere.

Global Challenges | Satellite Answers

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Overview

The world is increasingly interconnected, as digital devices have become an integral part of our daily lives. From making phone calls, to having access to education, healthcare, financial services, or entertainment, and in times of emergencies, all of these applications come with the expectation that we are always connected. For decades, satellite networks operating in mobile satellite service allocated bands have provided ubiquitous global connectivity to users on land, sea, and in the air.

Significant portions of the world rely on satellite connectivity as they have little to no ground-based infrastructure that provides terrestrial coverage to them. In the Americas, for example, 22% of the rural population is not covered by any terrestrial mobile signal, while an additional 5% only have access to a 2G network—meaning that 27% of that population is unable to access the Internet. In Africa, this figure is up to 29%, with 15% without coverage whatsoever and 14% who only have 2G network.[1] Even in well-connected countries, terrestrial coverage can be spotty in rural and remote areas, or in case of emergencies and disaster relief, connectivity may be disrupted even in urban areas. For terrestrial mobile network operators, the economics of providing ubiquitous coverage in their service area may not be viable when using traditional terrestrial means.

However, we are at an exciting time in the development of satellite Direct-to-Device connectivity (D2D) to smartphones and other digital devices, such as the Internet of Things (IoT), which have resulted in a paradigm shift in connectivity.

To address this new market, some early solutions providing limited services (e.g., SMS) are currently being developed:

- Multiple consumer mobile devices, including iOS (Apple), Android, and IoT devices, implement necessary satellite features enabling access to satellite networks based on existing in orbit space segments
- Additionally, some providers of D2D are developing new space segment and specific network infrastructure operating in spectrum allocated to the mobile service that would be able to address pre-Release-17 3GPP compliant consumer mobile devices

1 : Facts and Figures 2022 – Mobile network coverage (itu.int)

Recent and ongoing standardization activities at 3GPP on Non-Terrestrial Network services[2] have included satellite as a key part of 5G systems in 3GPP Release 17 and beyond. This standard enables the 5G system to support any satellite networks, including the provision of wideband services directly to handheld devices/smartphones. It also leverages the economies of scale of the mobile industry that comes with being included in the 3GPP ecosystem. EchoStar, Intelsat, Omnispace, Viasat, and others are planning to leverage this 3GPP defined NTN standard to provide wideband services to consumers' mobile devices. These mass-market smartphones and IoT devices will be able to connect seamlessly with terrestrial mobile networks and/or with NTN based satellite networks when out of range of terrestrial connectivity. This will ensure that connectivity will be available to anyone, anywhere in the world.

Enabling Satellite D2D

Satellite D2D is being deployed and further advanced as standards mature and evolve. To allow satellite D2D to reach its potential, it is critical that regulators consider the following key aspects that are necessary to ensure the development of a competitive satellite D2D marketplace.

› A Flexible Regulatory Framework that Enables Competition

Regulators must adopt regulatory regimes that are flexible, which allow for the development of a competitive marketplace. Examples of flexible regulatory frameworks include technology neutrality, open skies policies, streamlined licensing regime with reasonable spectrum fees, and mutual recognition of homologation and type approval of devices. Existing regulatory frameworks do not contemplate some of the varieties of D2D services planned and offered today and a new regulatory framework would need to be defined.

› Globally Harmonized Spectrum

Irrespective of the regulatory framework under which satellite D2D connectivity is provided, access to harmonized spectrum is a foundational requirement. To meet the expected growing demands for this service, sufficient spectrum must be safeguarded and made available to accommodate the expected large numbers of end users' devices.

2 : Non-terrestrial network (NTN) refers to a Radio Access Network, which provides non-terrestrial access with 5G New Radio (NR), 4G NB-IoT or 4G eMTC radio interfaces to User Equipment by means of an NTN payload embarked on an airborne or space-borne NTN vehicle and an NTN Gateway (see 3GPP TS 38.300). The underlying technology, maturity, deployment model, and commercial timelines of a given NTN will vary.

Foster Global and Open Standards

This will enable multi-vendor interoperability and develop a worldwide market promoting economies of scale. As part of its Release 17 on NTN, 3GPP published standards now include the necessary requirements for satellite operations in the S- and L-bands within its 5G standards. This work is continuing in Releases 18, 19, and beyond with the introduction of additional frequency bands (e.g., Ka- and Ku-bands) and features that enable additional use cases and increased service performance. These efforts are supported by governments, vertical stakeholders, and the telecommunication industry (both terrestrial and NTN) around the globe and is integrated into the International Telecommunication Union's (ITU's) work streams as appropriate.

Spectrum Certainty

To meet the expected demands for satellite direct connectivity to devices, current international and domestic allocations (including the Mobile Satellite Service) are insufficient considering the increasing demand for services, including the need for higher throughput. Regulators should protect existing satellite spectrum and prioritize allocating additional harmonized spectrum to the maximum extent at a worldwide level for Mobile and Fixed Satellite Services (MSS and FSS) at upcoming World Radiocommunication Conferences to ensure connectivity for all.

Transparent and Rational Licensing Regime

While having access to spectrum is important, governments must also ensure that satellite licensing rules for satellite direct connectivity are in place, transparent, and streamlined. This includes ensuring that spectrum is available using administrative processes for MSS operations. The use of classic auctions, given the global nature of satellite networks, would prevent affordable services and/or render the space network infrastructure costs unsustainable, essentially stopping innovation.

Where we are today

The emergence of satellite integration in the 3GPP ecosystem is the result of a joint effort between mobile and satellite industry stakeholders, along with strong support from verticals, such as automotive, transport, public safety, media/entertainment, agriculture, and others. The 3GPP defined NTN standard supports seamless interoperability across terrestrial and NTN components. This standard creates the opportunity for the addition of the satellite network component in the 5G New Radio (NR) systems, delivering the promise of a ubiquitous mobile system that can support the "Anywhere, Anytime, Any Device" (AWATAD) objective. Furthermore, it paves the way towards 6G with the native inclusion of the satellite component.

When defining a frequency band for NTN, 3GPP defines the Radio Frequency parameters and characteristics of the satellite access node and user equipment.

Table. NTN operating bands in FR1- NTN

NTN Operating Band	Uplink (UL) Operating Band SAN Receive / UE Transmit FUL,low – FUL,high	Downlink (DL) Operating Band SAN 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 MHz – 1626.5 MHz	2483.5 MHz – 2500 MHz	FDD

The frequency bands n256 (MSS allocated S-band) and n255 (MSS allocated L-band) have been defined as part of the 3GPP Release 17, while some other bands are being defined as part of Release 18.

The definition of current and additional frequency bands in the 3GPP standards allows for the creation of a global market for satellite enabled user equipment with an economy of scale similar to the mobile industry.

On the regulatory front, regulators are still grappling with how to deal with providers who propose to use mobile service allocated spectrum rather than the traditional MSS spectrum for D2D services. The ITU has also highlighted regulatory considerations, including those associated with harmful interference, that need to be addressed when using mobile service frequencies by satellite systems.

Conclusion

Satellite D2D is and will continue to contribute to bridging the digital divide, while improving users' safety of life and opening new horizons for connecting everyone. The result is bringing meaningful connectivity to consumers, increased digitalization of services for governments, and new business opportunities for enterprises.

The continued development of the global 3GPP defined NTN standard, coupled with a regulatory regime that is transparent, safeguards existing spectrum and enables access to additional harmonized spectrum at a worldwide level, will ensure that affordable D2D services are available to all.

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