Presentations by Eminent Speakers

1) Jitendra Singh, Head Government Affairs, Qualcomm (India) & Head Spectrum Strategy, Qualcomm (APAC)
2) Nandan Patel, Sr. Director (Regulatory Affairs), Viasat
3) Harsimranjit Gill, Country Manager, Intelsat India

07-08-2024

Qualcomm

August 7th, 2024

5G from space:
The final frontier for global connectivity

Jitendra Singh

Qualcomm

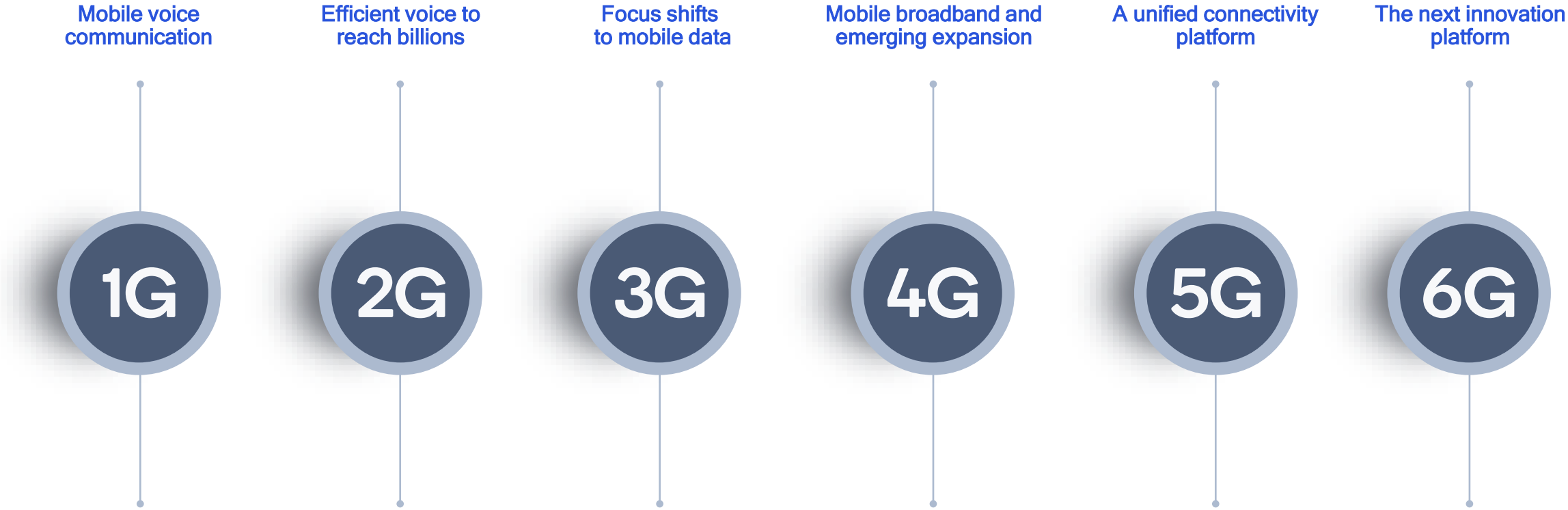
Agenda

The 3GPP 5G non-terrestrial networking (NTN)

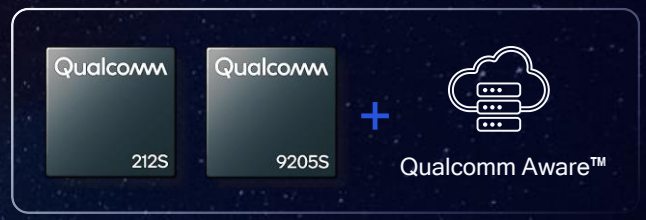
WRC-27 Mobile Satellite Agenda Items
(1.12, 1.13 & 1.14)

5G IoT-NTN solutions and management platform
from Qualcomm Technologies

Mobile has made a leap every ~10 years



A long history of innovation in satellite communication



1988 OmniTRACS

Two-way data communication with OmniTRACS and Qualcomm two-satellite positioning for pre-GPS fleet management

1991 Globalstar

Globalstar joint venture with Loral Space & Communications formed in 1991. First public satellite call in 1998.

2015 OneWeb

Co-developed technologies for the OneWeb satellite constellation, including a new, high-performance wireless air interface, hardware and software reference designs, and end-to-end system analysis and optimization

2023 5G IoT-NTN

Launched new 5G IoT-NTN satellite solutions in collaboration with Skylo to provide uninterrupted remote monitoring and asset tracking. Seamlessly integrates with Qualcomm Aware™ Platform for device management and more accurate tracking.

5G NTN

IMT-2020-Sat candidate technologies

Support a broad range of use cases with 5G non-terrestrial networking

5G Advanced will further enhance the non-terrestrial networks (NTN) foundation

5G NR-NTN

Complementing terrestrial networks in underserved areas

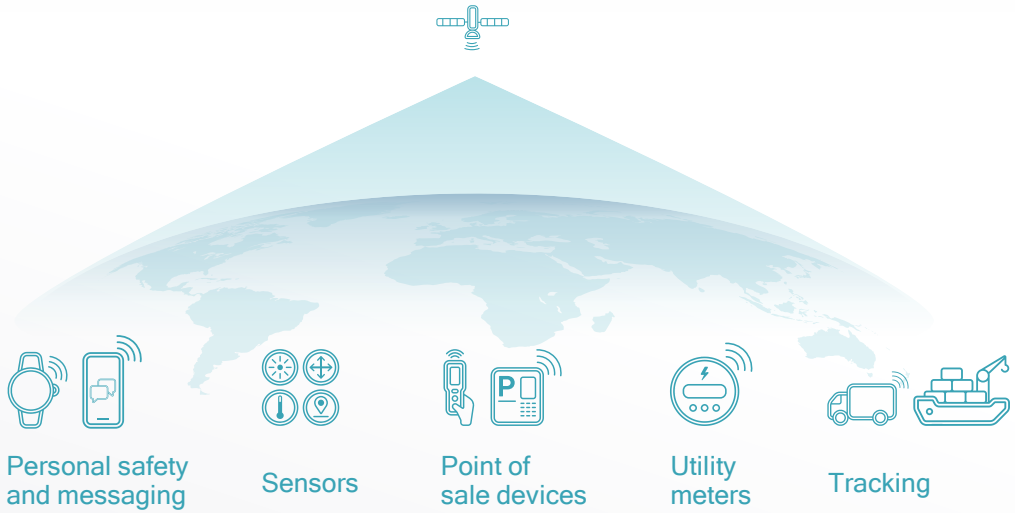
Rel-17+ NR-NTN
GEO / MEO / LEO

Mobile broadband | Automotive | Mobile compute | Satellite backhaul | Fixed wireless access

5G IoT-NTN

Expanding addressable market for the 5G massive IoT

Rel-17+ NB-IoT
GEO / MEO / LEO



Personal safety and messaging | Sensors | Point of sale devices | Utility meters | Tracking

Leveraging cellular for non-terrestrial communication

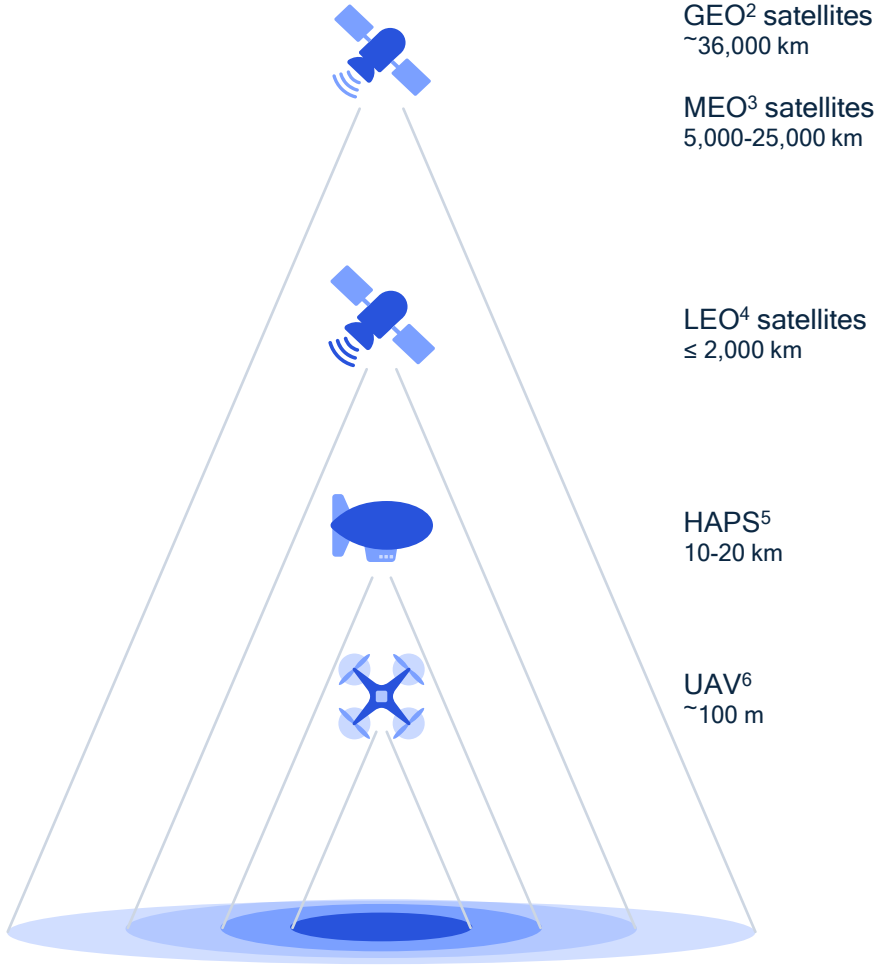
5G Rel-15
Study focused on deployment scenarios and channel models

5G Rel-16
Study focused on adapting 5G NR to support NTN

5G Rel-17
Projects focused on satellites for eMBB & IoT[1] and HAPS/UAV

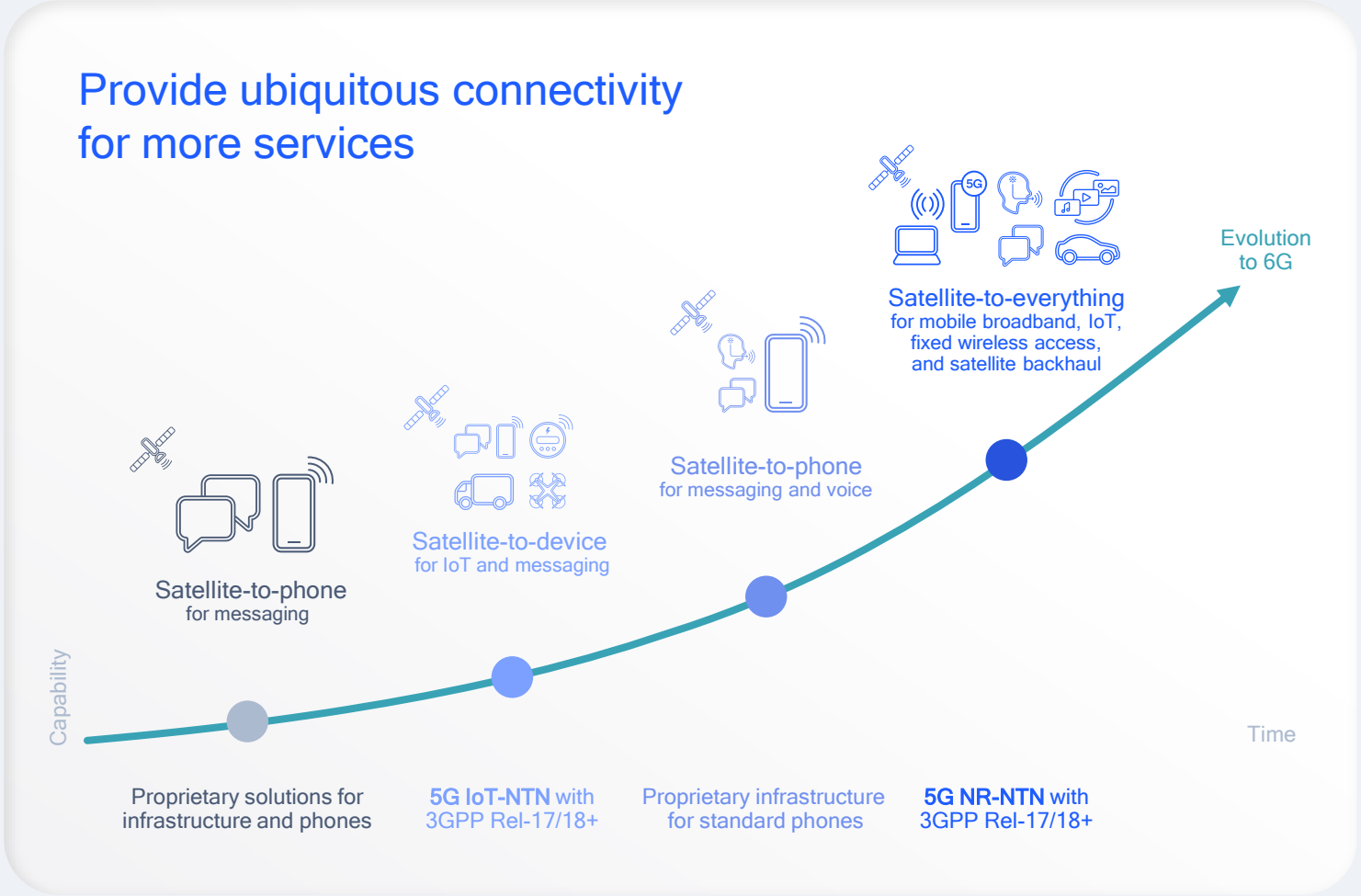
5G Rel-18+
Further enhancements for UAV, HAPS, and satellites

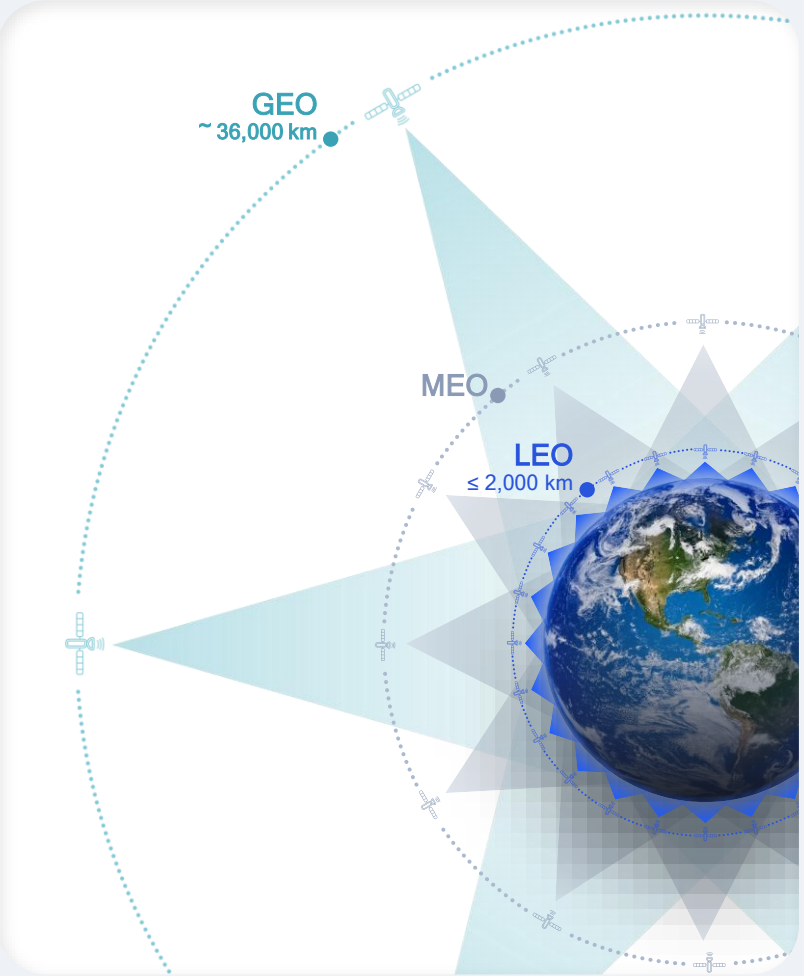
6G
Continued evolution of 5G NTN & NTN IOT into the 6G era, depending on ecosystem status at that time



1 eMTC and NB-IoT; 2 Geostationary; 3 Medium Earth Orbit; 4 Low Earth Orbit;
5 Unmanned Aerial Vehicles; 6 High Altitude Platform Station;

5G NTN brings new efficiencies for a broad range of use cases

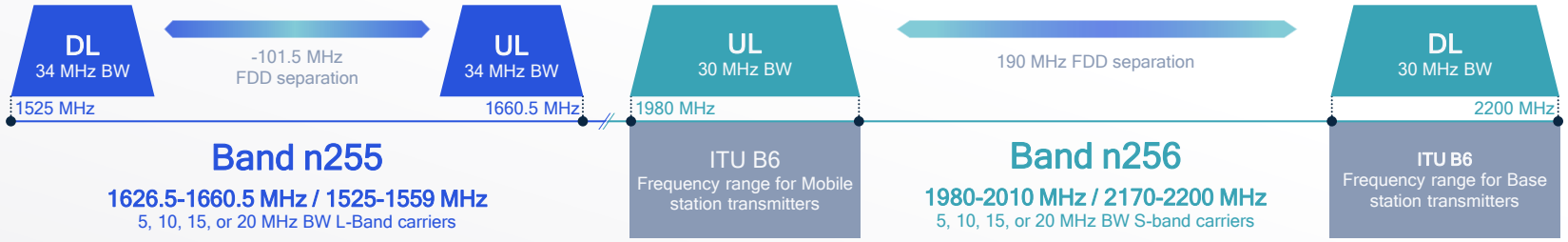




Leverage a global NTN ecosystem

with 3GPP standardized frequency bands

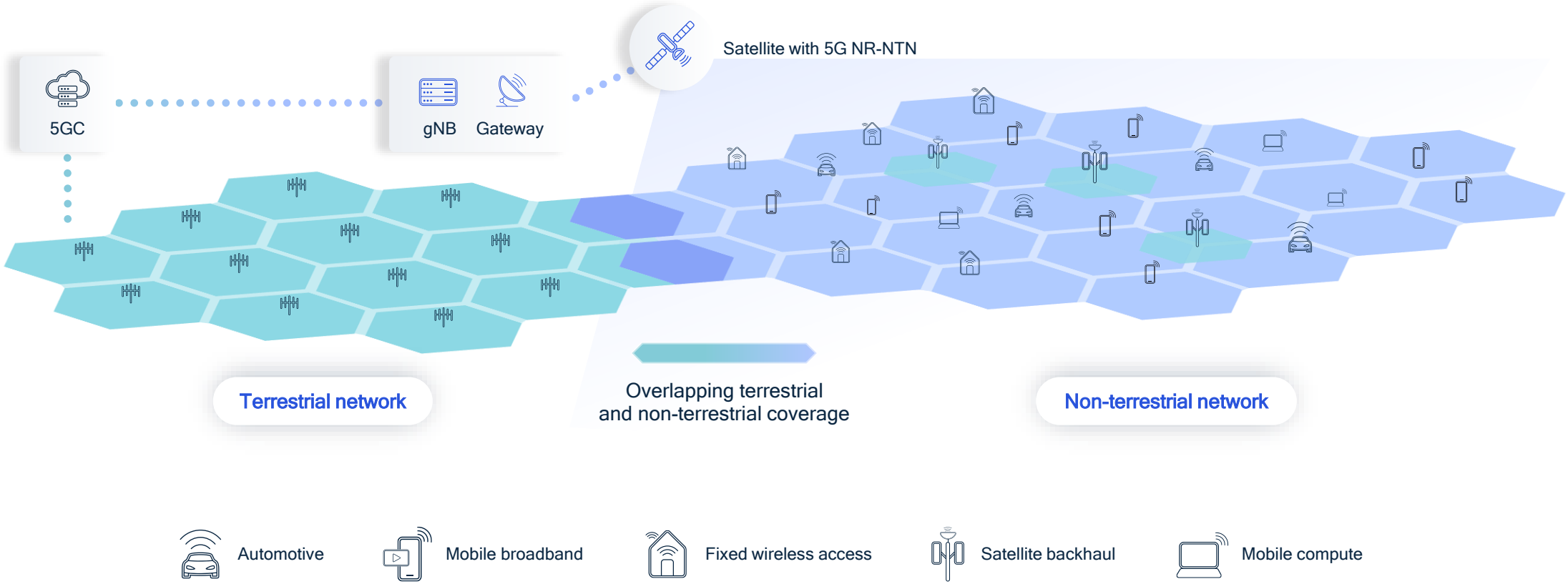
FR1 FDD frequency bands for 5G NTN in 3GPP Release 17



FDD frequency band candidates > 10 GHz for 5G NTN in 3GPP Release 18*

* Reference: R4-2220239 WF for above 10GHz band definition and system parameters_v8

Unlock new revenues in underserved areas with 5G NR-NTN



Improve customer experience with seamless 5G coverage across larger footprints by integrating terrestrial and non-terrestrial networks

WRC-27 Mobile Satellite Service Agenda Items

- Triggered by the ubiquitous connectivity goal of UN sustainable development, there is growing demand for mobile satellite service.

WP 4C leads
WP 5D,4B and others contribute

WRC-27 AI1.12
MSS allocation for Low-data-rate NGSO mobile satellite system

Frequency bands:
1 427-1 432 MHz (s-to-E),
1 645.5-1 646.5 MHz (s-to-E) (E-to-s),
1 880-1 920 MHz (s-to-E) (E-to-s),
2 010-2 025 MHz (s-to-E) (E-to-s)

Potential Technology:
3GPP IoT NTN
Proprietary satellite access tech

WP 4C leads
WP 5D,4B and others contribute

WRC-27 AI1.13
MSS allocation in IMT bands for direct connectivity to complement the terrestrial IMT network coverage

Frequency bands:
the frequency bands between 694/698 MHz to 2700 MHz range with terrestrial IMT deployment in M.1036

Potential Technology:
3GPP LTE, 5G NR
3GPP LTE NTN, NR NTN

WP 4C leads
WP 5D,4B and others contribute

WRC-27 AI1.14
Additional allocation to mobile satellite system

Frequency bands:
2 010-2 025 MHz (E-to-s) in R1&R3
2 160-2 170 MHz (s-to-E) in R1&R3
2 120-2 160 MHz (s-to-E)

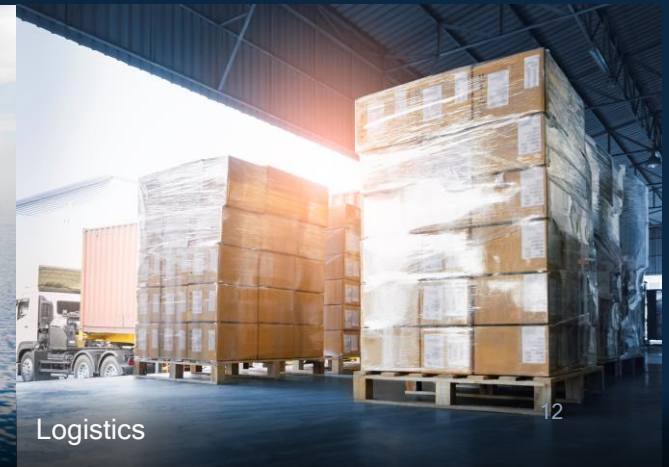
Potential Technology:
3GPP NR NTN
Proprietary satellite access tech

WRC-27 Agenda Item 1.13

Resolution 253 (WRC-23)

- Progress in ITU-R WP 4C
  - Preliminary discussion on the work plan of WRC-27 AI1.13
  - Decided to study IMT frequency arrangements addressed in the most recent version of Recommendation ITU-R M.1036 between 694/698 MHz and 2.7 GHz
  - Sent out LS to request for the characteristic of incumbent services in April of 2024
- Progress in ITU-R WP 5D
  - WP 5D is expected to provide studies which include regulatory considerations on the protection of terrestrial component of IMT.
  - Expected joint topics for WP4C and WP5D meeting in October
    - Concept of operations (e.g. description and functionality)
    - How to ensure that the envisaged satellite systems do not cause harmful interference, or claim protection, from terrestrial IMT
    - Frequency arrangements consistent with terrestrial IMT operations.
    - Terminology.
    - TDD operations.
    - Other matters and relevant issues, if any (e.g. MMSS).

Qualcomm® 212S and Qualcomm® 9205S modems are IoT-NTN solutions that easily establish off-grid connectivity for stationary and in-transit industrial uses cost-effectively at low power



Qualcomm Technologies products power ubiquitous IoT connectivity

5G IoT-NTN solutions based on 3GPP Release 17 (GEO/GSO only) for 3GPP NTN frequency bands

Qualcomm® 212S

- Ultra low-power consumption enabling multi-year operation in remote areas with the help of solar panels and super capacitors
- Can be attached to SOC or MCU host as a peripheral to provide satellite connectivity. Location provided by host
- No GNSS support necessary for standalone deployments, eliminating additional BOM costs
- Single mode NTN enables off-grid stationary or nomadic applications
- Module with NTN patch antenna to accelerate integration for variety of IoT use cases

Qualcomm® 9205S

- Low power wide area (CAT-M/NB-IoT) support with 2G for terrestrial network connectivity and superior mobility
- Highly capable applications processor and peripheral support to enable hub type of use cases
- Integrated GNSS to provide location for NTN connectivity
- Ideally suited for hybrid use case applications that require mobility between terrestrial and satellite networks
- Small 60mm x 60mm reference card provides flexibility to design form factors to address variety of IoT applications

Establish off-grid connectivity for stationary and in-transit industrial uses cost-effectively at low power with 5G IoT-NTN solutions

Thank you

Qualcomm

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India SatCom 2024

Spectrum and technical issues in Satcom

Government policy enablers for satellite services

Spectrum access for satellite services


ETPrime
TECH & INTERNET

Satellite launch market grim, need to create internal demand: ISRO chairman S Somanath

Agencies

Synopsis

ISRO chairman S Somanath stresses the need to create internal demand for rockets, referencing PSLVs, SpaceX, and Blue Origin's strategies.

"We would like to find orbital slots and frequencies which can be given to industry to build satellites and launchers."

Ensuring satellite services are not degraded or blocked

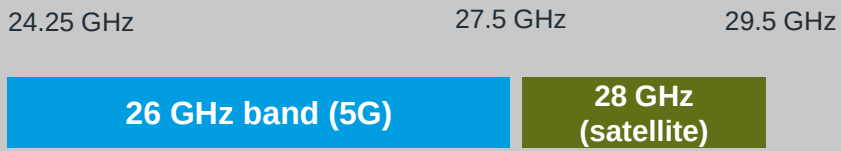
"We believe that the protection offered under Article 22 to GSO network from NGSO **doesn't need to be revised** and **the ongoing work on the quantification about the modelling aspects should be studied** at a different level. So **we are not in favour of any study in the next cycle for Article 22 revision**."

Viasat

Spectrum access for satellite broadband

- 5G industry has exclusive access to the entire 26 GHz band (3.25 GHz of bandwidth). Plus enjoy exclusive access to higher bands above 30 GHz and multiple bands below 10 GHz. No country has rolled out national 5G networks in 28 GHz successfully. Multiple substitute bands.
- Satellite spectrum use is not exclusive, it is shared globally. Satellite needs access to the 28 GHz band. No substitute bands.
- Satellite service providers will not replace 5G terrestrial operators. But will simply complement their coverage to achieve full national connectivity. Satellite has few bands to connect the underserved areas. Satellite will also connect users in mobility with this same spectrum across land, sea, and air.
- India depends on spectrum access for satellite broadband to achieve national broadband objectives.

We propose:



Good outcome would be: '3Rs'

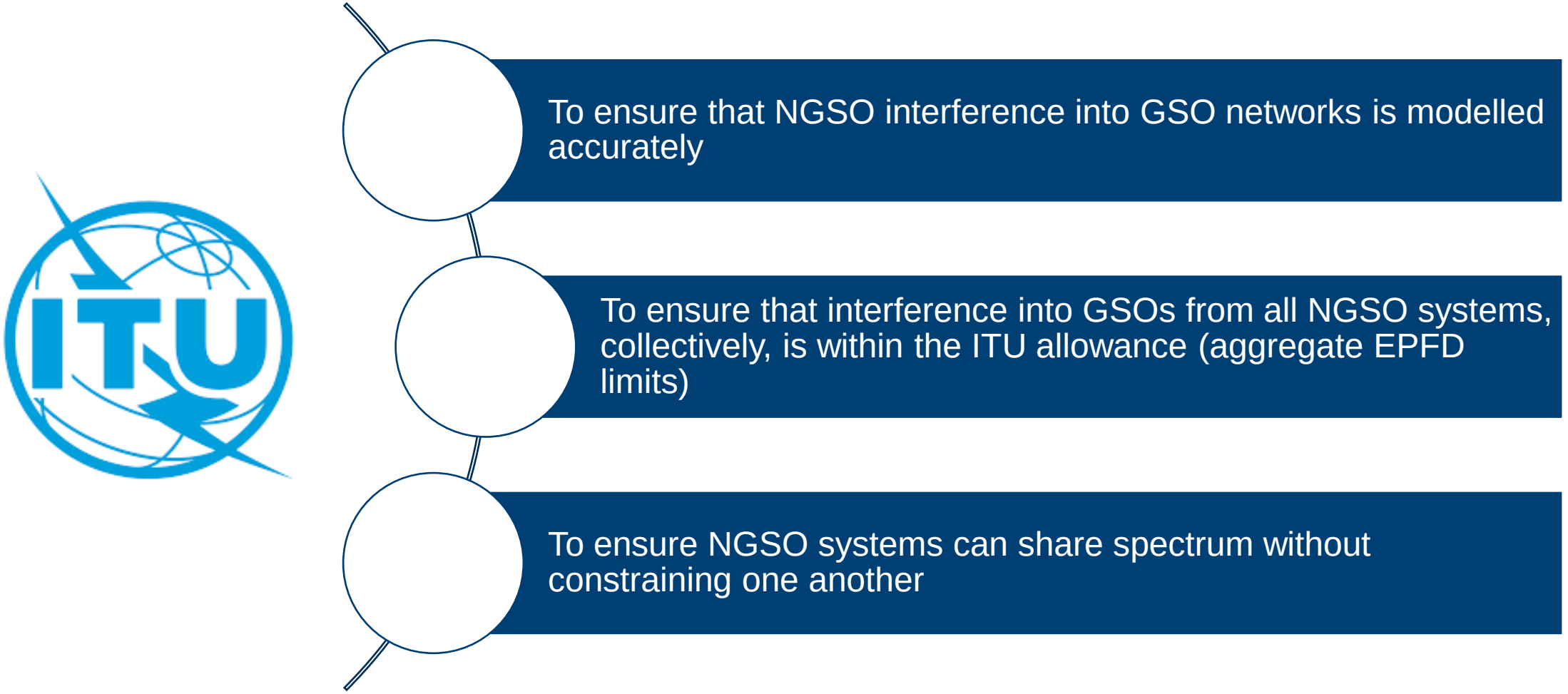
- ✓ **Right spectrum**
- ✓ **Right amount**
- ✓ **Right conditions of use**

Viasat

Spectrum access for GSO and NGSO systems - Technical Issues

Viasat

ITU focus – Managing adverse effects of mega-constellations



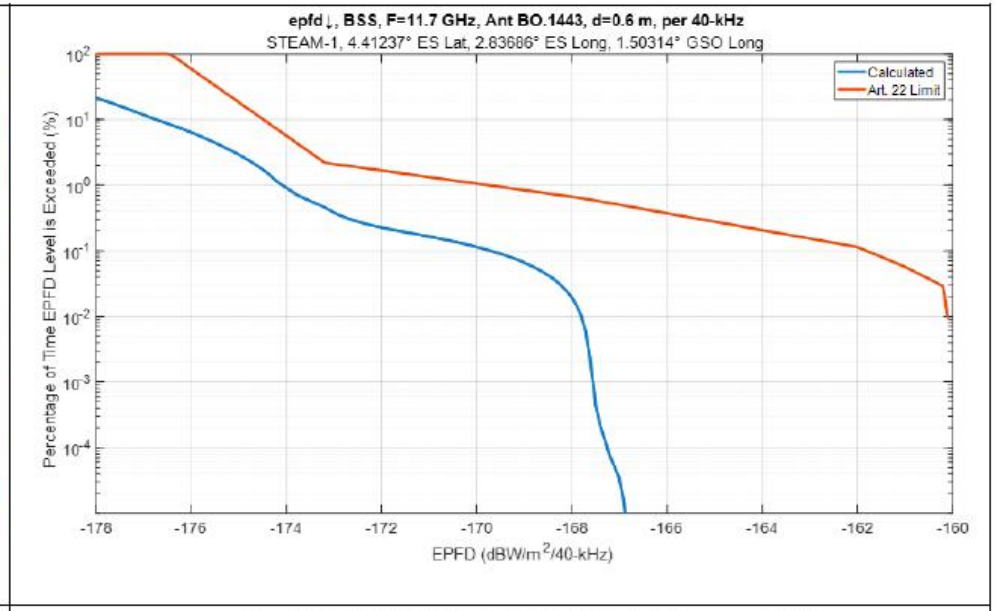
ITU prohibits “unacceptable interference” from NGSOs to GSOs through power density limits.

India has significant sovereign GSO systems

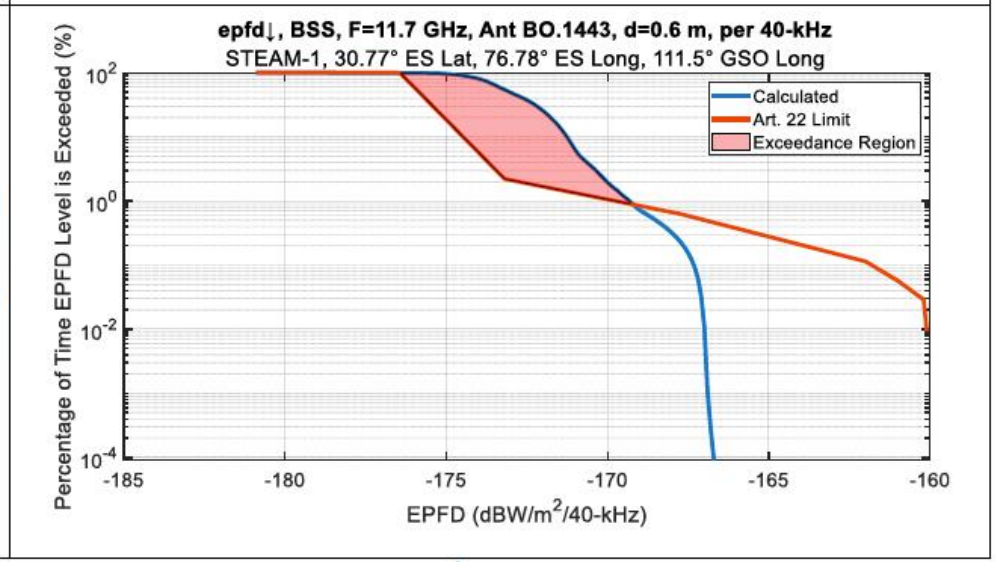
Viasat

Failures of ITU software to identify NGSO EPFD limit exceedances

WCG (ES: 4.41°N, 2.84°E, GSO: 1.50°E)

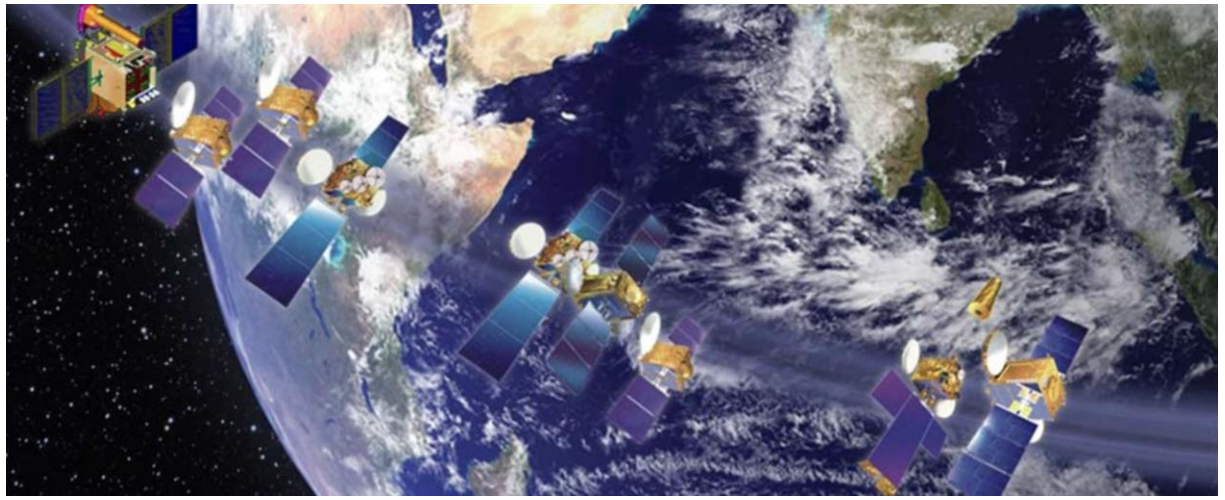


Chandigarh, India



Viasat

Impact

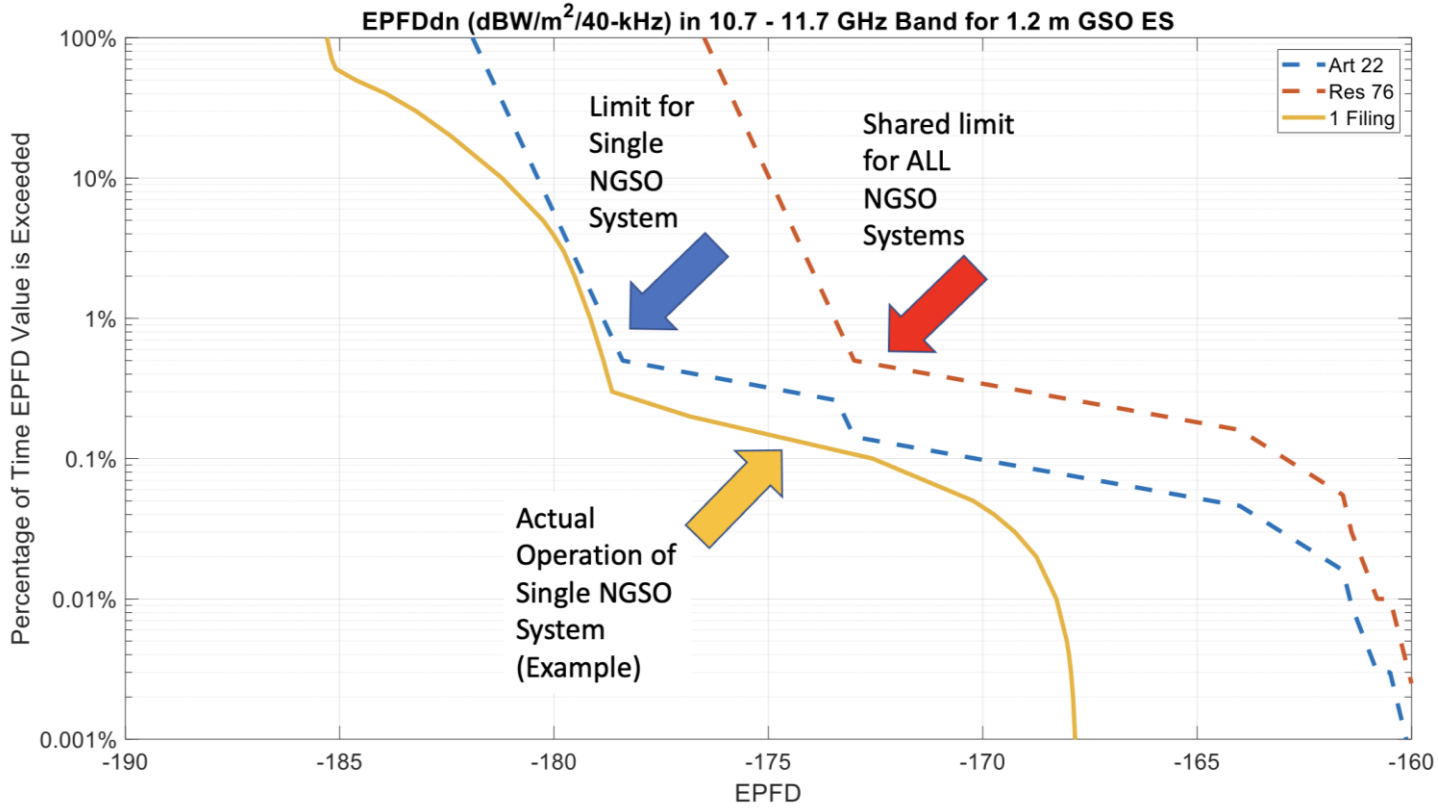


India Sovereign GSO satellite services

- Telecommunication
- Television broadcasting
- Satellite news gathering
- Societal applications – healthcare, education etc
- Weather forecasting
- Disaster management, search and rescue operations
- Defense

Ensuring equitable share of aggregate EPFD limits for all NGSOs

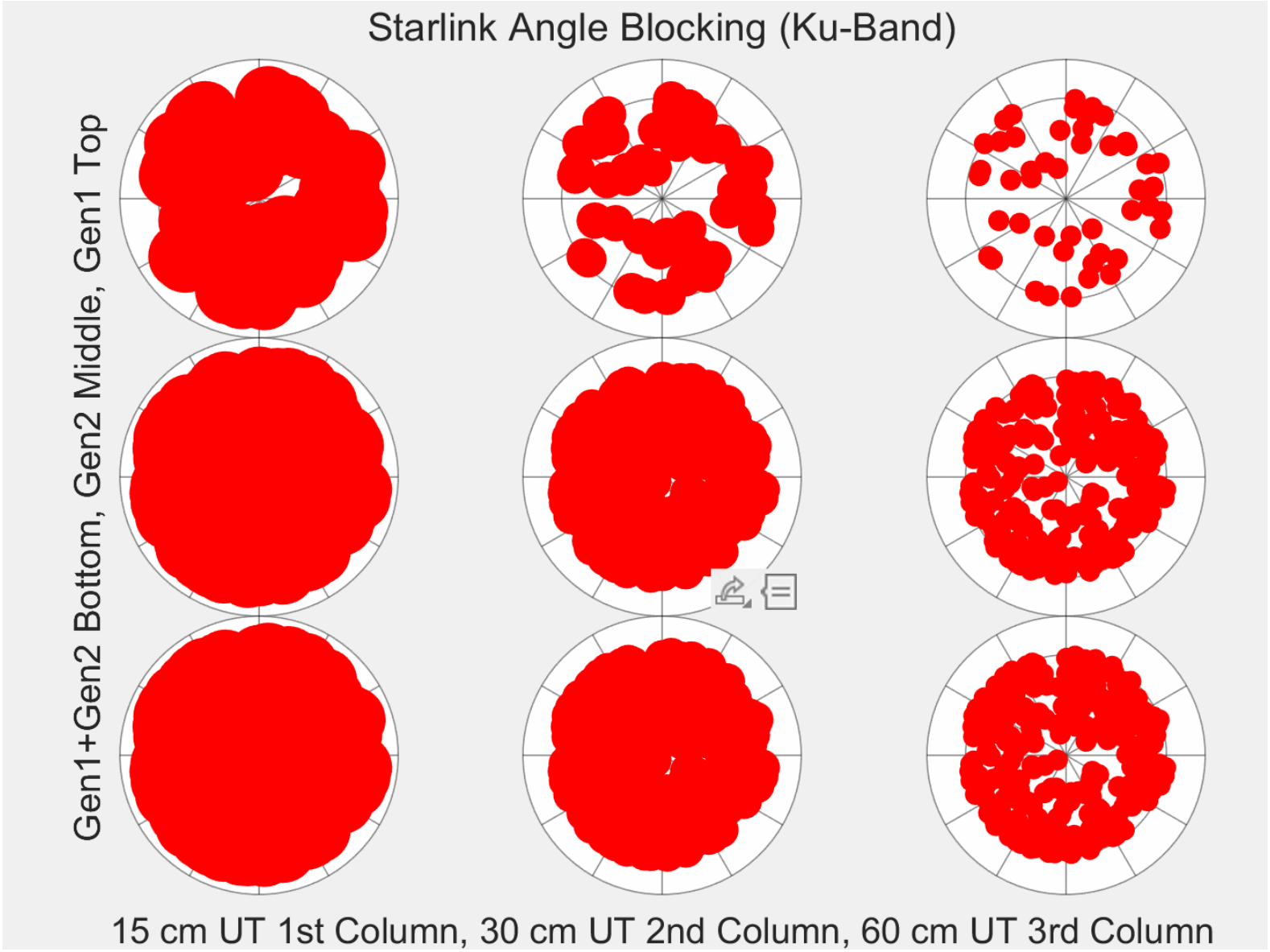
- WRC-23 (Dubai 2023) decided that administrations should
  - assess and ensure compliance by NGSO systems with the aggregate EPFD limits
  - reduce EPFD levels of NGSO systems if limits are exceeded
- Aggregate EPFD limits **assume only 3.5 NGSO systems** operating co-frequency
- Two large NGSO operators together claim 86% of the EPFD allowance today for ***all NGSOs in the world***



Viasat

Mega-constellations can block other NGSO systems from using same spectrum

- Using 1000s of satellites and small user antennas allows mega-constellations to consume virtually all “look angles” toward space, blocking smaller systems
- As depicted, use of small antennas and phased arrays by large NGSO systems worsens the sharing situation



Key takeaways for national NGSO licensing framework

- Framework must implement measures to avoid NGSO mega-constellations' overconsumption of orbital-spectrum resources:
  - Set look angle consumption restrictions in order ensure there is enough space for other and smaller NGSO systems, including national NGSO systems
  - Conduct own technical analysis of compliance with the ITU limits (single and aggregate EPFD compliance checks) including within India's own territories, and for the specific NGSO satellites proposed to serve India

Thank You

Viasat

Spectrum & Technical issues in Satcom

07-August-2024

Connecting People for Nearly 60 Years

We pioneered the satellite market, and today we are the driver for innovations

52
Satellites

62
Teleports & POPs

1,500
Daily TB of Carrier-grade Traffic

100,000+
Fiber Miles

10M +
Terminals

We're the largest satellite capacity provider to the U.S. government

We provide **inflight internet to 21** commercial Airline Partners and nearly **3,000** Aircraft

We are the leading provider of satellite bandwidth to the maritime industry

We deliver TV and radio content to **more than 2 billion people** worldwide

We serve 7 of the world's top 10 Mobile Network Operators

Intelsat and India’s Satellite Partnership

Since 1990s

Satellite ventures with ISRO

Including joint payloads and satellite-related services

Top media partner

Distributing ~half the market TV content

Services in India

Mobile connectivity
In-flight connectivity
Maritime connectivity

Partnerships in India

Serving your broadband needs – land, sea and air

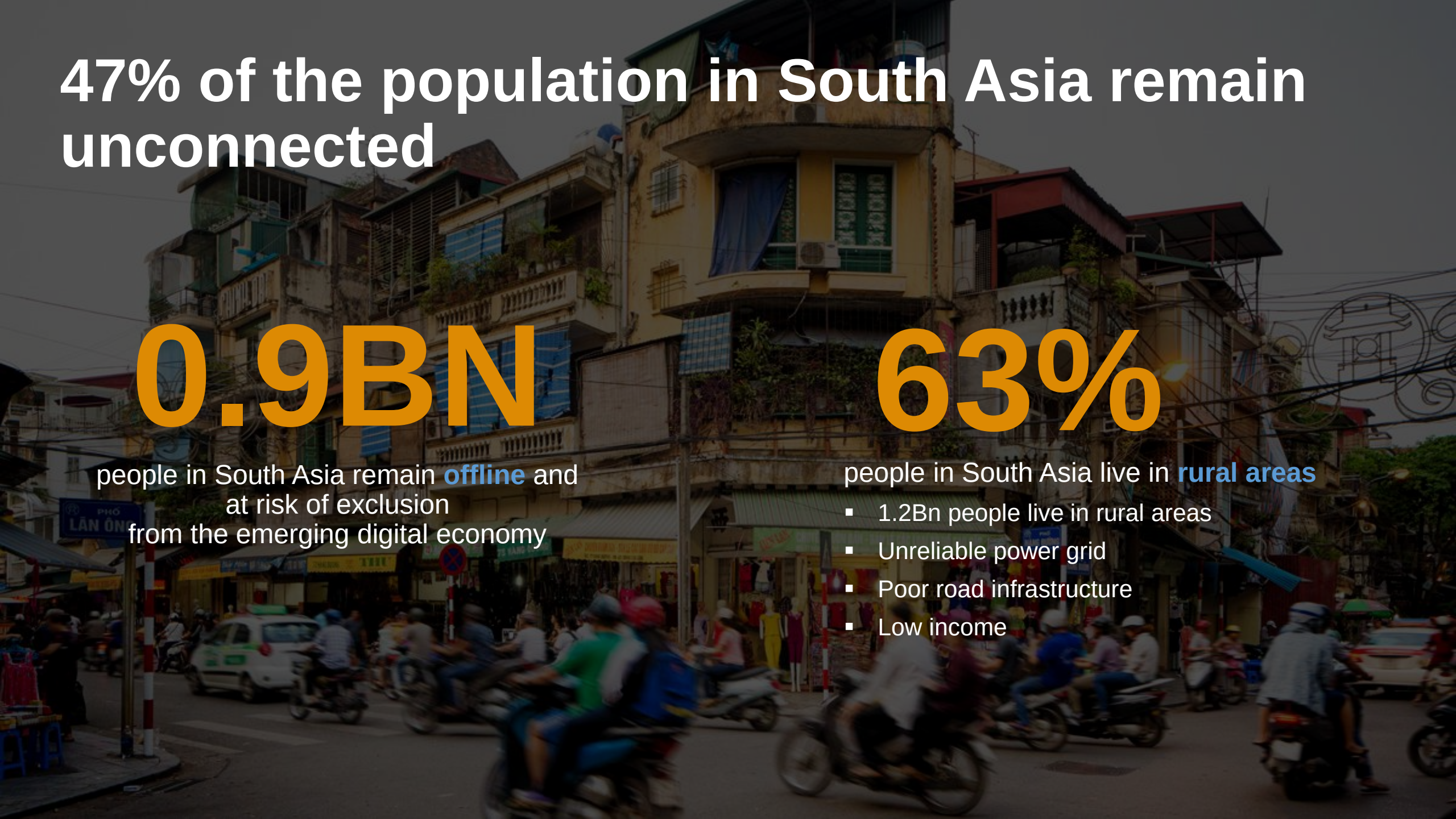
- Partnerships in India to provide multiple services via HTS satellite IS-33e:
  - **Nelco:** Provides CBH services to leading MNO's & In-flight connectivity
  - **CloudCast Digital:** Hosts Flex Node, providing Flex Maritime, Flex Move, Flex Enterprise services

Intelsat Vision

Multiple components blended to offer an unparalleled connectivity experience

Software-Defined Satellites	Multi-Orbit/Network	Software-Defined Network	5G – Standards Based	Smart Edge Terminals
Dynamic Capacity driven by automated resource management: Beam Shape Capacity and Power Coverage Frequencies	**Seamless Integration** into a single solution: LEO MEO HEO GEO HAPS Terrestrial Networks	**Virtualized Network** cloud-native functions orchestrated via software: Service Chains Teleports & Platforms Terminals Fiber Network OSS/BSS Private/Public Clouds	**End-to-End 5G** leveraging new NTN standards: Core Network Radio Access (NTN) Edge Terminal End-User Devices	**Empowering the Edge** to create new value: Flat-panel ESAs Auto-commissioning Virtual Modems Edge Cloud Integrated Customer Apps

47% of the population in South Asia remain unconnected



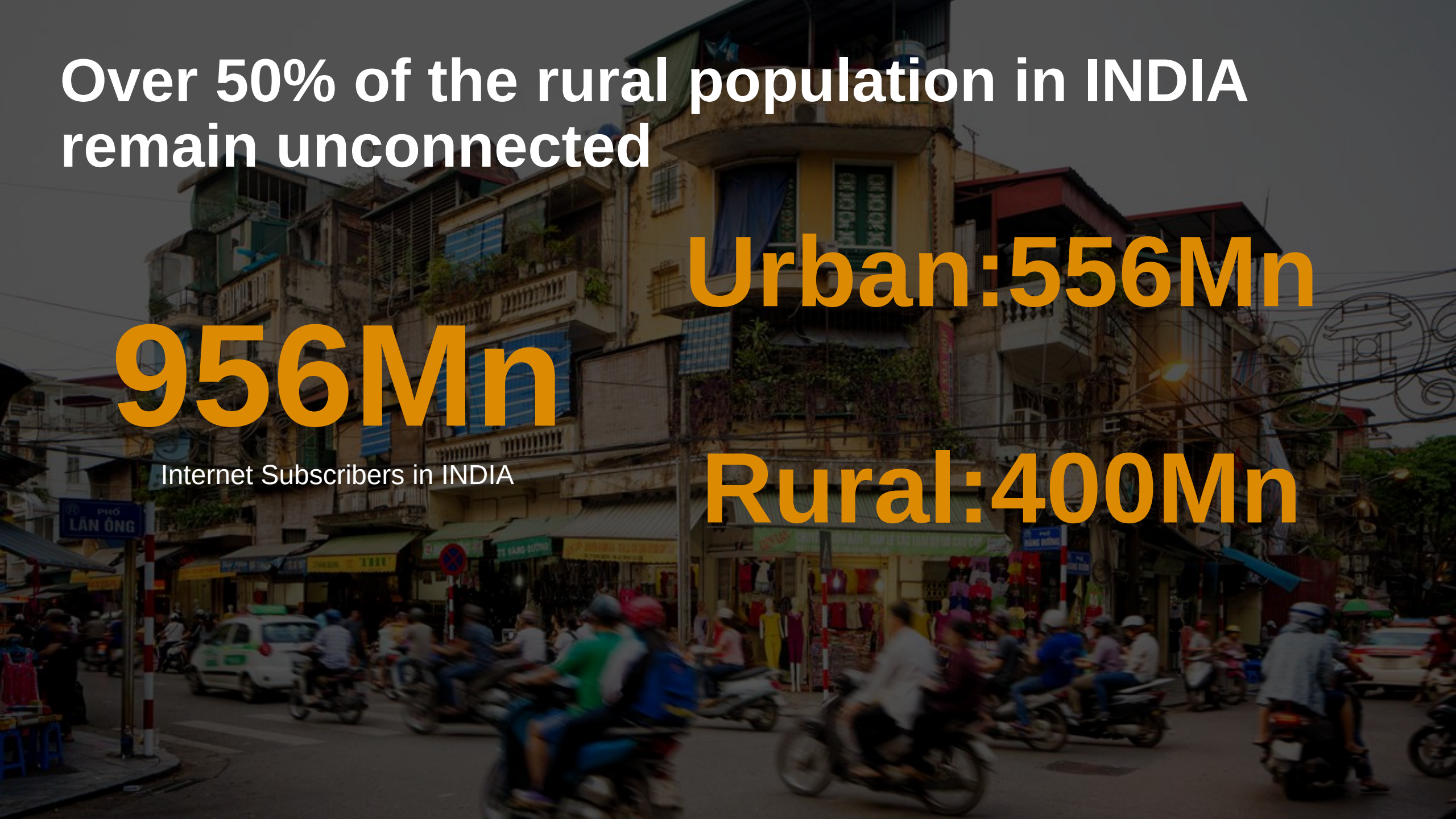
0.9BN

people in South Asia remain **offline** and at risk of exclusion from the emerging digital economy

63%

people in South Asia live in **rural areas**

- 1.2Bn people live in rural areas
- Unreliable power grid
- Poor road infrastructure
- Low income



Over 50% of the rural population in INDIA remain unconnected

956Mn

Internet Subscribers in INDIA

Urban:556Mn

Rural:400Mn

Map for Planned 5G in C-band

Color Map by:
Frequency Range Affected

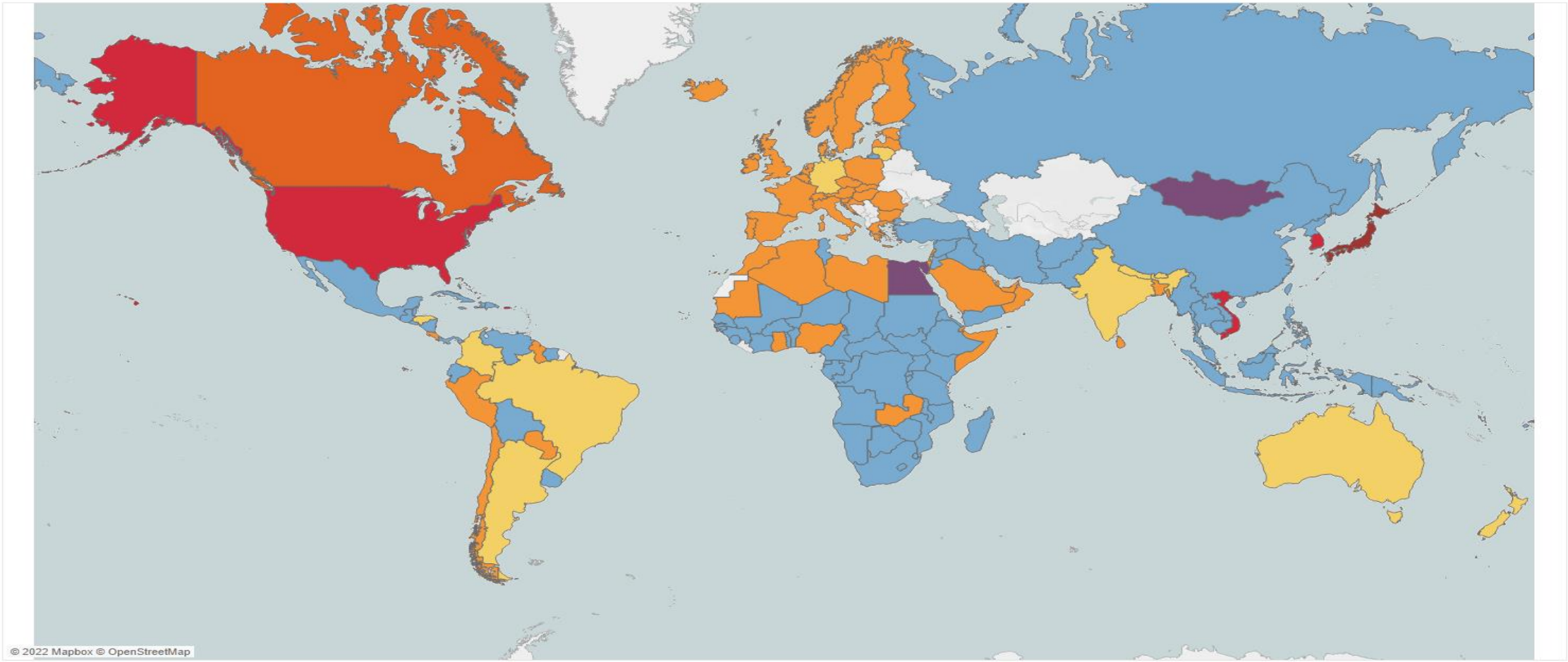
Global Overview of Planned National 5G Spectrum in C-band

Countries colored by Frequency Range Affected

*5G spectrum information sourced from **Spectrum Strategy** team. Please reach out to **spectrum@intelsat.com** for more information.*
***Note** - Spectrum information presented in this report is as per the latest data available to the Spectrum Strategy team. The information in this report is under review and will be updated as changes are made to known to the spectrum team.*

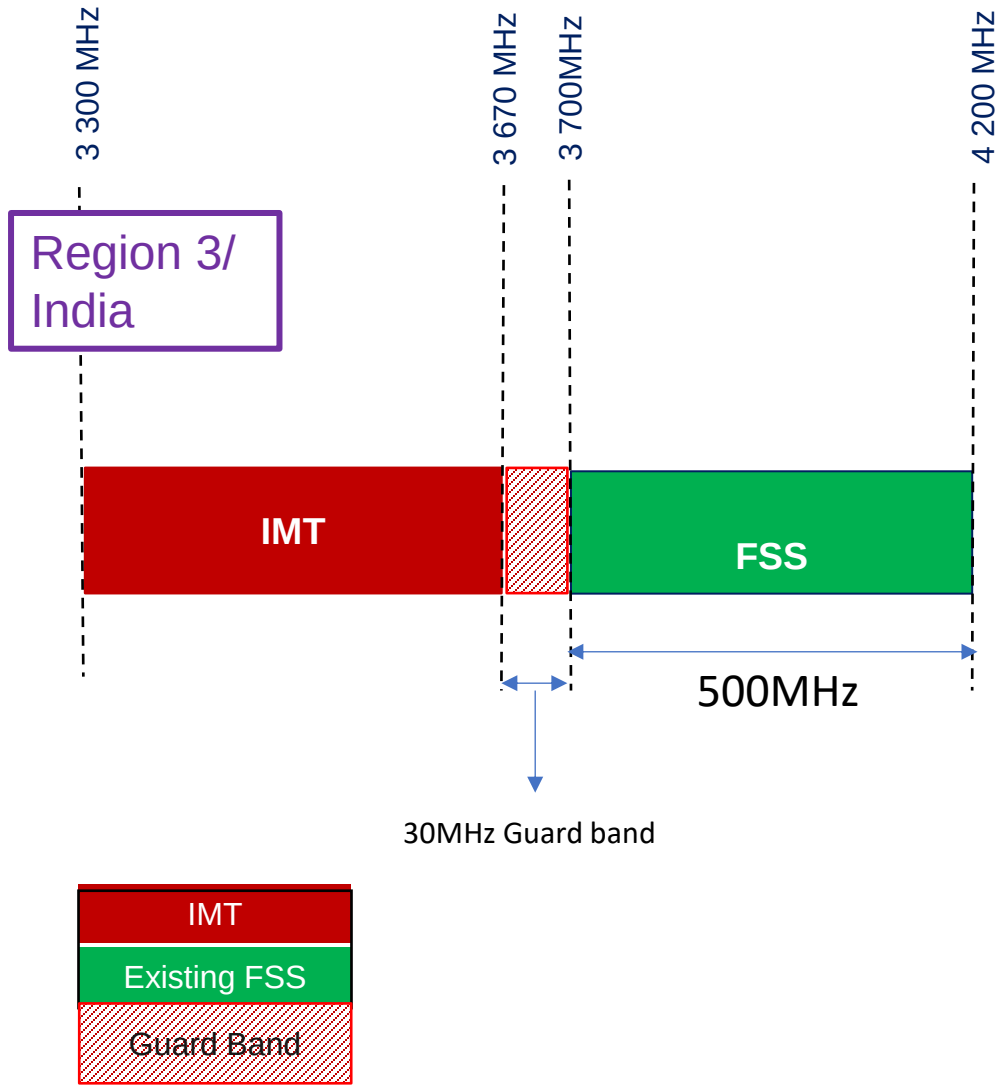
Color Legend

N/A | 3.4 - 3.6 GHz | 3.6 - 3.7 GHz | 3.7 - 3.8 GHz | 3.8 - 3.9 GHz | 3.9 - 4.0 GHz | 4.0 - 4.1 GHz | 4.1 - 4.2 GHz



C-band Spectrum

- C-band(3,700MHz – 4,200MHz) continues to be relied on for providing **Media and critical FSS services**
- India has over 900 licensed satellite channels who rely on C-Band for downlinking content across the country
- 200Mn households across DTH, Cable and HITS platforms
- Recent IMT identification at WRC-23 allows regulators to provide spectrum to **MNOs upto 3,670MHz with 30MHz of guard band** while continue to allow **critical satellite services above 3,700 MHz**
- Regulators should continue to balance the need for C-band spectrum for FSS satellite services and IMT terrestrial operations and adopt rules to **ensure compatibility** between services.



Challenges and way forward

Currently being defined by an ITU Recommendation to guide implementation globally

Regulatory	5G Operators	Satellite Service users
Provides clear technical guidelines balancing the needs of spectrum users	**Executes network planning according to guidelines**	**Deploys FSS E/S including mitigation techniques as necessary**
1. In-band limits and OOB spurious level specifications for 5G 2. Defines coexisit conditions a. Protection/Exclusion zones b. Use of databases of BS and FSS E/S for identifying needs of coordination c. Processes to address coexistence issues	1. Control EIRP of BS to meet regulatory conditions 2. Verifies presence of stations from adjacent band services to anticipate needs for eventual coordination	1. Deploy RF filters as required for adjacent-band operation 2. Registers E/S with regulator to increase understanding of band usage

Intelsat’s commitment in supporting its customers

- We constantly track spectrum policy updates and national consultations around the globe
- Developing an ITU Recommendation to assist regulators ensure the protection of satellite assets
- An online 5G and C-band Resource Center:
  - General overview of the issue
  - Description of practical steps to protect your satellite usage
  - High level view of administrations’ plan for 5G in the 3.5 GHz range
  - Link to a library of technical material

Thank you