

Zero Debris Approach

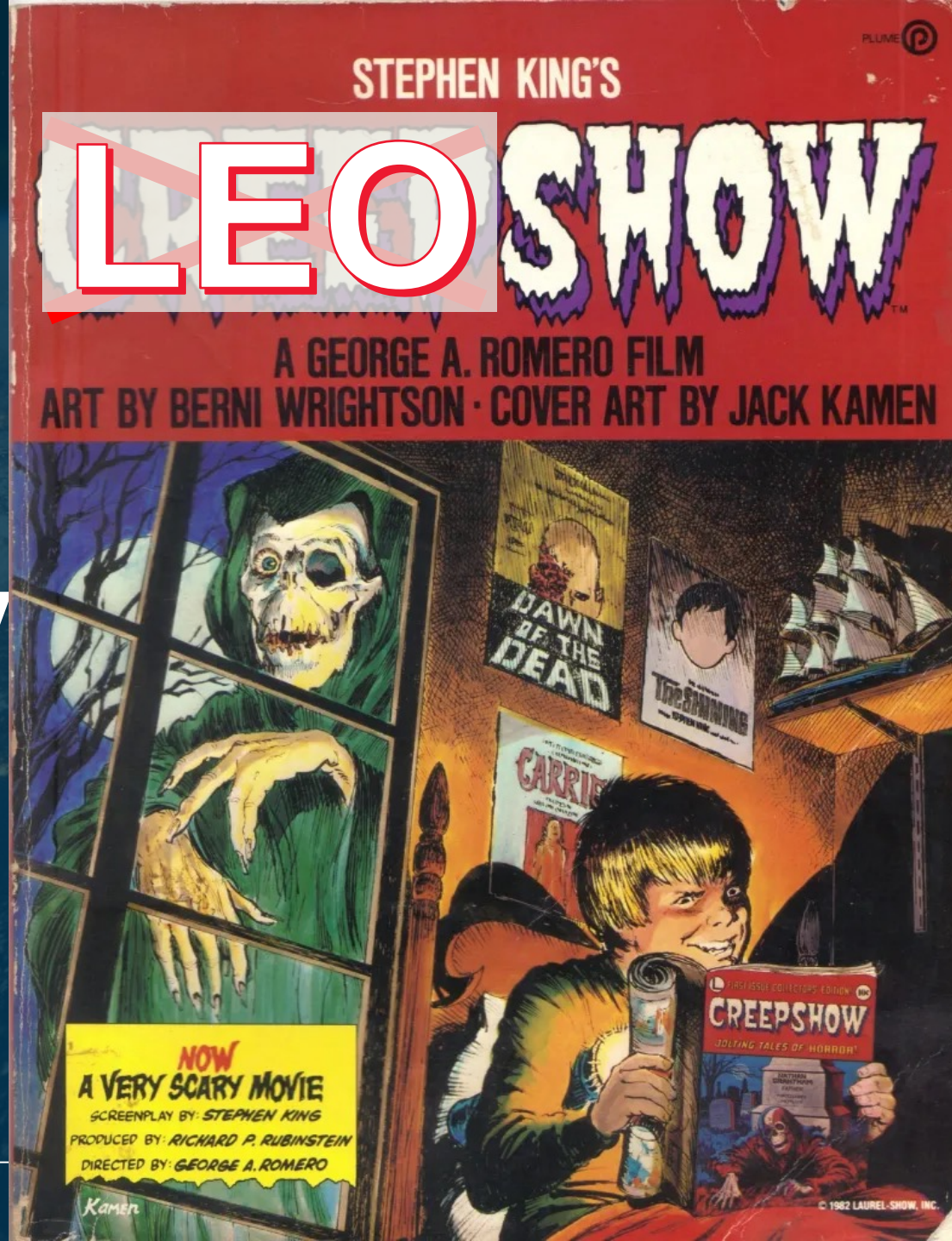
The why, the what and the how

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ESA ESTEC

10/10/2022

Why

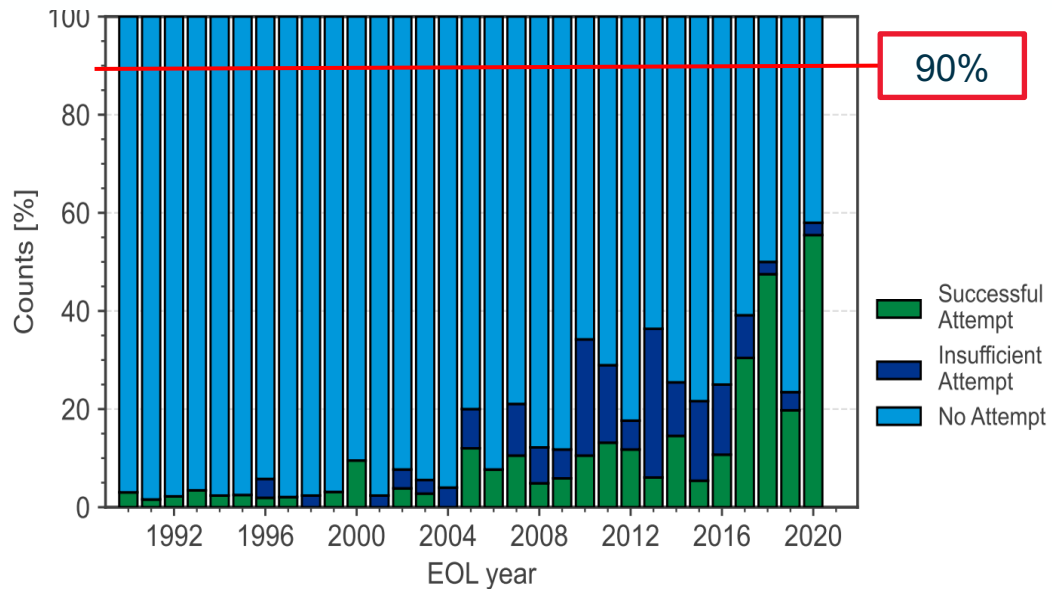


Why?

the space sector is changing, the behaviour not yet!

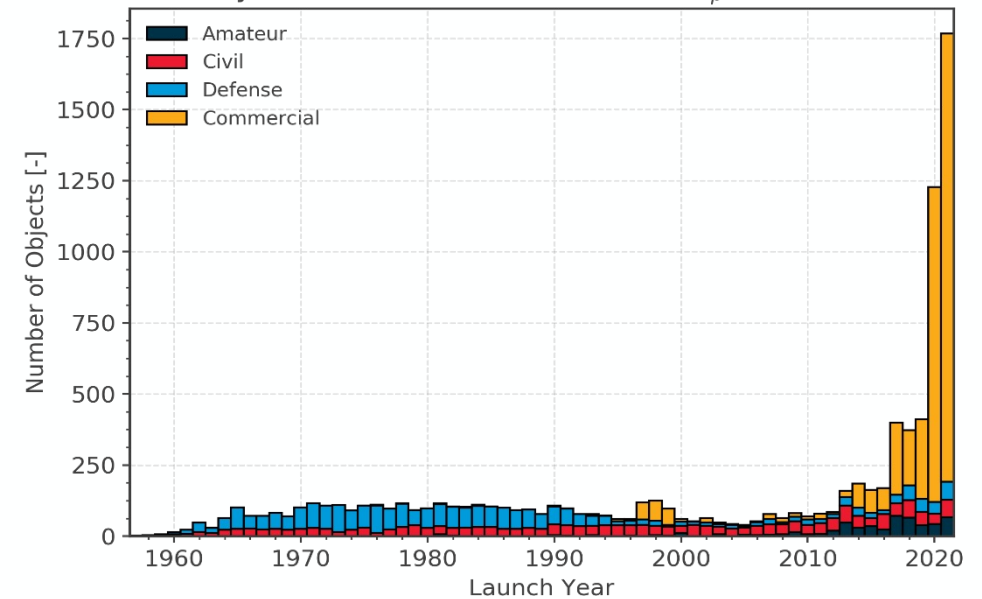
Successful disposal in LEO significantly below 90%

LEO Payload Clearance (excluding natural compliance)



In the next 3 years there will be more satellites launched than in the past 60

Payload Launch traffic in LEO



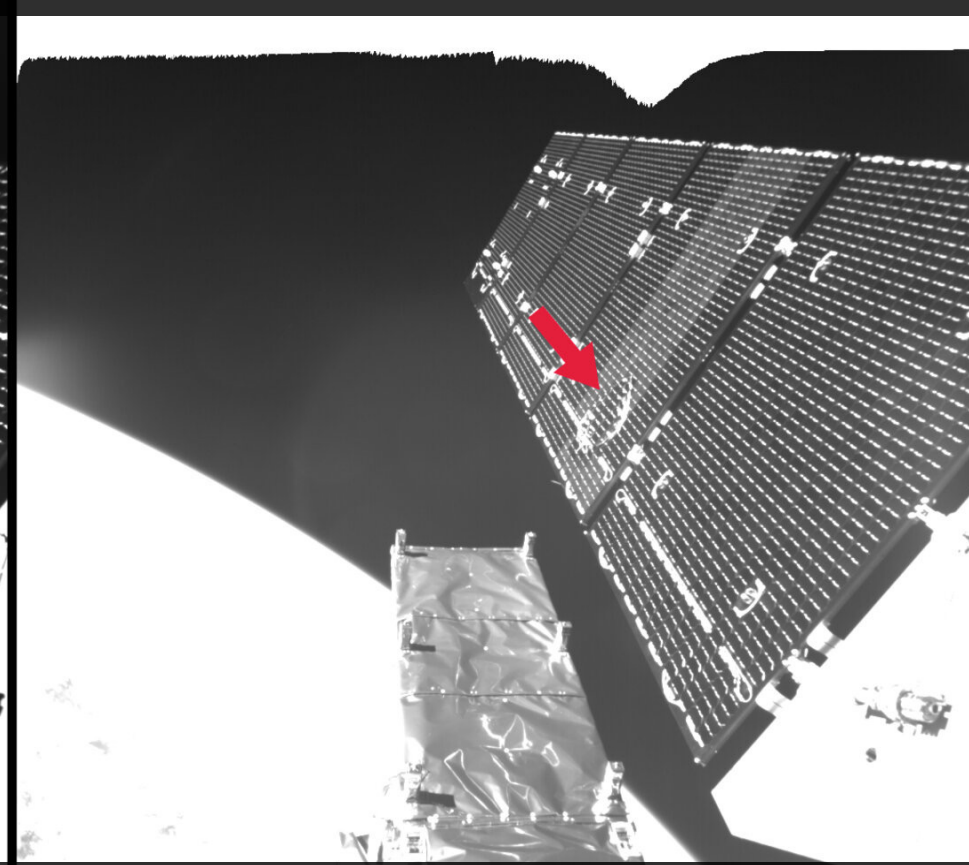
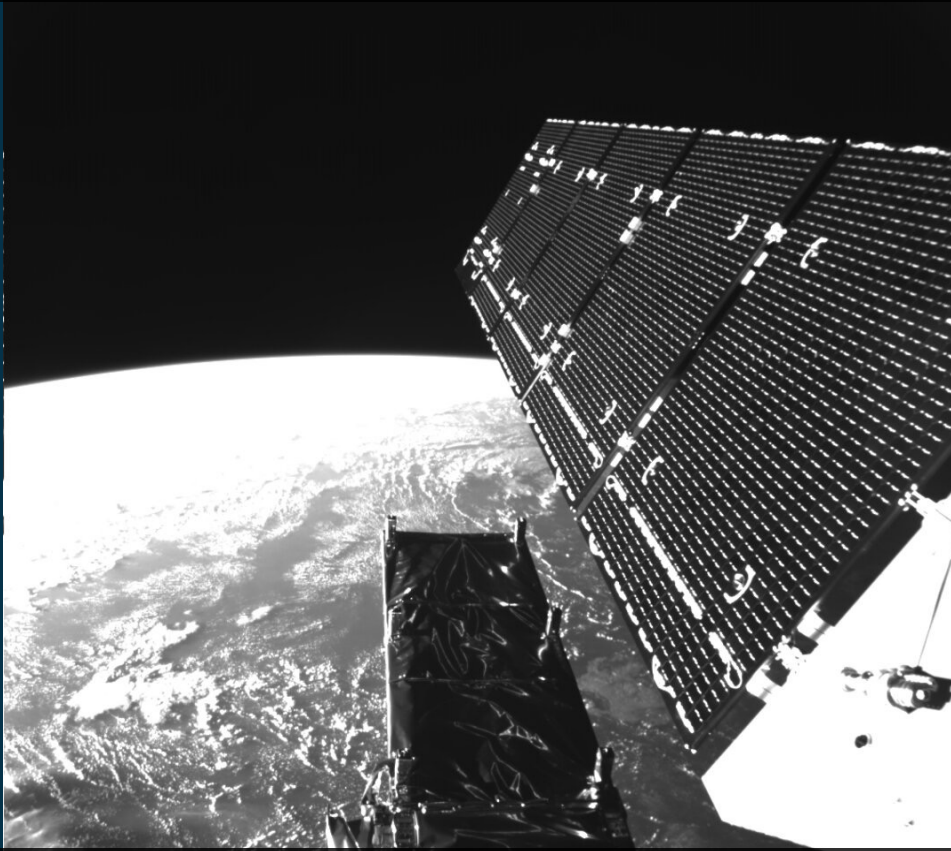
Space Debris Mitigation requirements will have to become more demanding

IADC advises probability of successful disposal significantly above 90% (with a goal of 99%)



Why? the situation right now

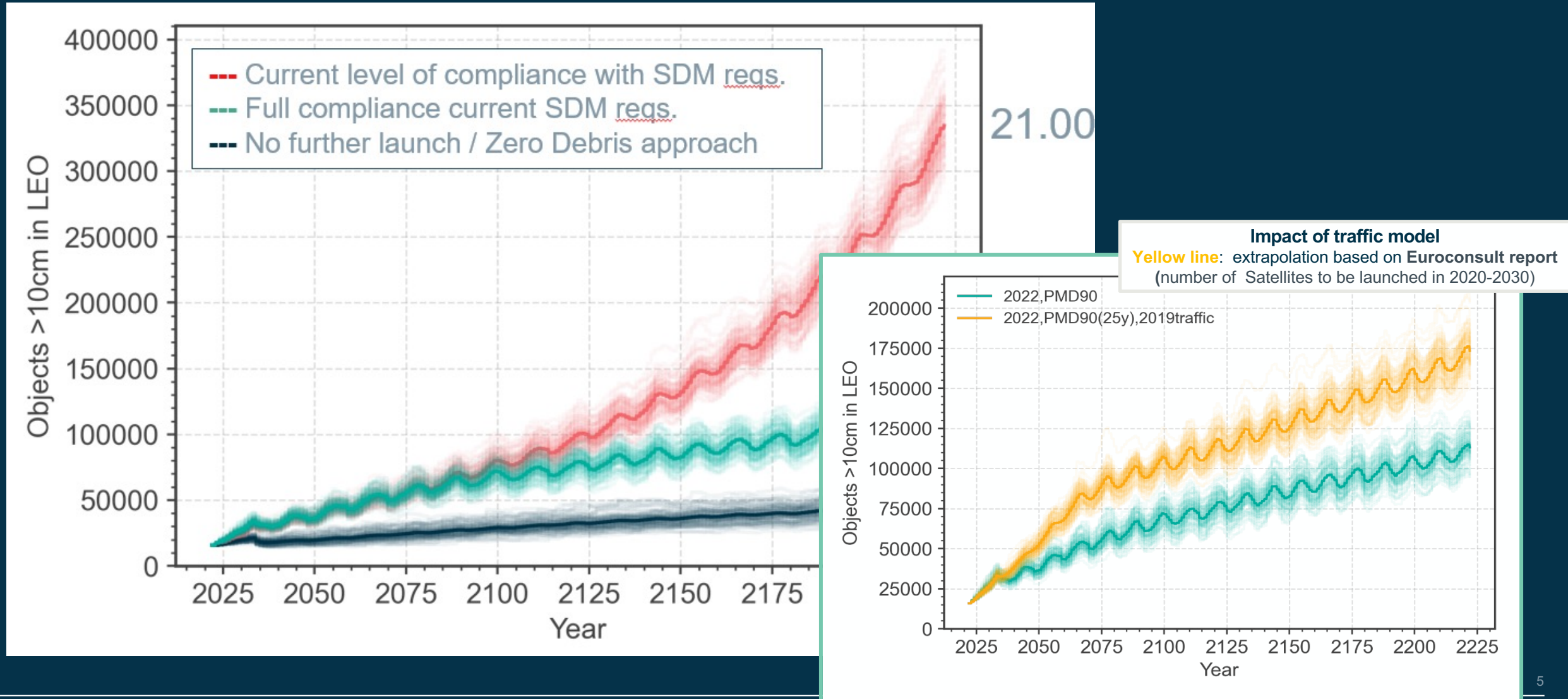
hit by ~5mm debris → 40 cm damage → at least 8 trackable debris (> 5cm)



~ 6% chance of being hit by a lethal un-trackable debris (i.e. between 1 cm and 5 cm)
during operational lifetime

Why?

what will happen to valuable orbital regions





“In ESA we are implementing a policy that by 2030, we have a **‘net zero pollution’ strategy for objects in space**, by consistently and reliably removing them from valuable orbits around Earth immediately after they cease operations. We need to **lead by example** here.”

ESA Director General, Josef Aschbacher

What?

Defining the Zero Debris approach



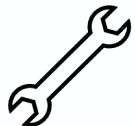
This approach is inline with the Net Zero Space charter, which was launched Nov. 12 during the Paris Peace Forum in France

Zero Debris

By 2030



Design and operate for **probability of successful disposal well above 90%**



Removal services for remaining in-orbit failures



Circular Space Economy

By 2050



Reposition, Repair, Repurpose, Recycle

Zero Debris

Mandatory disposal

High probability of successful self-disposal

Prepare for Removal

Successful deorbiting



Satellite self deorbit functions – e.g. 90%



Continuous monitoring to ensure self deorbit



Complementary ADR service

What?

The devil is on the details...

But how does ESA policy have an actual impact?

Is the technology ready?

We need to be able to try new things... where?

Is systematic ADR really the solution?

Is this affordable?

Is it going to kill New Space?

What about Cubesats?

How far can we rely on self disposal?

Won't this prevent ESA from collaborations/partnerships?

is 25 years still enough?

And passivation?

Who is going to pay?

What?

One thing is clear.....

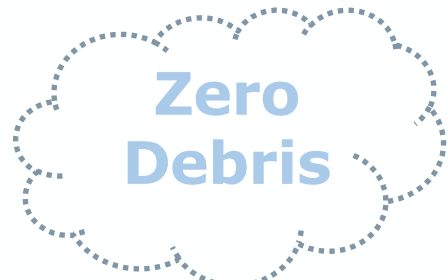
Is not going to be
easy



We need to do it
together!

What?

And we are



Zero Debris

WEBINAR & Informal consultation

Technical recommendations :

- *Recom. 1*
- *Recom. 2*
-

Proposed roadmaps

- *Knowledge*
- *Technical developments*
- *Policy & standards*



ESA
Zero Debris
is...

Zero Debris CDF

- Fast & high level
 - + First assessments
- Open
- Technical
 - + environment experts
 - + space systems experts
 - + operators
 - +
- Not binding!

Formal ESA WG

- Detailed analysis of impacts
- Formal consultation process

Studies & technical developments

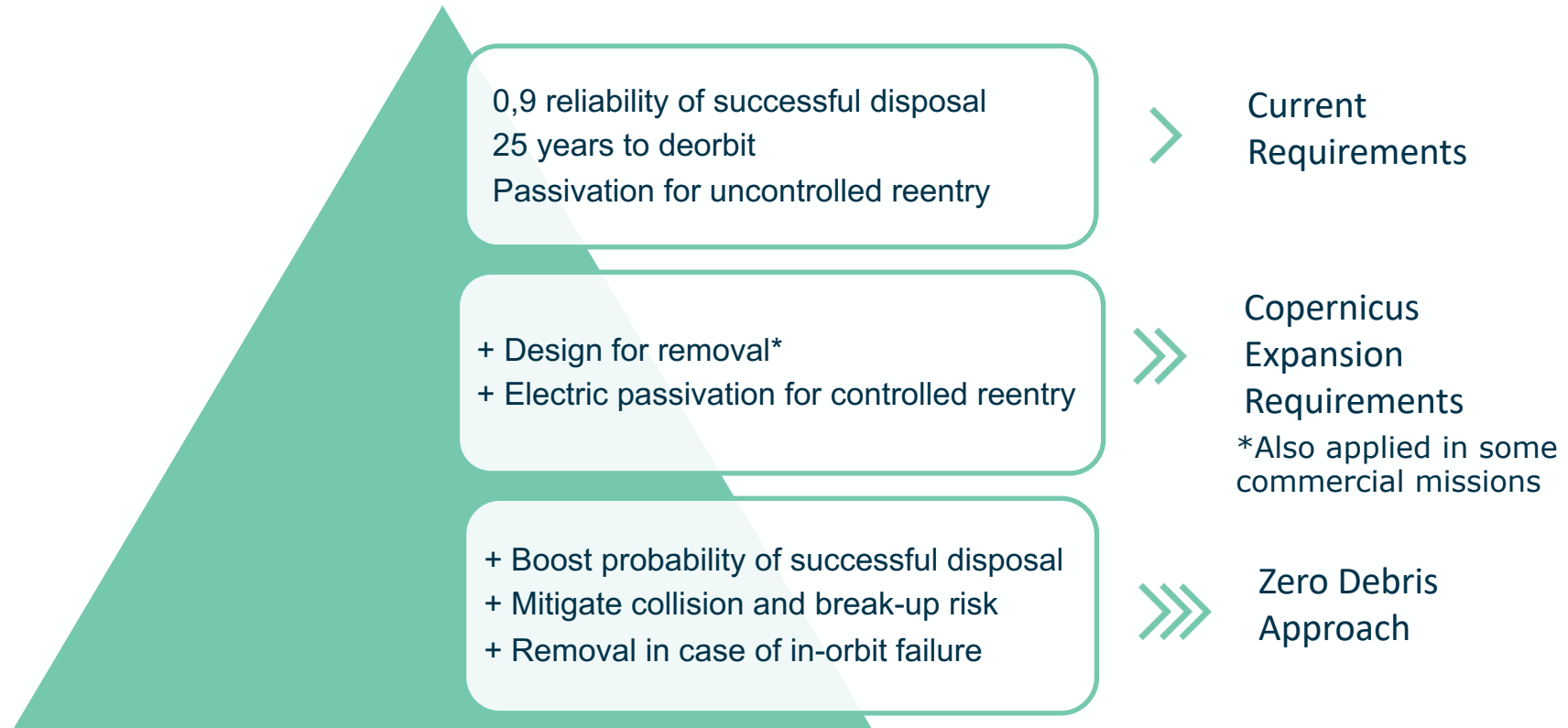


transversal action required - the 4 pillars:





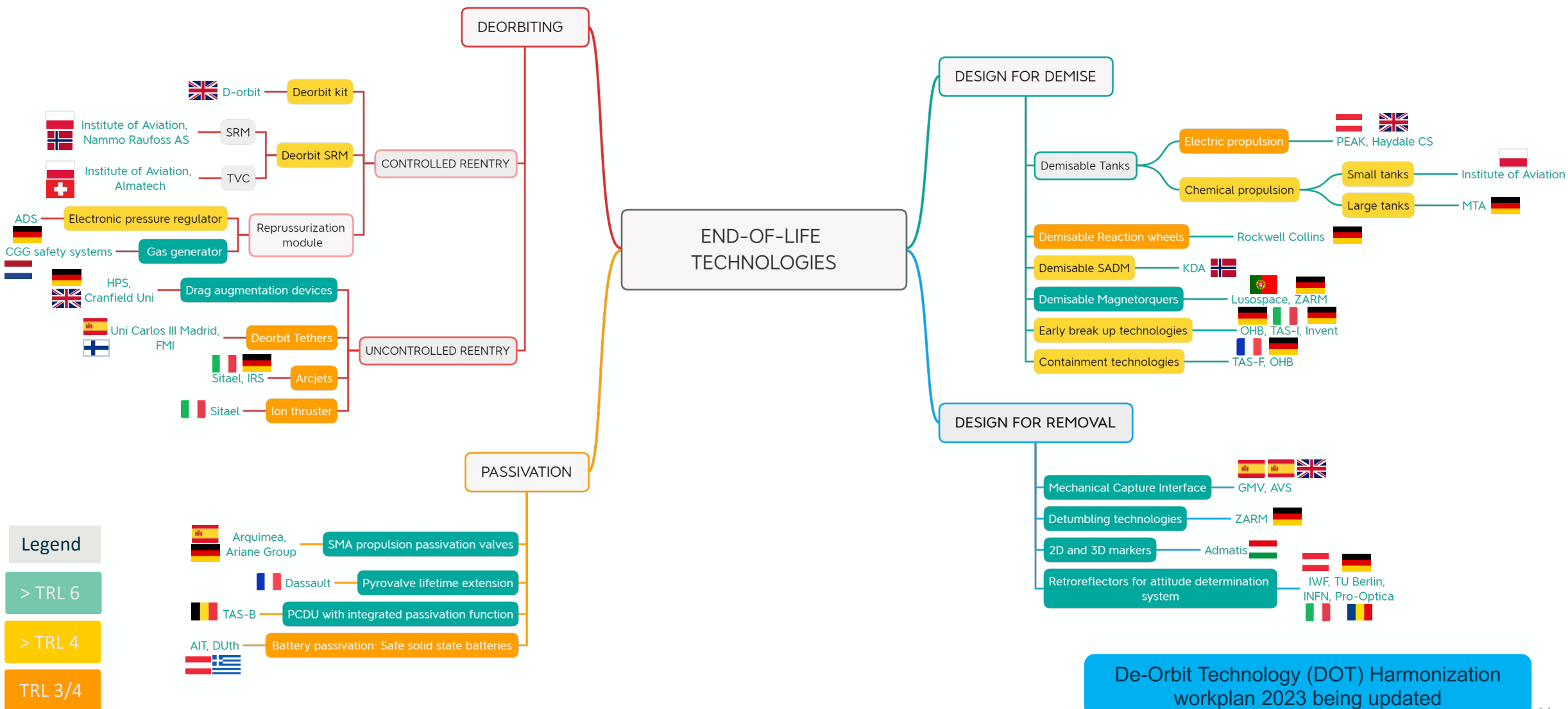
Steps towards Zero Debris Policy



 ESA is currently updating the Space Debris Mitigation Policy to **initiate a step-by-step approach towards Zero Debris by 2030.**



End of Life technologies



Legend

- > TRL 6
- > TRL 4
- TRL 3/4

De-Orbit Technology (DOT) Harmonization workplan 2023 being updated



📋 The European platforms need to evolve

Pillar 2: Platform upgrade

Requirements apply at system level, but impact subsystems and equipment



Mature technologies need integration at system level for future missions



Need standard products ready at a very early stage of the projects

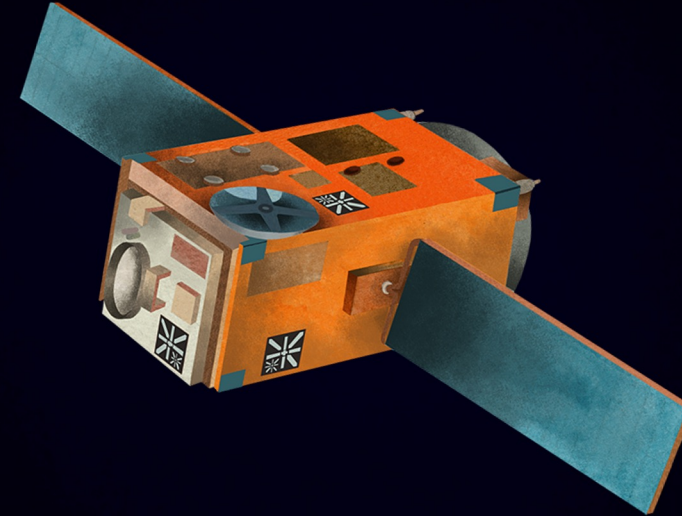
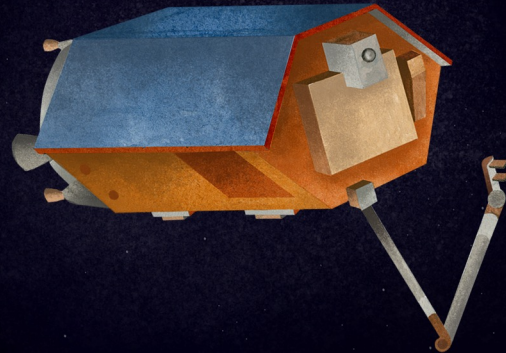


Zero Debris Platform activity

- ✓ To “bridge” the non-recurrent costs of evolving product lines ahead of future missions, while maintaining platform recurrent costs
- ✓ System level activity with strong involvement of suppliers
- ✓ Make Zero Debris a competitive advantage for European products



Debris Removal as a Service



 Active Debris Removal should become a **recurrent in-orbit operation and service**



Standardised interfaces started being adopted both by ESA (EO/Copernicus) and industry (e.g. OneWeb)
→ reduce ADR cost and risks

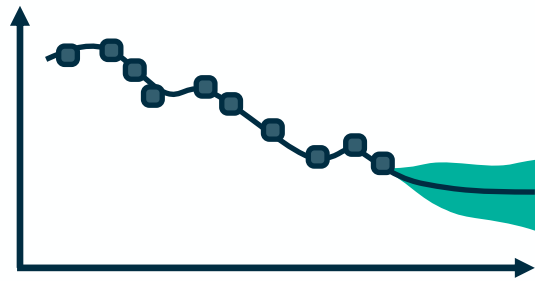


Foster development and qualification of systems to provide debris removal services, to ensure first mover advantage for European industry



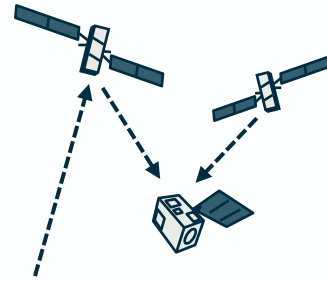
Synergies with In-Orbit Servicing, such as AOCS takeover, refuelling or others
→ Potentially open up new sustainable business markets

Improve collision avoidance



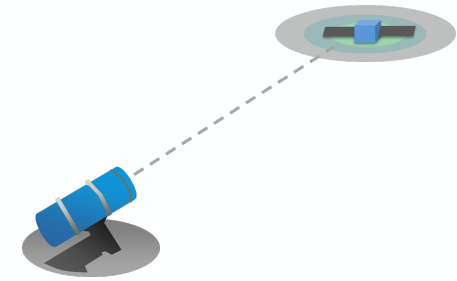
Automation
(reduce operator burden)

- Machine learning & uncertainty quantification
- Advance manoeuvre optimisation
- Automated decision criteria



Coordination
(reduce interruptions)

- Communication protocols, data needs, manoeuvre negotiation
- Data integrity, persistence, encryption, traceability
- Late commanding paths and operations concepts



Accuracy & Knowledge
(reduce risk)

- Moving the detection limits of ground and space based sensors

What's Next?

Stay in touch



Recordings of webinars

<https://blogs.esa.int/clean-space/clean-space-webinars/>



Zero Debris Forum

LinkedIn



**Council WG
Presentation October**



**Zero Debris CDF
Final Presentation
25 October @ online**
Open to European observers
Registration:
cleanspace@esa.int



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