Introduction – Zero Debris Approach

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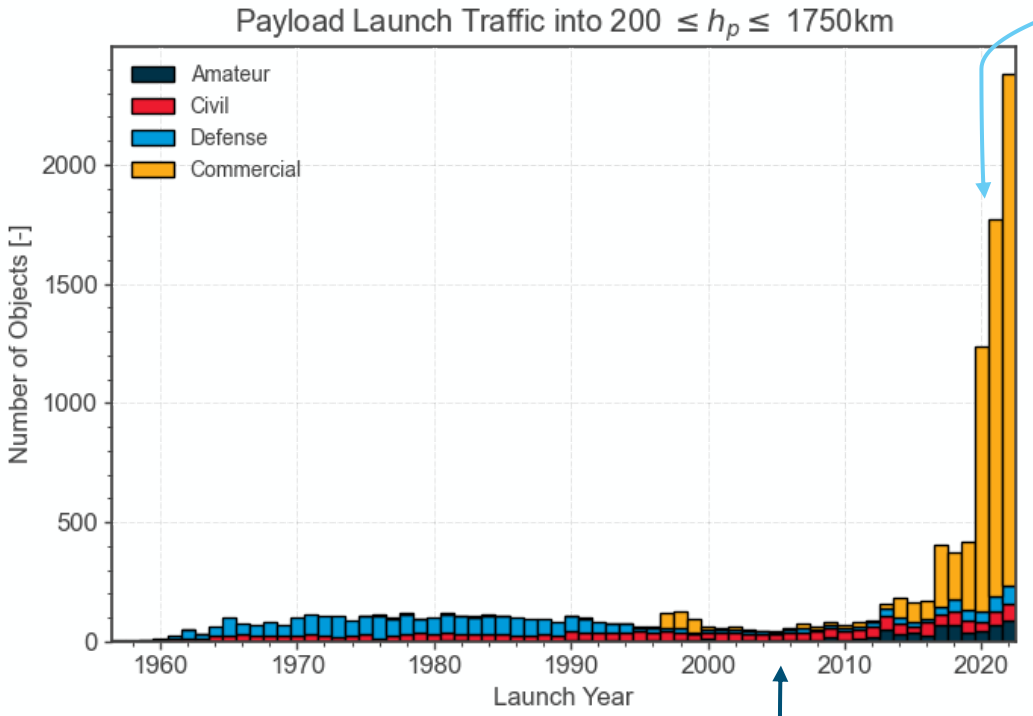
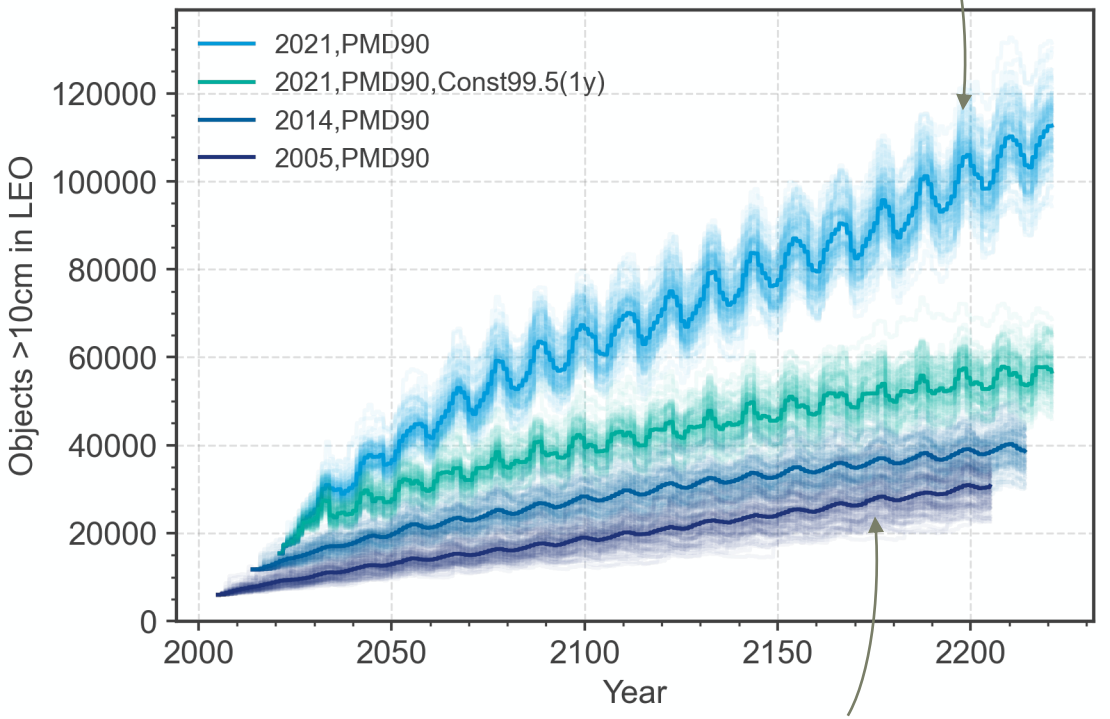
27/07/2023

Why do we need Zero Debris



What PMD90(25y) means now:
is this acceptable?



What PMD90(25y) meant when
IADC drafted their recommendation

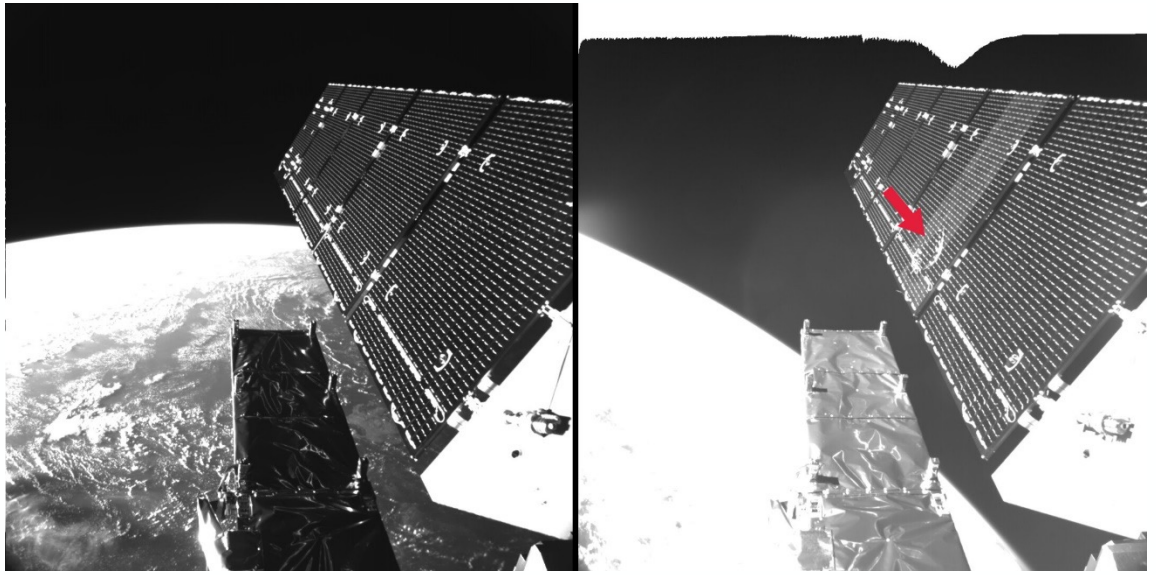
More stringent Space Debris Mitigation requirements are necessary

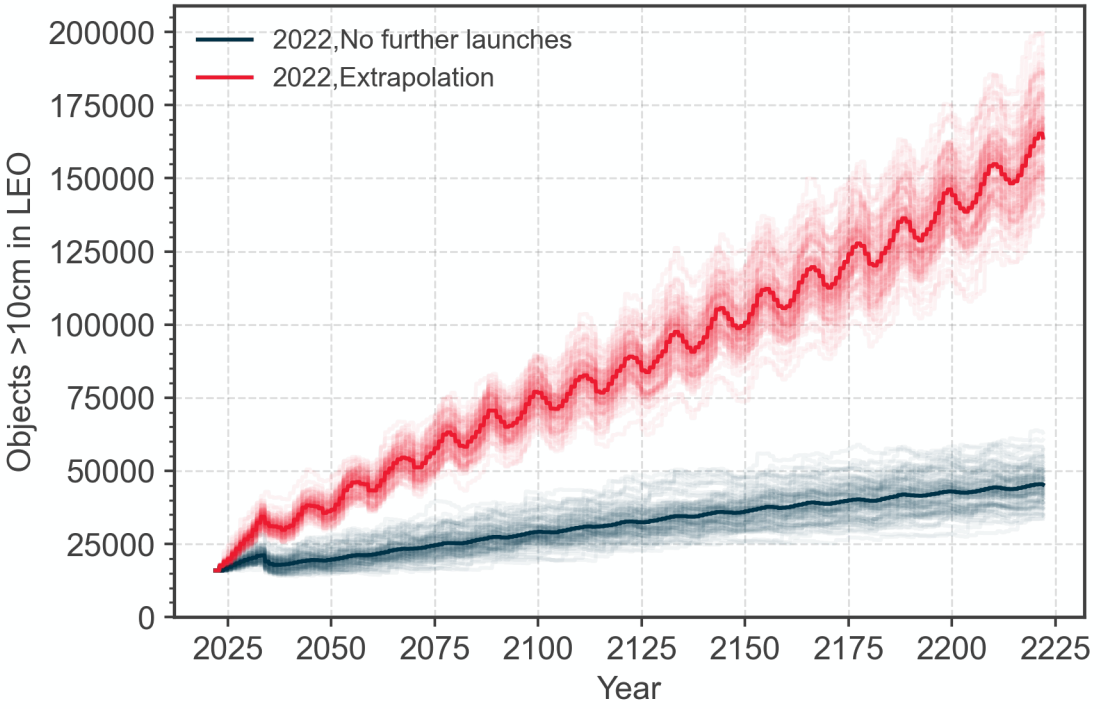
Why do we need Zero Debris

Collision with Sentinel-1A

→ hit by ~5mm debris in 2016
→ 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 7 cm) during operational lifetime





- Even if we stopped launching, the amount of debris would keep growing
- If we keep the current behaviour, the amount of debris will increase x10

"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

Engage with all interested partners to promote collaboration and capacity building through partnership

Zero Debris implementation

ESA Space Debris Mitigation Standard & Policy

New state-of-the-art technical requirements, applicable to ESA missions, in a step-by-step approach to implement a Zero Debris by 2030.

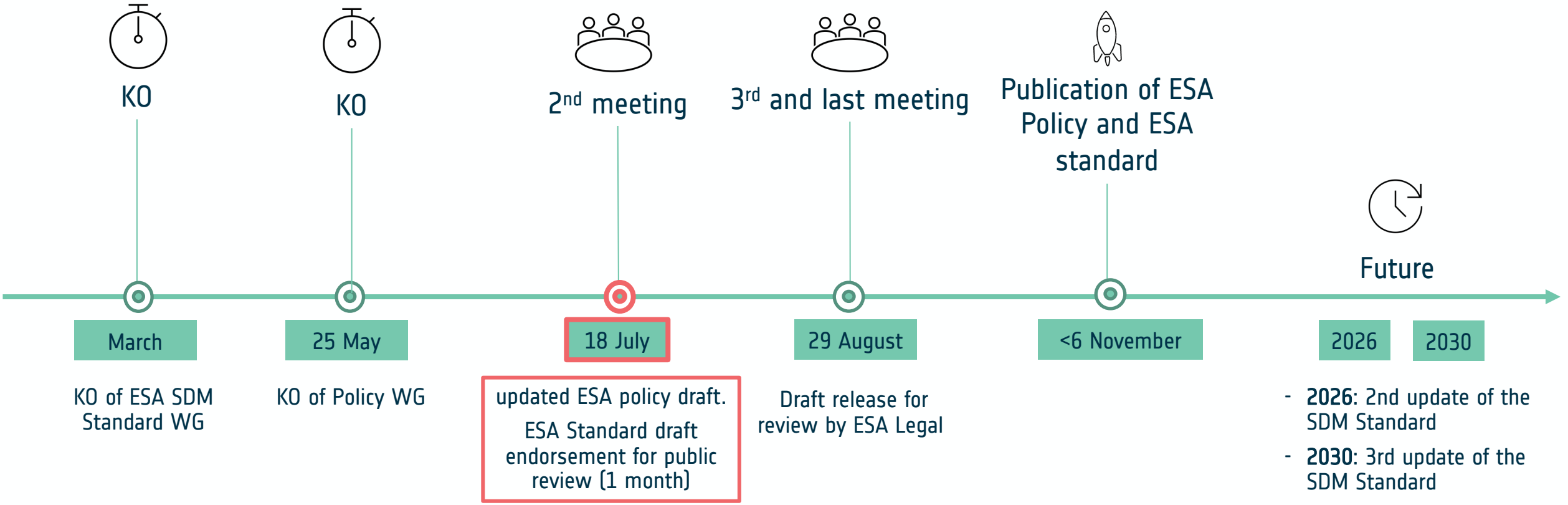
Zero Debris Participative Technology Booklet

Technical roadmap co-development with Zero Debris community to achieve the jointly defined sustainability targets by 2030

Zero Debris Charter

Engaging like-minded actors of the space sector in a collective effort towards space safety and sustainability

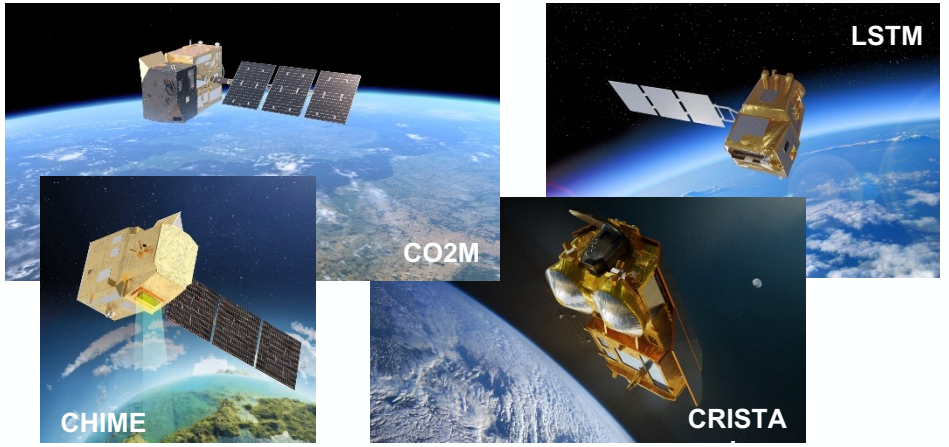
New ESA SDM Standard and Policy



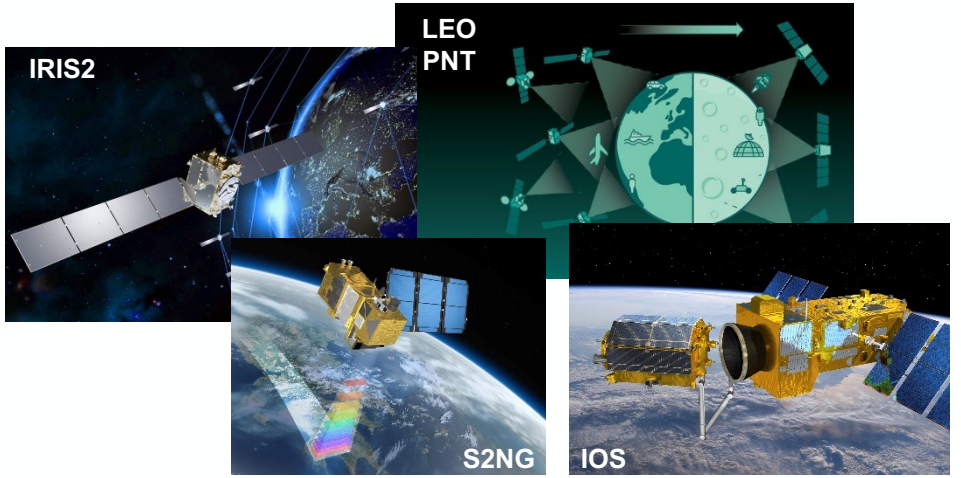
Applying Zero Debris to new missions

The new ESA SDM standard expected to become applicable to **all ESA missions** by the End of the Year.

Missions already that proactively applied dedicated requirements aligned with the Zero Debris e.g. Design for Removal interfaces and extra passivation features



Missions entering design phase, with specific additional requirements aligned to Zero Debris



Policy Evolution – other initiatives

Institutional initiatives

And private initiatives

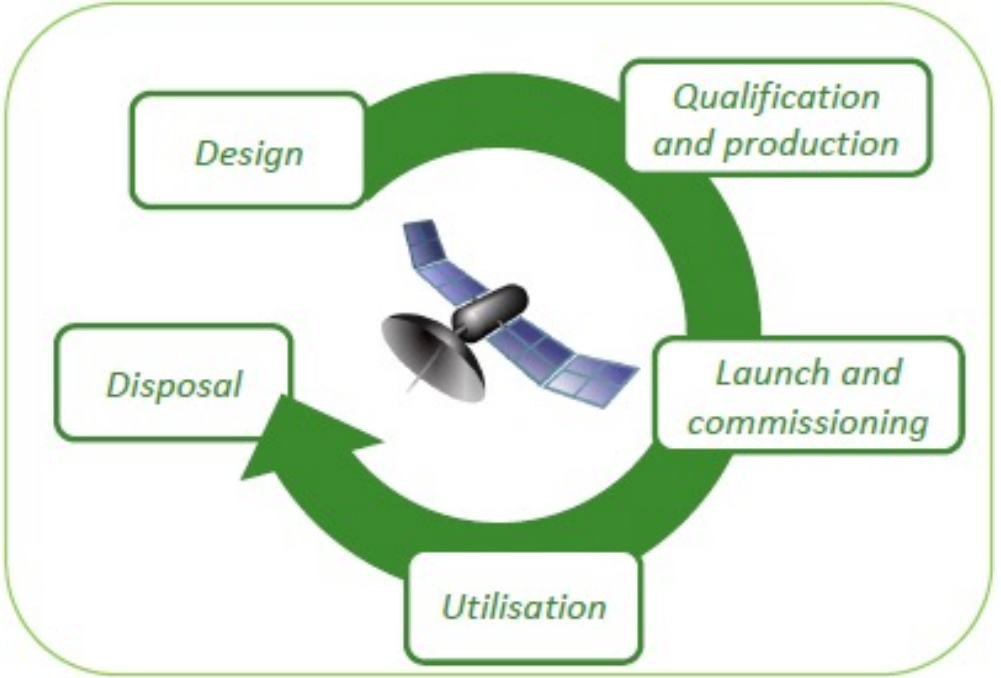
Communication and collaboration between all actors is key

ESA intends to work collectively towards clear and meaningful targets by 2030


Zero Debris Approach definition

Space Debris mitigation - Risks

- Unsuccessful Post Mission Disposal
- Satellites not prepared for removal
- Risk of explosion
- Risks of collision after End of Life
- Casualty risk on ground



- High number of collision alerts (Crossing of crowded orbits)
- Risk of dead-on arrival
- Release of Mission Related Objects

- Impacts with non trackable debris
- In orbit break up
- Unpredictable failure leading to loss of mission and/or unsuccessful Post Mission Disposal
- High number of Collision Avoidance Maneuvers

The Zero Debris approach: a combined approach

1 The traffic is increasing → **need to take action**

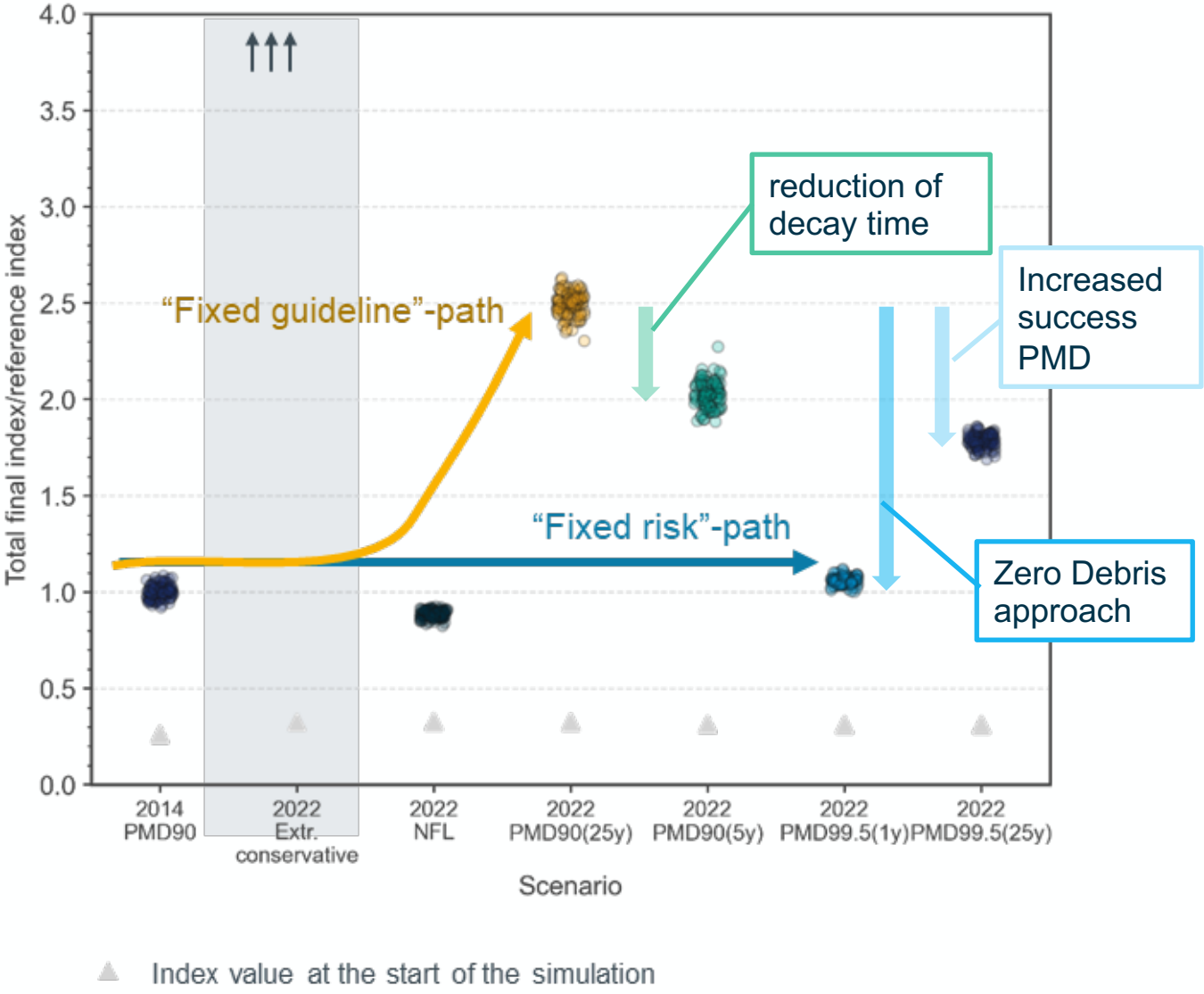
2 **Zero Debris** aims to **limit the risk** for future missions

3 This is only feasible through a **combined approach**:

1) Improving the **probability of post mission disposal**: going towards ~100%

2) **Improving the orbital clearance:** reduced time and collision risk threshold

3) **Avoid orbital break-ups** from internal and external sources



Technical Recommendations 2023 Summary

1 Applicable orbits

- **Extend space debris mitigation** measures to other earth orbits and lunar orbits.

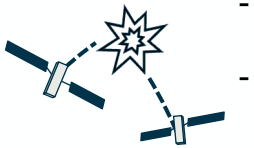
2 Guarantee successful disposal

- Improve probability of successful **self-disposal**
- **Prepare for removal**

3 Improve orbital clearance

- **Reduce time** left in protected regions **below 5 years ***
- Improve clearance in **other Earth orbits**

4 Avoid in-orbit collisions

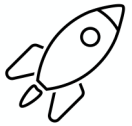


- Improve **collision avoidance strategy**
- Cumulative **probability of collisions after EoL < 10^{-3} ***
- Share **maneuver data**
- Improve **trackability**

5 Avoid internal break-ups

- **Mandatory** passivation features
- **0.95 * probability of successful passivation**

6 No intentional release of space debris



- **Prevent release** of launcher related objects and interference with valuable orbits

7 Limit on-ground casualty risk

- **Standardize** models and methods to assess demise
- **Improved demise** or controlled reentry of recurrent designs (e.g. launcher stages and constellations,)

8 Guarantee dark and quiet skies

- Mitigate impacts on **ground astronomy**

* numerical values under finalization within the SDM WG

Note: Dedicated requirements under definition for constellations

Zero Debris 2030 Targets

Probability of Successful Disposal from high-risk orbits > 99% through complementary removal services in case of failure

No intentional generation of space debris and **risk of accidental debris generation bellow 1 in 1000** for all objects

Improved monitoring of debris > 5 cm and **on-demand high accuracy tracking capabilities** to support Space Traffic Coordination

Systematic controlled re-entry or full demise of recurrent designs to mitigate aggregated on-ground casualty risk

Protection of Dark and Quiet skies for Astronomy and Citizens

Note: targets under consolidation through internal consultation and discussion with partners

Priority Technical Developments

Zero Debris implementation by 2030 relies on a roadmap of key technical developments:

Zero Debris compliant spacecraft platforms, e.g.:

- Interfaces for Removal,
- Demisable critical equipment,
- Improved Health Monitoring,
- Deorbit systems (e.g. 1U deorbit system for nanosats),
- Technologies to protect Dark and Quiet Skies.

Development & Demonstration of Remoual Seruices, e.g.:

- Cameras, Robotics, Integrated capture payload bay
- Implement ADR & IOS missions like ClearSpace-1, SUNRISE, CAT-IOD, etc.
- Collect and share lessons learnt in standards and guidelines.

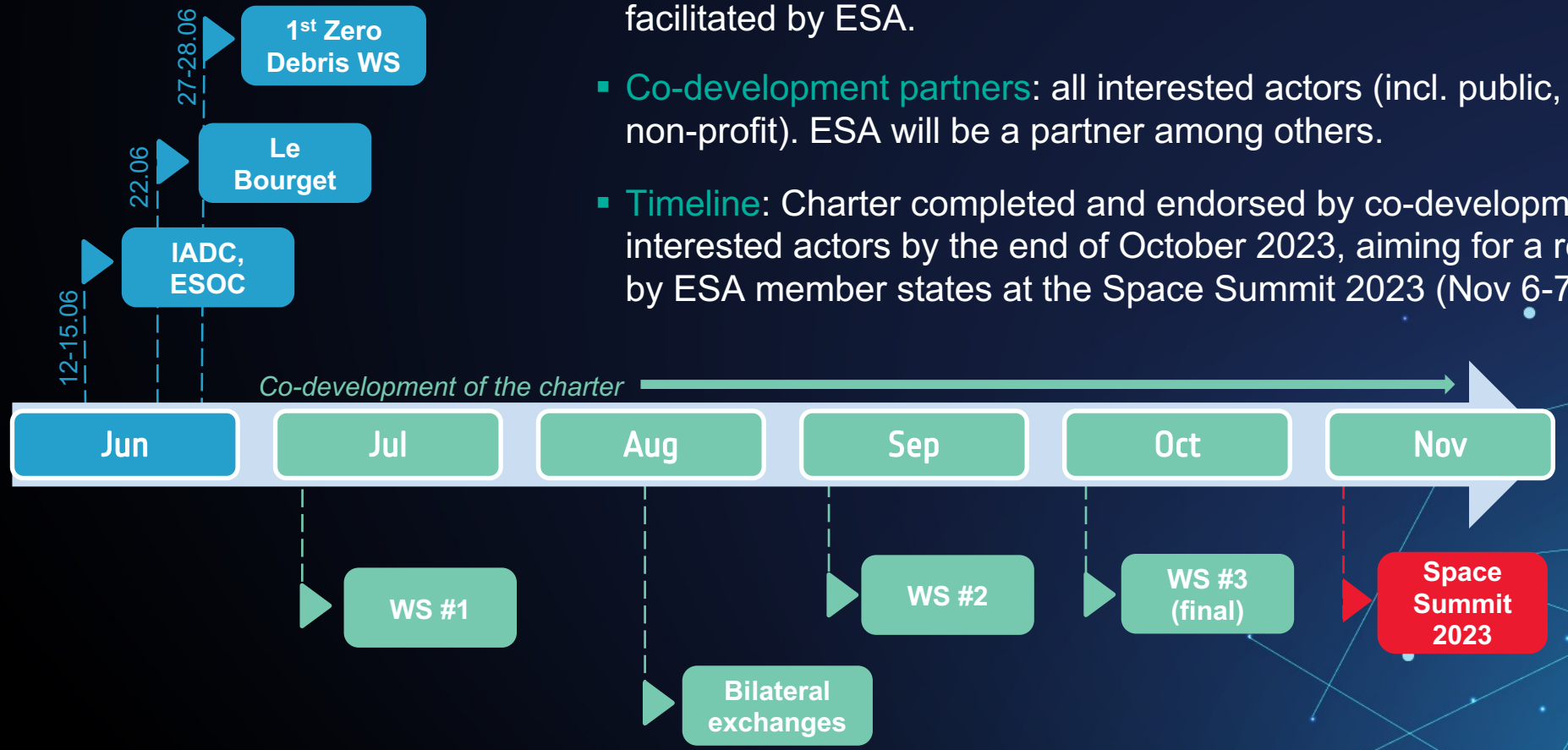
Technology improuement for SST and collision auoidance, e.g.:

- Small sized debris monitoring improvement,
- On-demand high accuracy measurements,
- Enhanced collision avoidance operations and coordination

ESA wants to foster capacity building though partnership

Zero Debris: Charter initiative

- Objective: demonstrate the intention of the European space sector to act collectively towards jointly defined, ambitious and meaningful targets, paving the way for collaborative capacity building activities.
- Process: initial draft proposed by ESA, followed by a co-development process facilitated by ESA.
- Co-development partners: all interested actors (incl. public, private, academic and non-profit). ESA will be a partner among others.
- Timeline: Charter completed and endorsed by co-development partners and other interested actors by the end of October 2023, aiming for a recognition of the Charter by ESA member states at the Space Summit 2023 (Nov 6-7 in Sevilla, Spain).



The Zero Debris Charter: announcement at Le Bourget

→ THE EUROPEAN SPACE AGENCY

EXPLORE NEWS INNOVATION SERVICES SPACE SAFETY

ESA announces the Zero Debris Charter initiative

Submited on 22 Jun 2023

Zero Debris Charter co-development kick-off webinar

10 July 2023 (Monday), 13:00 – 14:00 CET

Agenda

- Detailed presentation of the Zero Debris Charter initiative
- Release of the Zero Debris Charter ‘draft 0’
- What we expect from partners

→ Registration link will be provided at end of the workshop

Thank you for listening

Keep following the Zero Debris progress :

https://blogs.esa.int/cleanspace/

#cleanspace #zerodebris #spacesafety

https://fr.linkedin.com/showcase/esa-clean-space

https://www.linkedin.com/groups/12670558/

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