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 Policy, Legal, Institutional and Economic Aspects of Space Debris Detection, Mitigation and Removal  
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EMERGING LEO NANO-MICRO SATELLITE MARKET: HAS THE TIME ARRIVED FOR A  
 STRINGENT APPLICATION OF SPACE DEBRIS MITIGATION MEASURES, INCLUDING IN  
 EUROPE?

**Abstract**

The LEO long-term sustainability depends from the removal of old debris by the international community and the implementation of space debris mitigation measures by current/future satellites (e.g. to limit to 25 years post-mission lifetime).

Thus, there is a need for regulatory authorities around the world to ensure a consistent application of debris mitigation measures by all type of operators (e.g. commercial, university) and by all type of satellites (e.g. incl. nano-micro satellites).

The paper analyses the challenges that nano-micro satellites pose to regulatory authorities (with a focus in Europe) to ensure the application of debris mitigation measures (e.g. via space licensing, SST monitoring). It also presents trends suggesting that the time for a strict application of mitigation measures to these satellites may have come.

Current challenges include:

- Nano-micro satellites due to their affordability and easiness to assemble/operate are spreading geographically even in Countries with no/or limited space heritage/legislation, which is a regulatory challenge for a consistent application of mitigation measures
- Nano-micro satellites are more and more owned/operated by non-governmental entities, thus States are losing grip to maintain supervision and control through non-legislative means
- Nano-micro satellites inherent characteristics of affordability inhibited regulators to strictly apply mitigation measures, which would impose cost-prohibitive means (e.g. propulsion systems on nano-satellites) or limit the LEO market of these satellites (e.g. below 600km altitude)
- Nano-micro satellites due to their size tend to fall under the radar of national SST systems in Europe, which limits the possibility to monitor the implementation of the mitigation measures

Trends include:

- Nano-micro satellites are expected to significantly grow globally in coming years, thus the need to applying debris mitigation measures will increase, including in Europe
- Upcoming mitigation means (e.g. drag sail) are expected to be cost-effective (even for nano-satellites) to meet mitigation objectives (e.g. 25 years post mission lifetime); thus a strict application of mitigation measures would be feasible
- Upcoming SST systems in Europe should enable to independently monitor the implementation of mitigation measures (even by nano-satellites); thus legislation would be fully enforceable

- Mitigation measures are defined internationally (e.g. UN/IADC) and in Countries with most advanced national space law are (or becoming) mandatory; thus a level playing field is in principle achievable.