NGSO SATELLITE SYSTEMS OVERVIEW

A perspective for NGSO satellite systems' development, regulations and long-term sustainability

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ADVANTAGES

Benefits of NGSO Systems

High-speed Connectivity

Delivering low latency and massive throughput globally

Bridging the Digital Divide

Providing connectivity to remote and underserved regions

Global Coverage

Seamless connectivity across the globe (including oceans, poles)

Resiliency

Less vulnerable to jamming/interference

LIMITATIONS

Disadvantages of NGSO Systems

High Capital Expenditure

Massive upfront investment due to manufacturing and launch costs

Short Lifespan

Shorter satellite lifetime, necessitating continuous and costly replenishment

Complex Ground Infrastructure

Sophisticated gateway/user terminal architecture

Line of Sight Requirements

Signals can be easily blocked by physical obstacles, requiring a clear view of the sky.

REGULATORY FRAMEWORK

INTERNATIONAL

The ITU manages the Master International Frequency Register, coordinating the use of the spectrum resources to prevent interference UNOOSA registers launched objects under the 1967 Outer Space Treaty

REGIONAL

Regional organizations that adapt and harmonize global rules to regional needs

NATIONAL

Entities that grant actual market access, authorize earth stations, and enforce domestic universal service laws.

GLOBAL HARMONIZATION

Establishing uniform rules for the use of the radio frequency, spectrum and satellite orbits worldwide

EQUITABLE ACCESS

Ensuring fair and equitable access to spectrum and orbital resources for all Member States

ITU
RADIO REGULATIONS

INTERFERENCE PREVENTION

Preventing harmful interference between satellite systems and terrestrial services

GLOBAL COORDINATION

Promoting international cooperation and coordination to support reliable and sustainable services

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ITU Regulations

Art. 22 EPFD Limits

Equivalent Power Flux Density (EPFD) limits are a critical regulatory mechanism.

THE PURPOSE

Designed specifically to prevent NGSO constellations from causing unacceptable interference to GSO networks.

THE RULE

GSO networks have regulatory priority. NGSO systems must design their operations to stay within these hard power limits.

COMPLIANCE

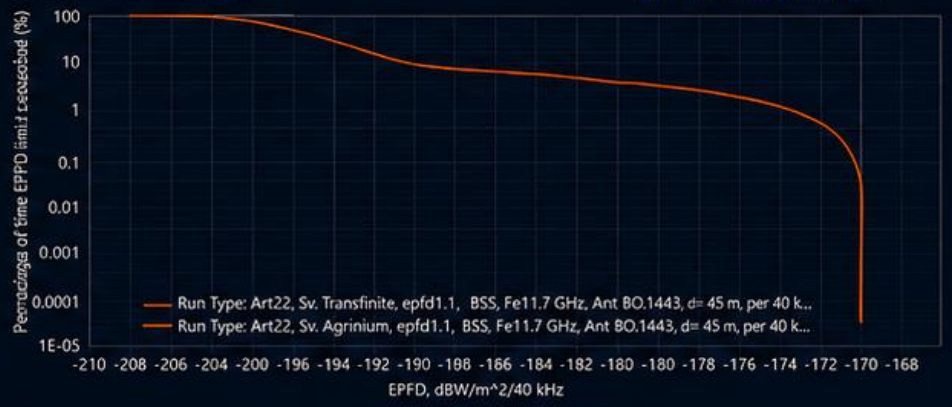
Requires complex software modeling and dynamic power management by NGSO operators.

GLOBAL COORDINATION

Through coordination and notification procedures, the ITU ensures equitable access to spectrum and orbital resources for all Member States.

Select input results | View results

EPFD RESULTS VIEW



Plot also limit (extracted from results) | Cap minimum at 1E-05 | Show legend

perc	EPFD1	EPFD2	deltaEPFD
100	-202.6	-202.6	0
99.99	-202.594565	-202.594565	0.000004
99	-202.210948	-202.210525	0.000423
95	-201.334358	-201.334358	0.00001
90	-200.232013	-200.232073	0.000061
80	-198.476055	-198.476116	0.000049
70	-197.7065	-197.706477	0.000021
60	-196.853292	-196.855551	0.000028
50	-196.067192	-196.067499	0
40	-193.399988	-193.399933	0.000039
20	-191.395839	-191.395926	0.000026
10	-188.529519	-188.529519	0
5	-178.229456	-178.229456	0
4	-176.128346	-176.128345	0
3	-174.026606	-174.026664	0.000235
2	-171.935117	-171.935117	0
1	-169.85397	-168.65597	0
0.5	-168.835229	-168.83512	0.00011

Copy Plot to Clipboard

Select Results to Display (press 'Ctrl' to make multiple selection of two software)

EPFD Type	sw_name	run_id	IncomingNSC	ExistingNSC	result_id	run_type	worst_es_lat	worst_es_long	worst_geo_lat
epfd1, BSS, Fe11.7 GHz, Ant BO.1443, d= 3 m, per 40 kHz	Transfinite	1	101	31	23	Art22	70.83	37.62	36.52
epfd1, BSS, Fe11.7 GHz, Ant BO.1443, d= 3 m, per 40 kHz	Transfinite	2	102	31	55	Art22	70.41	17.24	-27
epfd1, BSS, Fe11.7 GHz, Ant BO.1443, d= 3 m, per 40 kHz	Agrinium	19	102	31	280	Art22	70.41	17.24	-28
epfd1, BSS, Fe11.7 GHz, Ant BO.1443, d= 45 m, per 40 kHz	Agrinium	20	101	31	312	Art22	71.43	38.1	38.1
epfd1, BSS, Fe11.7 GHz, Ant BO.1443, d= 45 m, per 40 kHz	Transfinite	1	102	31	24	Art22	70.43	38.1	38.1
epfd1, BSS, Fe11.7 GHz, Ant BO.1443, d= 45 m, per 40 kHz	Transfinite	2	102	31	56	Art22	70.41	17.24	-28

Plot Selected Results

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NATIONAL POLICIES

National Sovereignty

National Licensing & Regulatory Compliance

While global frameworks enable access to spectrum and orbits, the right to provide services within a country remains a matter of national sovereignty

Compliance with national policies and licensing requirements is mandatory for lawful service delivery

SOVEREIGN RIGHTS
Each country has the authority to regulate the provision of satellite services within its territory

NATIONAL FRAMEWORKS
Countries implement their own regulations and procedures in line with national laws and priorities

POLICY ALIGNMENT
Operators must adhere to national policies regarding security, competition, and public interest

NATIONAL COMPLIANCE
Obtaining the necessary approvals and licenses is essential for legal and sustainable operations

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LICENSING

National Licensing Requirements

Operating NGSO services requires compliance with national licensing procedures and regulatory approvals

Global constellation coverage does not grant automatic rights within national territories

Securing the necessary licenses is mandatory for lawful and uninterrupted service delivery

KEY LICENSING AREAS

LANDING RIGHTS & MARKET ACCESS

Global constellation coverage does not grant automatic rights within national territories; operators must secure formal commercial landing rights from national telecom authorities

SPECTRUM & GATEWAY APPROVALS

National frequency coordination may require separate authorization for gateway earth stations and user terminals

REGULATORY ENFORCEMENT

Compliance audits, national security checks, and adherence to local telecom laws are legally binding for service delivery

ONGOING COMPLIANCE

Licenses may include ongoing reporting obligations, technical standards, and periodic renewal requirements set by national regulators.

SECURITY

The Threat of Unauthorised Terminals

User terminals operating in unapproved regions or smuggled across borders pose severe national security and telecom regulatory risks to sovereign nations

Authorities enforce rules via heavy penalties, equipment confiscation, and diplomatic pressure

Regulators increasingly mandate NGSO operators to implement strict geographic geofencing to physically disable terminals outside licensed territories

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RISKS

Operational Risks

The Challenges of Mega-Constellations

While NGSO systems offer transformative benefits, their large-scale eeployment introduces significant environmental, operational, and regulatory risks

Proactive risk management and international cooperation are essential to ensure the sustainability of space activities

KEY RISK FACTORS

SPECTRUM CONGESTION

The rapid and massive deployment of NGSO systems creates dense electromagnetic environments, increasing the risk of harmful interference among networks

ORBITAL CONGESTION

Thousands of satellites operating in the same orbital regions elevate the probability of collisions, threatening the safety of all space assets

ASTRONOMICAL IMPACT

Severe light pollution and radio frequency interference from satellite constellations pose major challenges to ground-based astronomical observations

Addressing these risks requires coordinated international regulation, advanced technologies, and responsible operations to protect both space assets and the shared space environment

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SPACE OBJECTS

Managing the Orbital Environment

46,420
TOTAL TRACKED OBJECTS[1]
Objects regularly tracked (as of 31 July 2026)

16,000
FUNCTIONING SATELLITES[1]
Still functioning

17,000 t
TOTAL MASS IN ORBIT[1]
More than 17,000 tonnes

660+
FRAGMENTATION EVENTS[1]
Break-ups, explosions & collisions

7,320
ROCKET LAUNCHES[1]
Since 1957 (excluding failures)

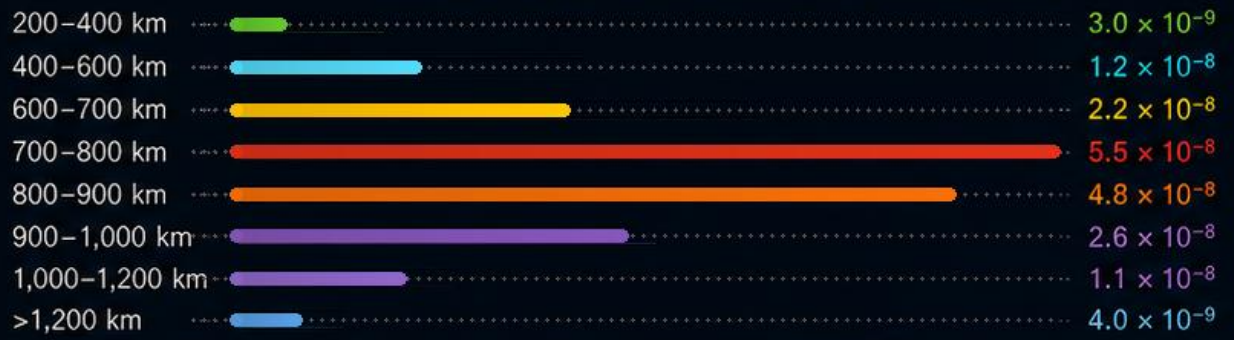
27,490
SATELLITES LAUNCHED[1]
Placed into Earth orbit

18,840
STILL IN SPACE[1]
Satellites remaining in space

54,000
OBJECTS >10 cm²
1.2 million: 1–10 cm
140 million: 1 mm–1 cm

Debris by Altitude[3]

Cataloged Fragmentation Debris – Spatial Density [1/km³]



Note: Density values are approximate (log scale) and represent the NASA ORDEM 3.1 environment model for objects > 1 cm in size.

Two dominant debris density peaks occur at ~750 km and ~850 km. Debris concentrations in these regions have increased significantly compared to previous years.

Source: NASA ODPO, Orbital Debris *Quarterly News*, Vol. 29, Issue 3, 2026.

Exponential Growth

Currently, there are approximately 16,000 active satellites in orbit.

Driven by the rapid expansion of commercial mega-constellations, the total number of NGSO satellites is projected to reach between 60,000 and 100,000 by 2030.[4]

Effective monitoring and responsible operation are essential to ensure the sustainability of space activities.

1. ESA Space Debris Office. (2026, July 31). ESA Space Environment Statistics – Objects in Earth Orbit. ESA Space Debris Office. https://sdup.esoc.esa.int/discosweb/statistics/
2. ESA MASTER-8, reference population (08/2024), for estimated untracked debris-size estimates.
3. NASA Orbital Debris Program Office. (2026). "Evolution of the Cataloged Population." *Orbital Debris Quarterly News*, Vol. 29, Issue 3.
4. European Space Agency. (2025, April). Around 100,000 satellites are expected to be in orbit by 2030. ESA.

Note: Numbers are rounded.

SUSTAINABILITY IN SPACE

Protecting Today, Preserving Tomorrow for all Nations

Sustainable use of Orbital Resources

- **Debris Mitigation**
  Reduce the generation of debris and implement active removal strategies to prevent the Kessler Syndrome
- **Orbital Congestion**
  Manage the growing number of objects in orbit through responsible operations and traffic coordination

Sustainable use of Spectrum Resources

- **Spectral Depletion**
  Prevent harmful interference and promote efficient spectrum use to avoid spectral depletion
- **Equitable Access to Spectrum**
  Ensure fair, transparent, and inclusive access to spectrum resources for all nations

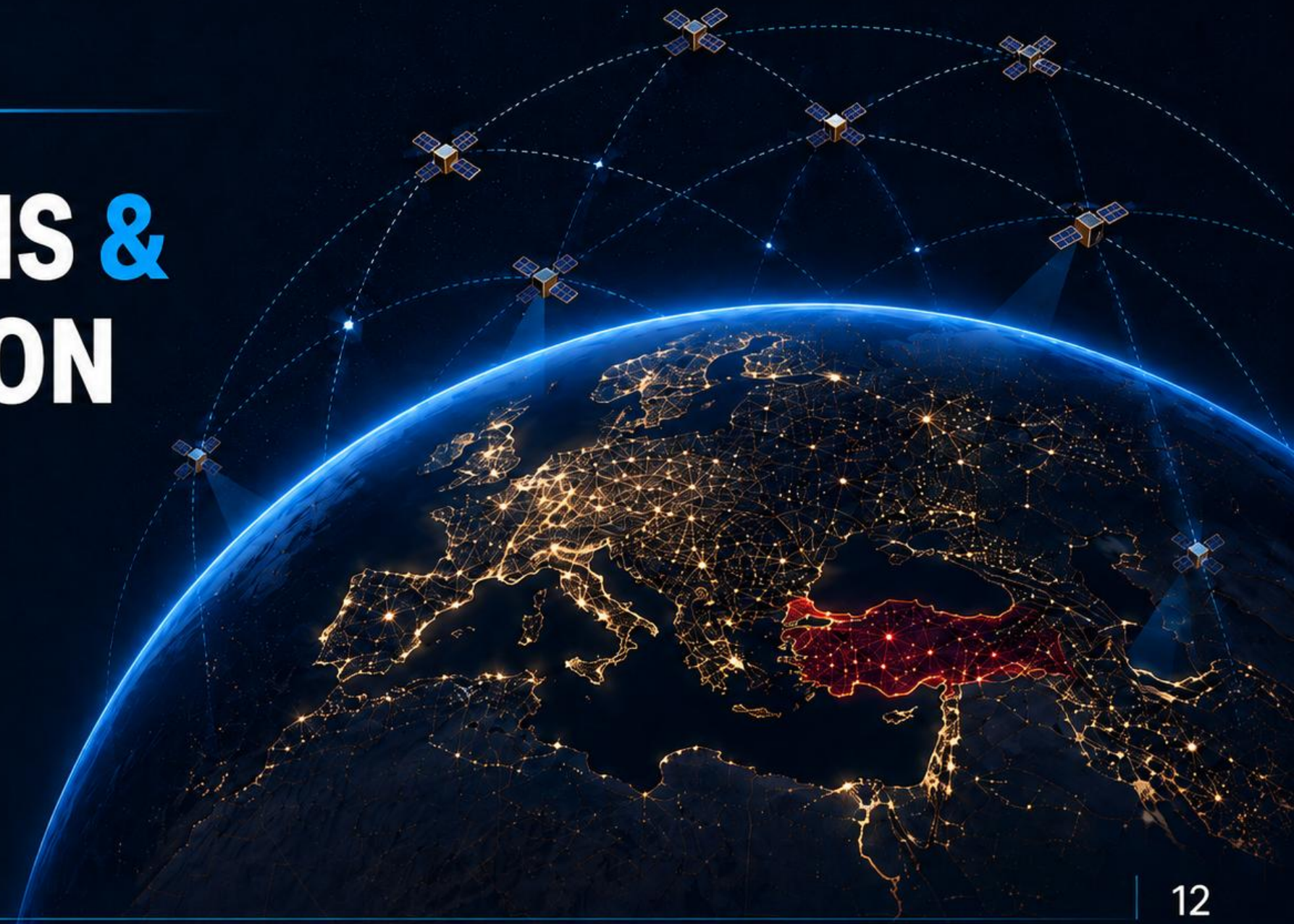
KESSLER CASCADE EFFECT

A collision creates debris. More debris leads to more collisions. The cycle continues, increasing the risk for all space missions.

Sustainable space activities require proactive risk management, international cooperation, and responsible behaviors to safeguard the space environment for current and future generations.

QUESTIONS & DISCUSSION

Thank you



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