



# Boeing Satellite Innovations and Broadband NGSO Vision

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# The Boeing Company – What We Do



- **Celebrating 100 years of leading innovation in aircraft and spacecraft technology**
- **Design, manufacture and support commercial jetliners**
- **Design and manufacture satellites and provide launch services, e.g. launch, operation:**
  - World's largest provider of satellites
  - Major service provider to NASA and prime contractor for the International Space Station
  - Integrate and support large-scale commercial and government satellite systems
- **Leading developer of innovative aerospace and satellite technologies**
- **More than 159,000 Boeing employees across the United States and in more than 65 countries**
- **Products and services support customers in 150 countries**



# Boeing's GSO Satellite Legacy

**Boeing has designed and manufactured GSO satellites for more than 20 nations and/or companies in those nations**

- GSO networks are the backbone of the satellite industry and Boeing business
- Boeing will protect the robust and effective operation of GSO networks
- NGSO systems can contribute significantly to the future of the satellite industry and help deliver global broadband services

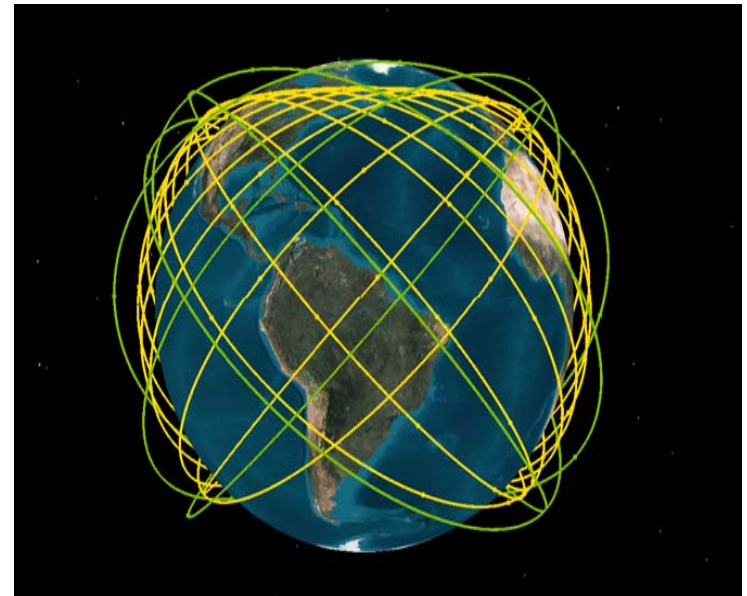


# Next Generation NGSO Broadband Vision



## NGSO global broadband communications serve users worldwide

- Uses Boeing innovative spacecraft technology designs to provide global broadband
- Can provide a variety of affordable advanced communications services including broadband data access, multimedia conferencing, video streaming, distance learning and medicine, IP voice and other applications to all users
- Enhances spectrum efficiency using next-generation satellite and earth station technology, and by intensively reusing existing satellite spectrum.



# NGSO Global Broadband Vision

- **Technological advances bring within reach the benefits of global broadband services using NGSO satellites**
  - Significant progress in satellite design and launch capabilities
  - Advances in technology enable mass-produced low-cost, satellite-tracking user terminals
  - Advances in satellite technology allow for efficient sharing of FSS spectrum between NGSO satellite systems and other services including GSO satellite systems
- **NGSO systems could efficiently use existing FSS spectrum to make new services available globally and deliver broadband to unserved and underserved locations and consumer groups**
- **Provisions in the Radio Regulations were developed based on previous generations of NGSO operations and technologies**
- **WRC-19 has the opportunity to update the regulatory provisions to enable new NGSO systems to deliver global broadband services while protecting GSO networks and other primary services**
- **This affords great potential to significantly reduce the digital divide and substantially improve use of spectrum and orbit resources.**

# ITU-R Activities on NGSO Broadband Satellite Services

- WRC-15 established Agenda Item 1.6 and Issue 9.1.3 of Agenda Item 9.1 with a view to study a range of issues associated with the development of technical and regulatory frameworks for these next-generation NGSO FSS systems.
- ITU-R Working Party 4A is the responsible working group for these Agenda Items
- **Agenda Item 9.1, Issue 9.1.3** seeks to enable new NGSO systems using circular orbits in C-band (3 700-4 200 MHz, 4 500-4 800 MHz, 5 925-6 425 MHz and 6 725-7 025 MHz)
- **Agenda Item 1.6** seeks to develop a regulatory framework to allow NGSO systems to operate efficiently in the V-band (37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz, and 50.4-51.4 GHz)
- ITU-R Working Party 4A has initiated studies on both Agenda Items, including adoption of Work Plans that provide milestones to complete the necessary work in advance of WRC-19.

# WRC-19 Agenda Item 9.1, Issue 9.1.3

- **Considers regulatory limits for operations of NGSO systems in C-band; 3700-4200 MHz, 4500-4800 MHz, 5925-6425 MHz, 6725-7025 MHz, while protecting GSO networks and other primary services**
  - C-band EPFD limits based on studies of HEO systems and worst-case assumptions resulting in overestimation of interference
  - Only considered Highly Elliptical Orbit (HEO) system designs and thus limits are not appropriate for other NGSO designs.
  - Result was C-band EPFD limits that are unnecessarily stringent for circular orbit NGSO systems
- **New NGSO systems using other orbital configurations should be accommodated**
  - Circular NGSO orbits were not studied in establishing C-band EPFD limits.
  - Circular NGSO orbits have significantly different operational parameters that can share spectrum more efficiently than HEO type orbits
  - Additional studies are required to establish C-band EPFD limits to adequately protect terrestrial and GSO operations while facilitating the introduction of new NGSO systems.
- **Contributions to WP4A seek to start work on sharing studies between the different services and circular-orbit NGSO systems since these types of studies were never completed in the C-band**

# WRC-19 Agenda Item 1.6

- **Seeks to develop a regulatory framework to facilitate efficient operation of NGSO FSS systems in the V-band; 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz, and 50.4-51.4 GHz**
  - There are currently no regulatory provisions for sharing between NGSO satellite systems and GSO networks in the V-band
  - The opportunity exists in the V-band for a sharing regime that enables efficient NGSO operations
  - Work is currently being undertaken in ITU-R Working Party 4A to define protection criteria and operational parameters for V-band satellite operations.
- **Contributions to WP4A meeting in September present:**
  - An overview of how aggregate EPFD curves are generated for frequency bands below 30 GHz
  - Describes propagation characteristics that affects FSS operations in the 50/40 GHz band
  - Discussions on methods to develop sharing in the V-band and operational considerations of each method to enable sharing that will maximize the opportunity for equitable co-frequency operation of NGSO systems while protecting GSO operations
  - Establish aggregate NGSO interference limits (EPFD limits or an alternative) for an agreed set of GSO reference links that will enable both NGSO systems and GSO networks to provide high-quality fixed-satellite services based on V-band propagation characteristics
  - Apportion the maximum allowable aggregate NGSO interference (e.g. aggregate EPFD limits) commensurate with the services provided by each NGSO system



# Agenda Item 9.1, Issue 9.1.9

- WRC-15 Resolution 162 (WRC-15), invites administrations to participate in the studies of spectrum needs for the development of the fixed-satellite service in the frequency band 51.4-52.4
- The sharing studies under this agenda item are limited to GSO feeder links but resolves 1 is focused on spectrum needs for all of FSS
- It is important that NGSO systems should be a part of the conversation on FSS spectrum needs as NGSO could help to provide worldwide broadband to all users

# Sharing considerations between GSO and NGSQ in bands above 30 GHz

- **ITU-R S.1323 is the recommendation that governs sharing criteria and protection margins between NGSQ and GSO FSS**
  - The recommendation currently only goes up to 30 GHz
  - For AI 1.6 and AI 9.1.9, we need to update the recommendation for bands in the 50/40 GHz (V-band)
- **Major issue for V-band sharing in ITU-R S.1323 is propagation**
  - Current sharing is based on propagation considerations for bands below 30 GHz
  - Current sharing methodology does not account for cloud loss
  - Current sharing methodology does not account for power control for the interferer
- **Contribution to September WP4A meetings proposes changes to Recommendation ITU-R S.1323 in order to produce sharing studies under WRC-19 AI 1.6 and 9.1.9 for bands above 30 GHz**

# Conclusions

- Next-generation broadband NGSO satellites have the ability to bridge the broadband gap through their inherent ability to deliver advanced communications services to all users regardless of location
- Recent technological advancements in satellite and user terminal technology can foster this use, enhance spectrum efficiency, increase broadband competition, and facilitate the deployment of broadband services to all regions of the world, including the most unserved and underserved regions.
- Global spectrum efficiency can be significantly enhanced by developing regulatory provisions to facilitate operation of NGSO FSS systems in C-band and V-band, while ensuring protection for GSO networks and other primary services in FSS frequency bands.
- Studies are underway within ITU-R WP4A to enable these next generation NGSO networks and promote more equitable sharing between GSO and NGSO FSS networks

# Boeing Application to the FCC for the Launch and Operations of a Global NGSO Broadband System

- Boeing seeks to leverage its expertise in aerospace and satellite technologies to develop innovative systems that efficiently deliver these new communications applications.
- With its vision for global broadband communications, The Boeing Company filed an application with the United States Federal Communication Commission (FCC) in June, 2016 for authority to launch and operate its global broadband system
- The application describes the benefits of operating a NGSO system to provide new competition, enable new technology, and introduce new efficiencies into the market for FCC
- Designing concepts for a broadband system is a natural evolution and extension of our more than 50 years of experience designing and manufacturing complex satellite systems, coupled with our ability to integrate advanced technologies in networked communications
- Filing of this application is the first step in realizing the vision of a true global broadband system that can enable advanced communications services including low latency broadband data access, multimedia conferencing, video streaming, distance learning and medicine, IP voice and other applications to all users
- Applications for licenses to operate and deliver service will be sought from other administrations in the future.

