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Space Traffic Management

The IAF initiative

Status of Working Group #2.1

Improving the knowledge

New technical means of space objects monitoring

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Special Session

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INTERNATIONAL ASTRONAUTICAL FEDERATION

Membership

WG#2.1:

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Motivation

Space object **monitoring** data represents the **foundation** of any Space Traffic Management system:

- Build-up & maintenance of **catalogues**
- Derivation of **statistical information** on objects in orbit

The **UN Long-Term Sustainability** (LTS) guidelines explicitly mention the relevance of the **collection and accuracy of orbital data** (B.2) and **develop related technologies** (B.4), together with the importance of promoting and supporting research and novel approaches to ensure sustainable operations in space (D.1, D.2).

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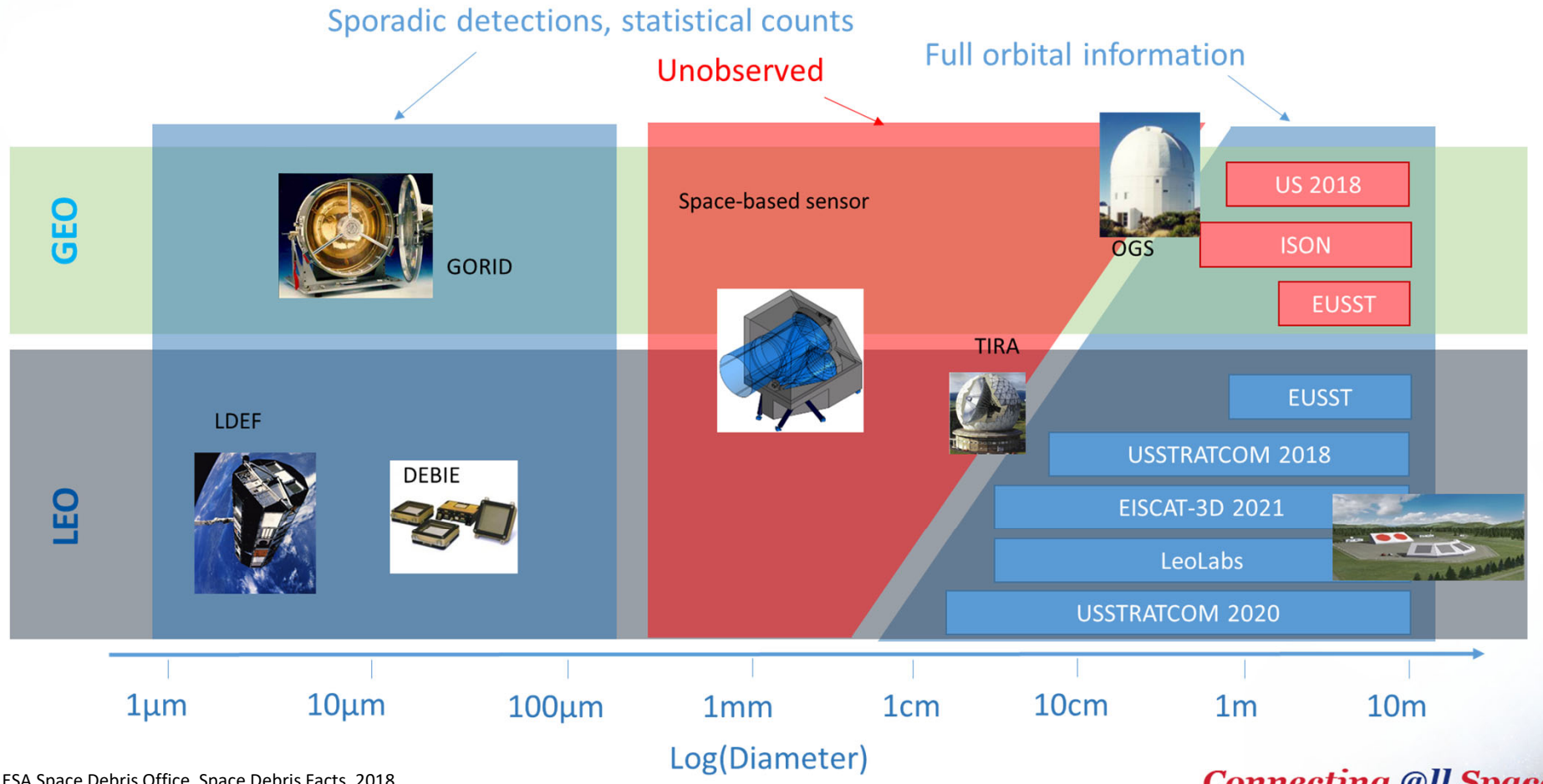
State of the art



ESA Space Debris Office, Space Debris Facts, 2018

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On-going developments

Focus on:

- the implementation of **optical surveys** in **LEO**,
- **laser ranging** to non-cooperative targets to maintain a catalogue of LEO objects with high accuracy orbits,
- development of techniques (such as light curve analysis) for **attitude** determination,
- the adoption of **active LED system** to support identification of small satellites and, more in general, attitude characterisation,
- the challenges related to **cis-lunar** applications

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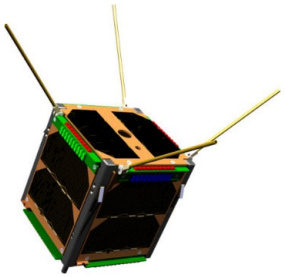
Example: Active LED systems

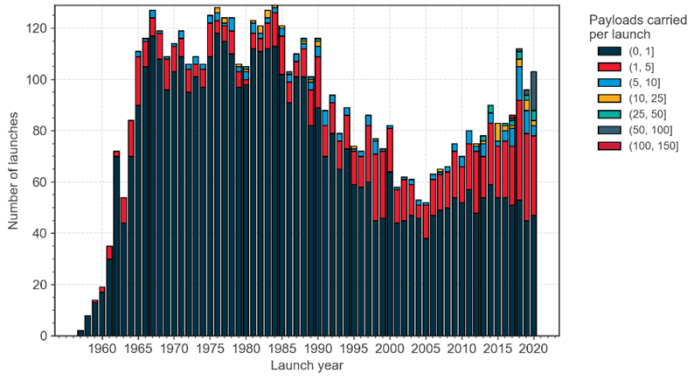
Small satellites deployed more often in **large quantities** (> 30 for commercial launch). The discrimination of their orbital elements in LEOP is paramount for operational awareness, early operations management and traffic assessment, so it is relevant to reduce the current **delay** in **object identification**

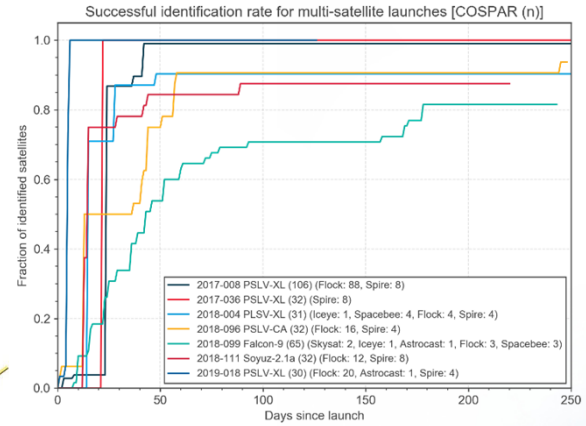
LED-based payloads on-board these platforms could use **specific patterns** to allow optical recognition and identification from ground soon after launch.

Larger platforms could implement **autonomous**, stand-alone **LED payloads**, which could help improving orbital and attitude state knowledge through optical observations, even in case of **satellite failure**



Rendering of LEDSAT, S5Lab, Università la Sapienza





ESA Space Debris Office, Space Environment Report (2020) [top] and AMOS Conference (2019) [bottom]

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Recommendations

<u>Objective</u>
identify technology developments to increase data volume and accuracy of observations.

Ground-based laser tracking

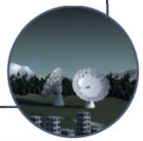
- reach sub-meter ranging accuracy,
- reduce by one order of magnitude the number of conjunction alerts

Passive optical LEO

- complement the visibility zones of radars for very low altitudes, e.g. during re-entry

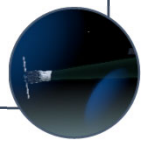
Passive RF

- complement the existing infrastructure by improving data timeliness
- enable late decisions in the collision avoidance process



Space-based measurements

- collect data for small size objects (e.g. in the mm and cm-range),
- fill gaps in environment models



Standards for attitude motion

- support emerging active debris removal and on-orbit servicing missions