



*Presentation to 59<sup>th</sup> COPUOS – STSC Session, Vienna*



*Multi-Satellite Low-Earth-Orbit Constellations:  
Interferences for Routine Space Activities  
& Astronomical Observations –  
Threats to Uncontrolled Space Debris Formation*

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*Based on CANEUS contribution to  
"National research on space debris"  
Reference: OOSA/2021/52, CU 2020/295(C)/OOSA/CPLA*

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# Proposals to **STSC**

**01.**

**Initiate system studies:**

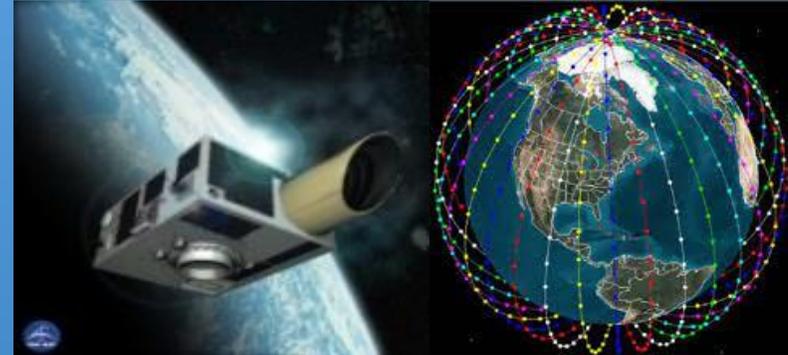
To address the problem of the **influence of multi-satellite LEO constellations** on traditional tasks solving both in outer space and from space (within COPUOS mandate)



**02.**

Consider potential modification to mandate of "STSC Agenda Item 7":

"To possibly "replace or add in its wording" the phrase "...**with onboard nuclear power sources**" with "low-orbit multi-satellite constellations"

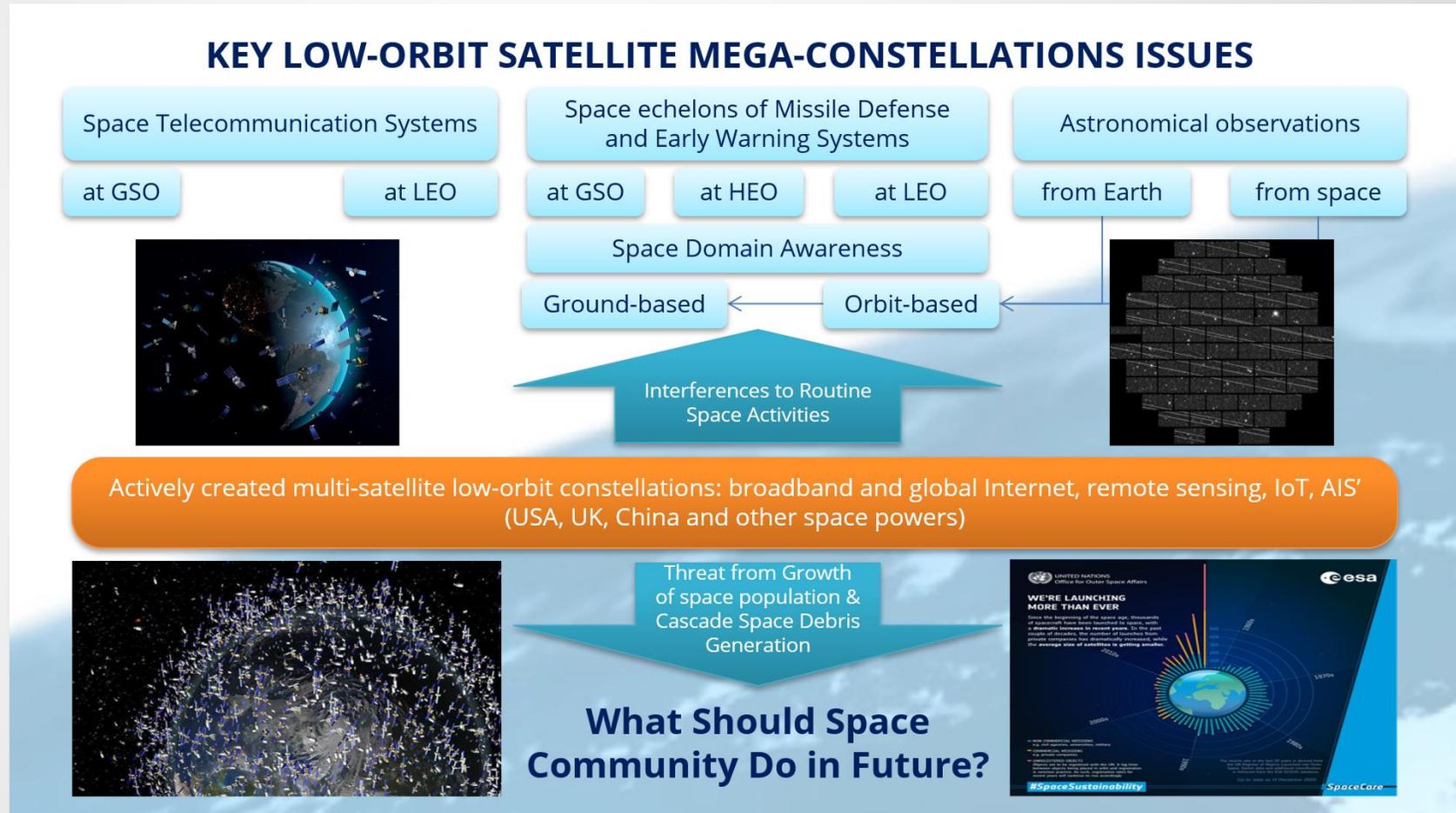


Explore creating an International Center to Address these Issues under the auspices of UN COPUOS

# Problems and Rationale: **Key Issues**

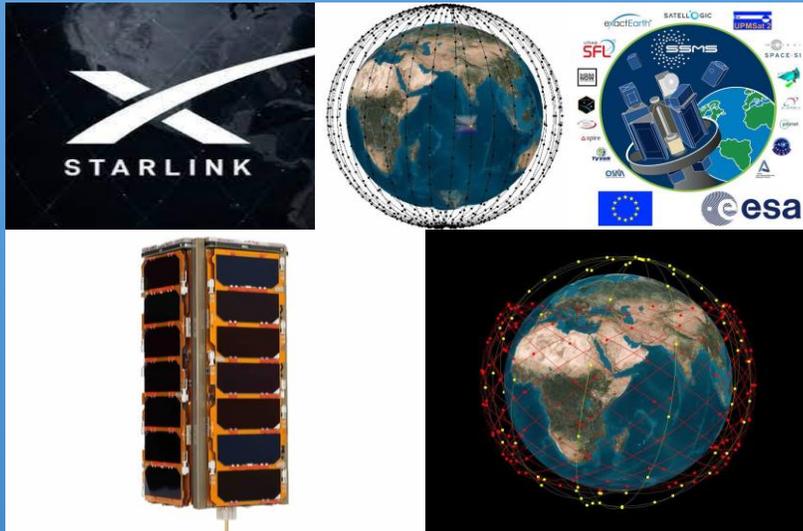
The emergence of new threats and risks that are directly or indirectly related to the problem of space debris exists in two self-sufficient dimensions:

- Energy (information) Interferences to ensure strategic stability and international security), and
- Smarm(small satellites) Constellations



# The “Problems” and “Rationale”

**01** In recent years, several LEO (Low-Earth-Orbit) multi-satellite constellations have been actively created and deployed both by **private and government** owned corporations

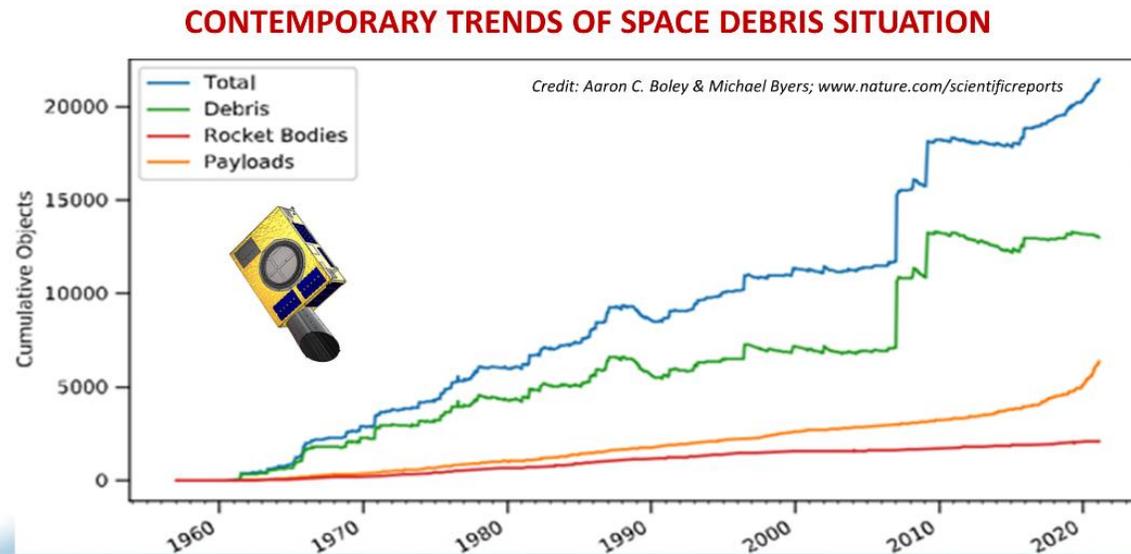


**02** Corporations are placing satellites into orbit at an unprecedented frequency to build “mega-constellations” of **communications satellites** in low-Earth-orbit.



Some estimates show that more than 100,000 satellites could orbit our planet by 2030

# Problems and Rationale: Contemporary Trends of Space Debris Situation



Cumulative on-orbit distribution functions (all orbits). De-orbited objects are not included. The 2007 and 2009 spikes are a Chinese anti-satellite test and the Iridium-33 (USA) and Cosmos-2251 (Russia) collision, respectively. The recent, rapid rise of the orange curve. Figure is produced using data obtained from the US SPACECOM satellite catalogue and cross-referencing with on-orbit fragmentation records. All orbits are included. Sudden rises in the CPDF are typically due to fragmentation events, while decreases are driven by orbital decay.

Credit: Aaron C. Boley & Michael Byers; [www.nature.com/scientificreports](http://www.nature.com/scientificreports)

- The number of active and defunct satellites in LEO has increased by over 50%, to about 5000 in two years
- Proposed “mega-constellations” of satellites that sit higher up are likely to cause far greater and longer-lasting problems.
- Around half of all the debris in space today comes from just two events: a 2007 anti-satellite test by the Chinese government, and an accidental 2009 collision between two satellites.

If all the mega-constellations launched, current tracking technologies would generate over 67,000 “collision alerts” annually.

## Problems and Rationale:

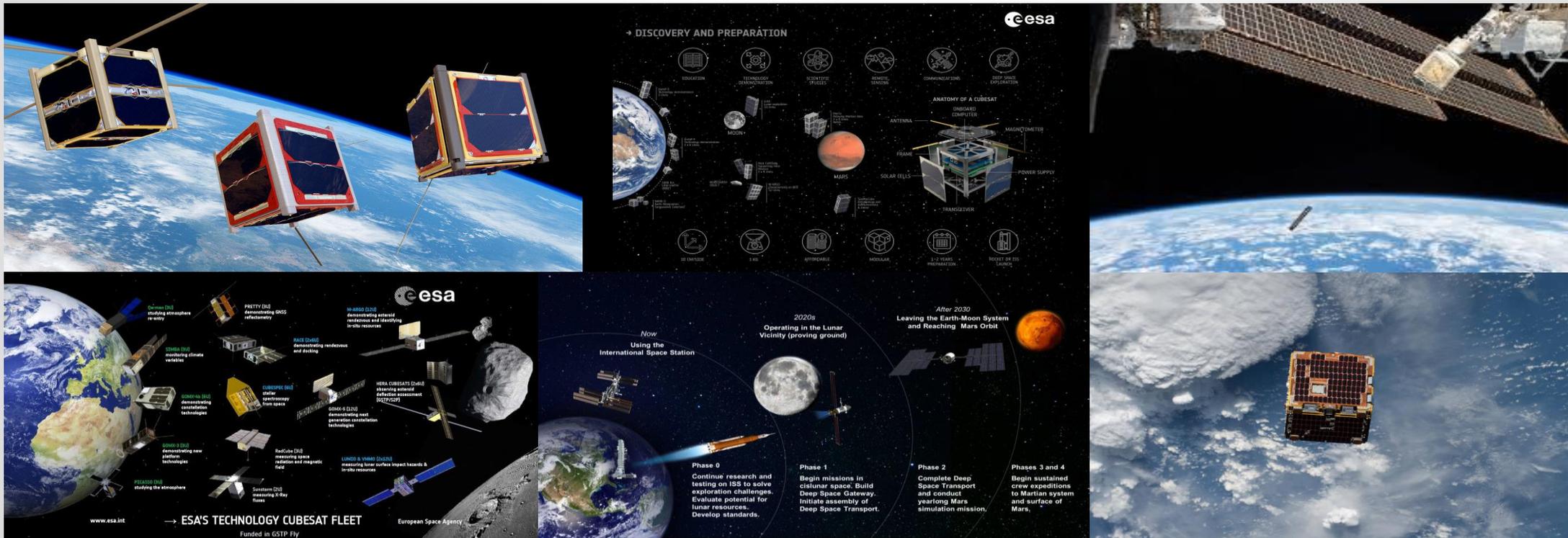
# Contemporary Trends of Space Debris Situation

Space debris updated on 05 January 2022 (Source: ESA)

Number of rocket launches since the start of the space age in 1957	About 6170 (excluding failures)
Number of satellites these rocket launches have placed into Earth orbit	About <b>12460</b>
Number of these still in space	About 7840
Number of these still functioning	About <b>5000</b>
Number of debris objects regularly tracked by Space Surveillance Networks and maintained in their catalogue	About 30040
Estimated number of break-ups, explosions, collisions, or anomalous events resulting in fragmentation	More than 630
Total mass of all space objects in Earth orbit	More than 9800 tonnes
Number of debris objects estimated by statistical models to be in orbit	<ul style="list-style-type: none"><li>• 36500 objects greater than 10 cm</li><li>• 1000000 objects from greater than 1 cm to 10 cm</li><li>• 330 million objects from greater than 1 mm to 1 cm</li></ul>

# Problems and Rationale: Issue 2

The second dimension is a threat of a cascade growth in the population of space debris associated with the observed intensification of the use of **Swarm of small satellites** (micro-) and ultra-small (nano-, pico-, and femto-formats) in the context of the use of automated control over them based on **micro-nanotechnologies and artificial intelligence**.



# Recent Efforts to Address the Issues:

STSC 2021 session, paragraph 98 of its outcome document (A/AC.105 /1240), contained a provision that

**01.**

There are **serious concerns about the deployment** of large multi-satellite constellations in low orbits **and the consequences** of such deployment

**02.**

Several delegations expressed that the **Subcommittee should consider this topic as a priority** in order to mitigate the impact of space debris

# Recent Initiatives by The International Astronomical Union: ISU

## 01.

The International Astronomical Union (IAU) together with the National Science Foundation had organized (SATCON1 and SATCON2 workshops held in July 2020 and July 2021) to minimize the negative impacts of satellite constellations on astronomy and the night sky.

## 02.

Last week (Feb 3, 2022) "IAU Centre for the Protection of the Dark and Quiet Sky from Satellite Constellation Interference" was launched to coordinate international efforts to find a solution, aiming to bring together astronomers, satellite operators, regulators and the wider community

# Challenges with Ongoing Efforts:

**01.**

Attempts to regulate the debris level in NEO, and recommendatory norms **to solve the problem of interference** with the emergence of multi-satellite constellations seems **inefficient**

**02.**

Space objects **with onboard nuclear power sources have not been launched**, at least for the last two years (exception was for radioisotope energy sources, used for interplanetary missions), and do not reflect an obvious threat, as posed by multi-satellite low-orbit constellations

**03.**

The problem of influence of **low-orbit multi-satellite constellations** both on the efficiency of astronomical observations and routine space activities in its various aspects, including ensuring strategic stability and international security, **is yet to be addressed by the STSC.**

# Proposed Potential Solutions:

01.

The issues and challenges **need to be addressed in a coordinated manner**, considering relevant multilateral regulatory frameworks, e.g., COPUOS, IADC (Inter-Agency Space Debris Coordination Committee)

02.

There are **no international regulations** on major aspects of mega-constellations

03.

The **IADC (Inter-Agency Debris Committee) guidelines** for de-orbiting within 25 years, **are not relevant** for mega-constellations and their placement

04.

Mega-constellations require a shift in perspectives and policies with an **understanding of Earth's environment**, including orbits.

## In short term,

Potential measures may include **actions by satellite operators** of low-orbit constellations of micro, nano and pico classes:

- Darkening the surface of satellites,
- Protecting them from the sun,
- Refusing to use non-rigid reflective materials to reduce impulse interference (glare)
- Changing the position of the small spacecraft
- Ensuring general availability of ephemeris with the highest possible accuracy.

## In longer term,

Through COPUOS

**Additional measures** can be developed to **eliminate or mitigate the effects of physical and energy interferences**, created by mega-groups to traditional space systems, as well as reduce the risk of collision in orbits and the formation of space debris

Proposal to STSC:  
**To initiate system studies of the problem of the influence of multi-satellite low-Earth-orbit constellations** on traditional solvable problem in outer space and from outer space.

Based on the results of such studies  
The leading space powers at the national level can be offered real measures  
**To exclude or mitigate the effects of physical and energy interference**  
Created by Mega-groups to traditional space systems

Explore creating an International Center under the auspices of UN COPUOS  
to compliment the Center by the International Astronomical Union



**Thank  
you**