NOVASPACE
Merger of Euroconsult Group and SpaceTec Partners

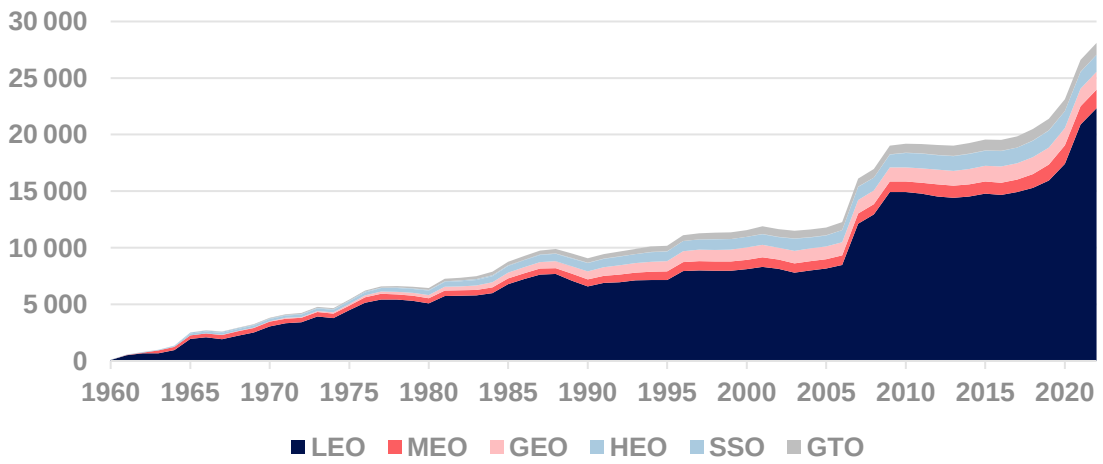
Active Debris Removal market

ESA Clean Space Days

October 2024

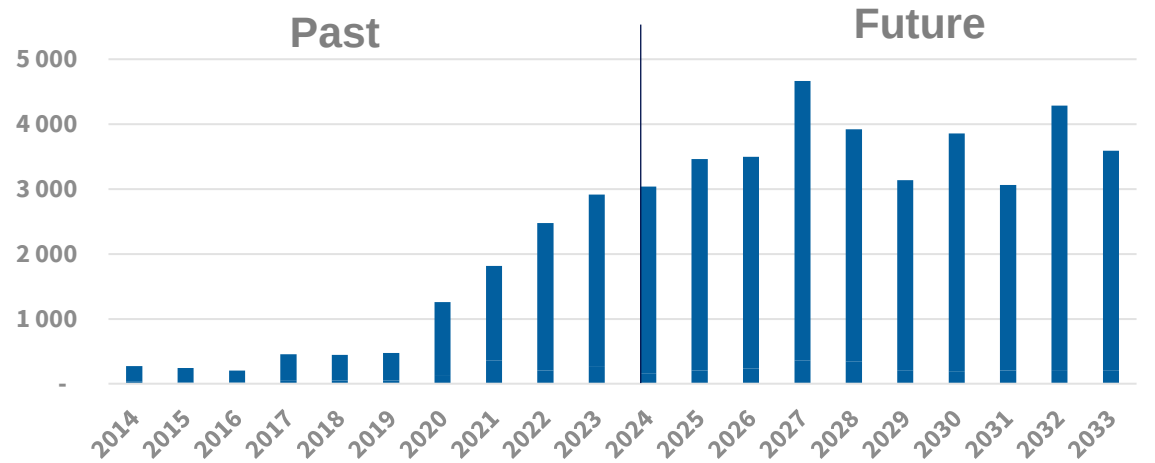
Space debris and launch rate

Number of tracked debris in space by orbit (1960-2022)



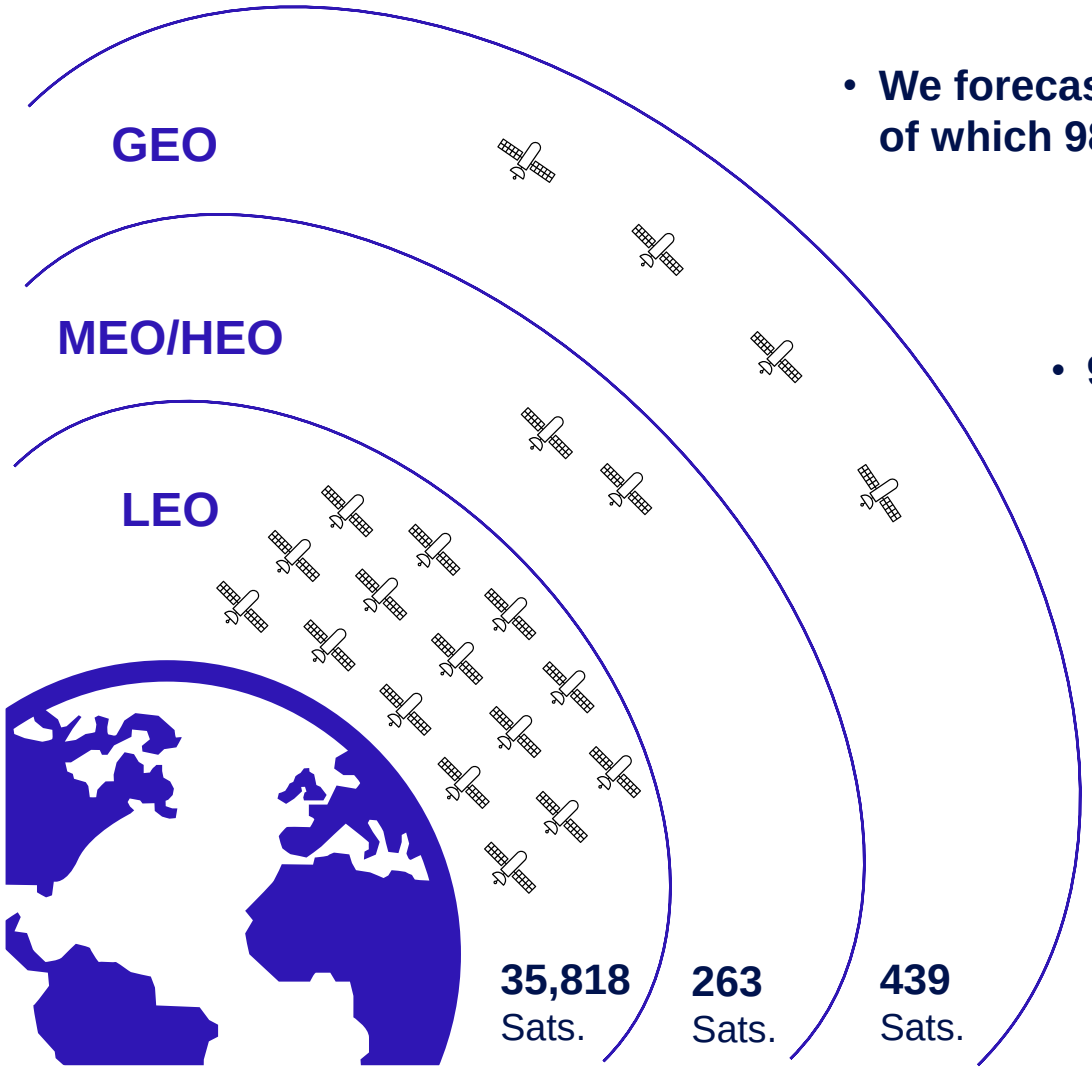
- **High increase of space debris over time**
- **As of today, over 35,000 objects are tracked orbiting Earth**
- **Most tracked debris are in Low Earth Orbit (LEO)**

Satellite launch in Earth orbit (2014-2033)



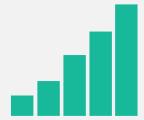
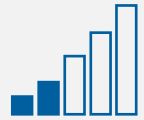
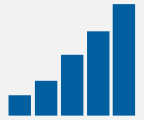
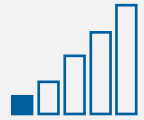
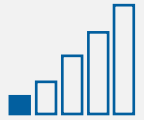
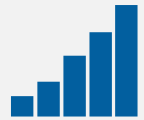
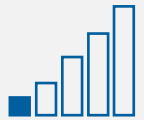
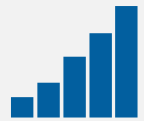
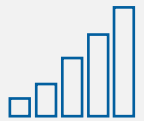
- **36,520 satellites to be launched in Earth orbit (2024-2033)**
- **x3.5 the number of satellites launched in the past 10y**
- **Increase in launched satellites is likely to further increase the number of debris in orbit**
- **6% of the satellites forecasted will be operated by EU operators**

Satellite forecast in Earth orbit



- **We forecast 36,913 satellites to be launched over next decade (2024-2033) of which 98.9% are in Earth orbit**
- **97% of satellites to be launched are in LEO**
- **GEO is a sensitive orbit for satellite operators. Hence although there are not many satellites, sustainable behavior is very important in this orbit**

Mitigation solutions

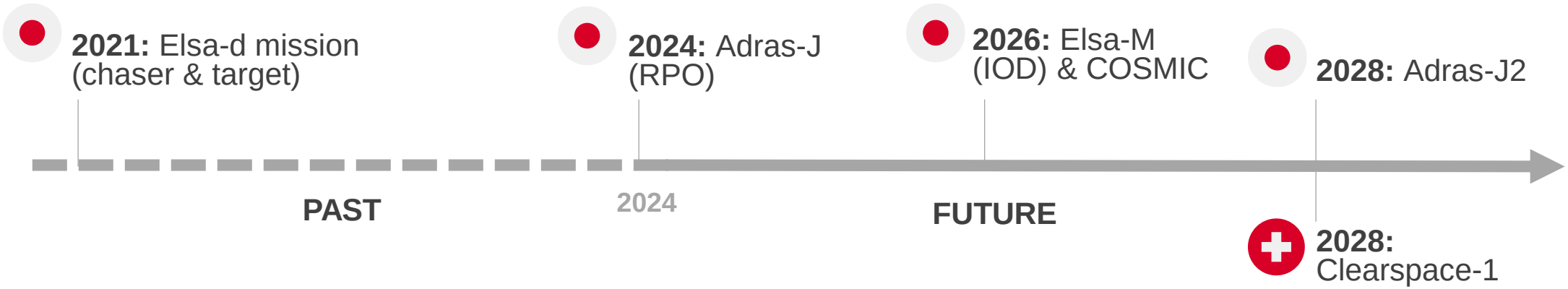
Mitigation solutions	Description	Cost	Deorbiting precision
Active debris removal	Spacecraft to set third party objects on controlled d-orbit trajectories		
Satellite own chemical propulsion	Controlled re-entry		
Built-in deorbiting devices	Uncontrolled re-entry: electromagnitic tethers, drag devices, electric propulsion or de-orbit solid kit		
Lower orbit by design	Causing rapid natural decay		
Divestment from LEO	Retreat to higher less crowded orbits		

- **ADR best fit for large object unable to deorbit (launched without EOL considerations or after a failure of an onboard deorbiting system)**

Active Debris Removal market – Market status

- **ADR is a developing market mostly relying on government contracts and fundings**
- **ADR technologies are still at the demonstration stage**

ADR missions of the Japanese Astroscale and Swiss Clearspace companies



Both companies develop ADR solutions and other in orbit servicing services (e.g. life extension services)

Active Debris Removal market – Market analysis

ADR inhibitors

High costs, low returns

ADR is a cost-intensive activity that doesn't give an advantage to its buyer.

Lack responsibility for debris

Prevent the emergence of coordinated demand from public authorities.

Cheaper alternatives

Satellite propulsion, lower orbits, passive de-orbiting, drag or propulsive kits.

ADR drivers

Tackle debris already in orbit

Large debris require controlled re-entry, which ADR enables.

Government regulations

Enforce mandatory de-orbiting rules, creating use cases for ADR.

Future reusable chasers

Would unlock more favourable economics and a strong price decrease for ADR.

Conclusion

1

- Both ADR technology and market are not yet mature

2

- ADR is driven by sustainability-focused governments.
- Commercial operators, on the other hand, have very low willingness to pay

3

- Mitigation solutions such as propulsion, solar sails, etc., being simpler and cheaper, will surely be preferred by satellite operators.
- ADR missions could therefore be used for satellites with a mitigation system failure

4

- Due to a lack of willingness to pay from commercial operators, the development of the commercial ADR market depends largely on the regulations implemented at regional and international level.
- Cost reduction of ADR services could, to a certain extent, increase their adoption

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