Introduction to e.Deorbit

Robin Biesbroek

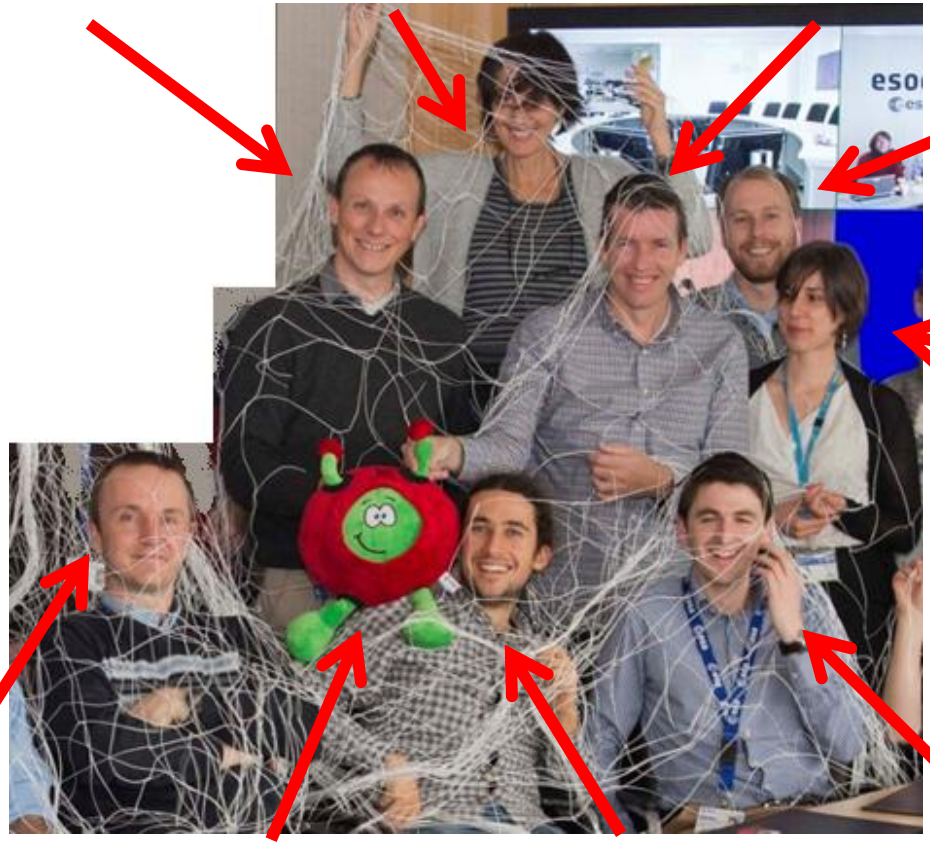
Meet the ESA e.Deorbit Phase A team

Kjetil
Robotics & net

Luisa
Clean Space manager

Robin
e.Deorbit manager

Jakob
system engineer



Jessica
Organised this symposium!

Alexander
Net dynamics

Paxi

Tiago
Clean Space roadmaps

Andrew
System engineer

Meet the ESA e.Deorbit team (cont..)

Sven

GNC systems

Rogier

Propulsion

Fulvio

Risk/PA

Michel

Cost

Otto

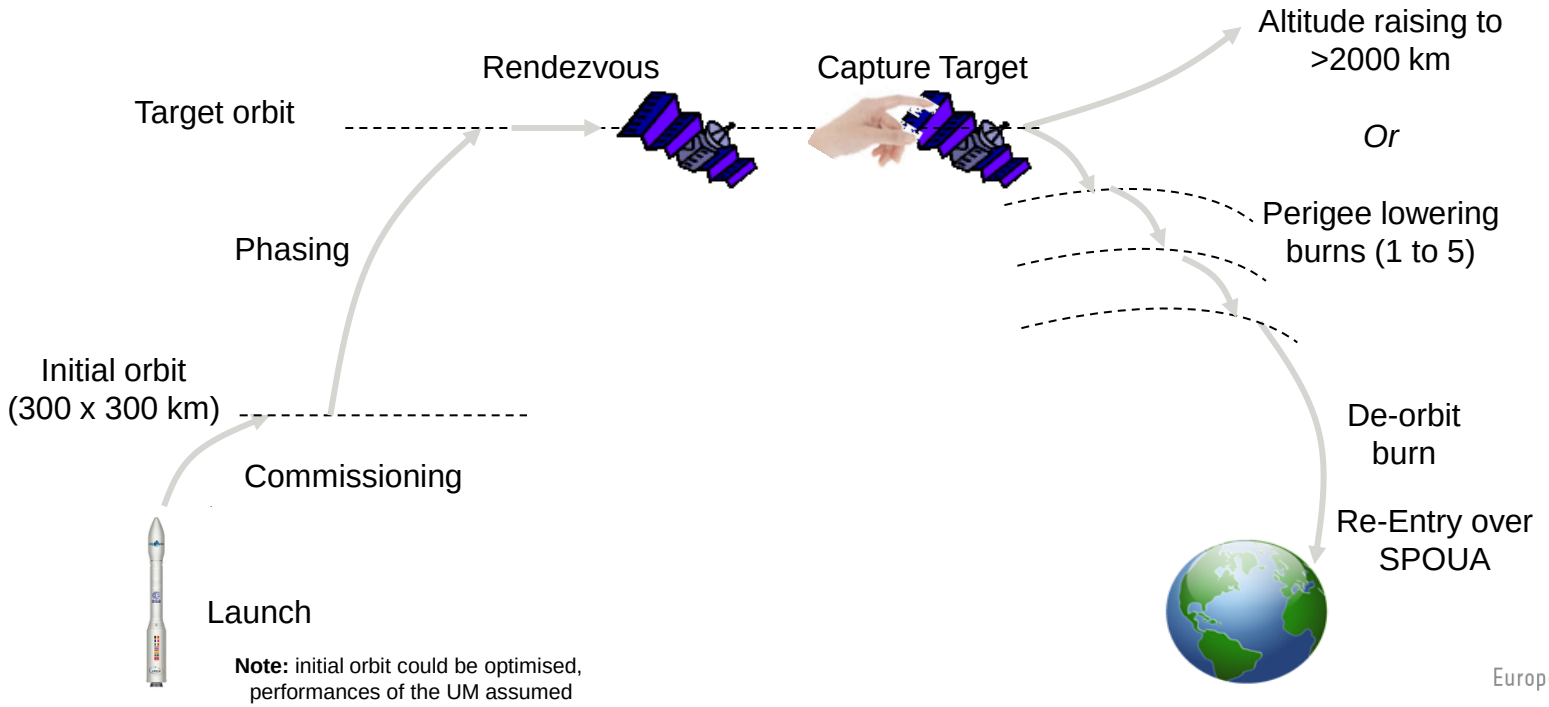
Programmatics

Benjamin

Space Debris

Mission Objective of e.Deorbit

1. The mission objective is to perform **active debris removal**
   a. Uncooperative ESA-owned debris object (large satellite or upper stage) with heavy mass (> 4000 kg)
   b. In 800-1000 km (near) polar region



A long time in a galaxy far, far away...

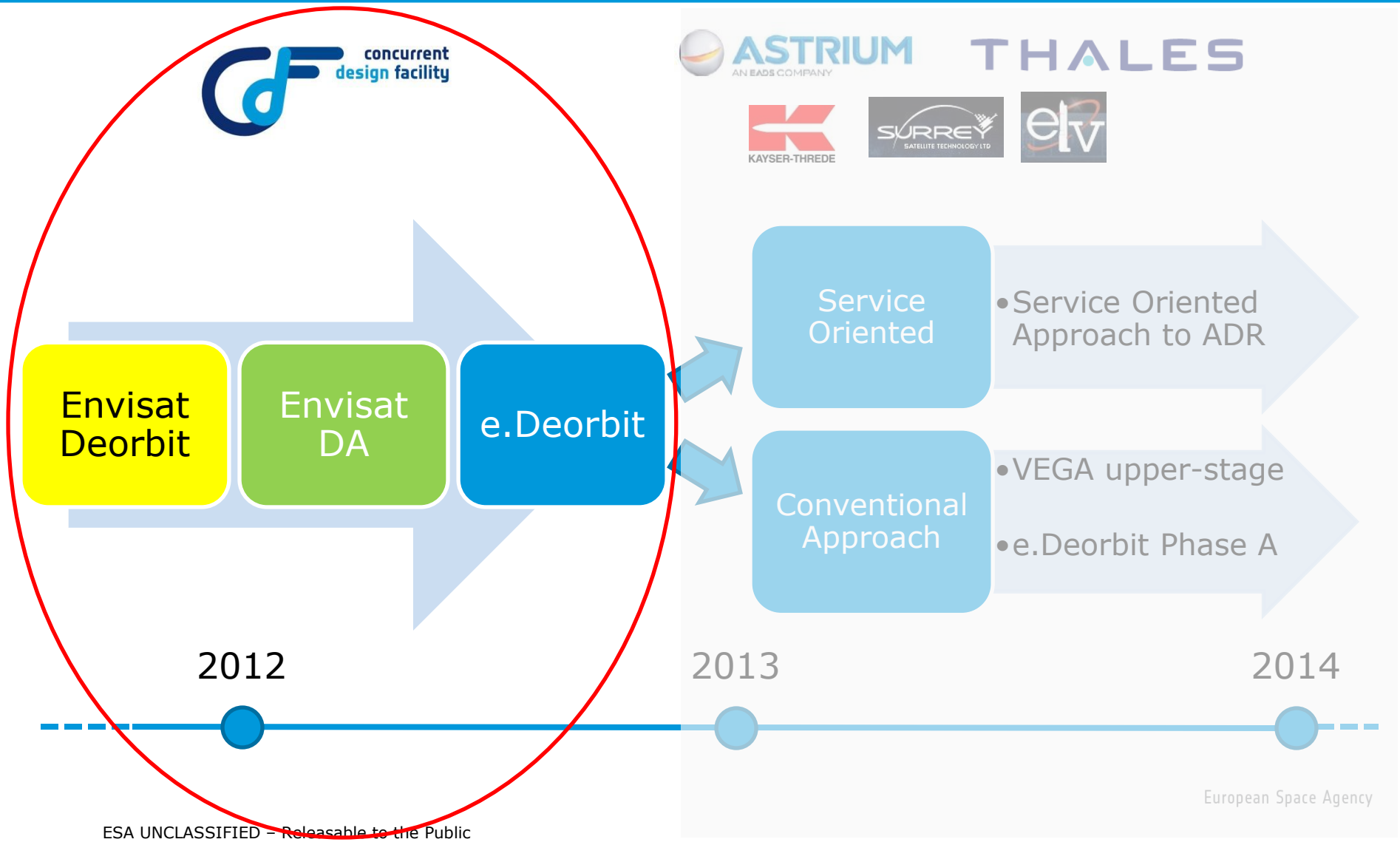
Meanwhile, back on Earth…

1967 © United Artists
1995 movie review by J. Berardinelli “rockets that swallow up spacecraft are a bit too extravagant.”

Now for real…

Mission Profile

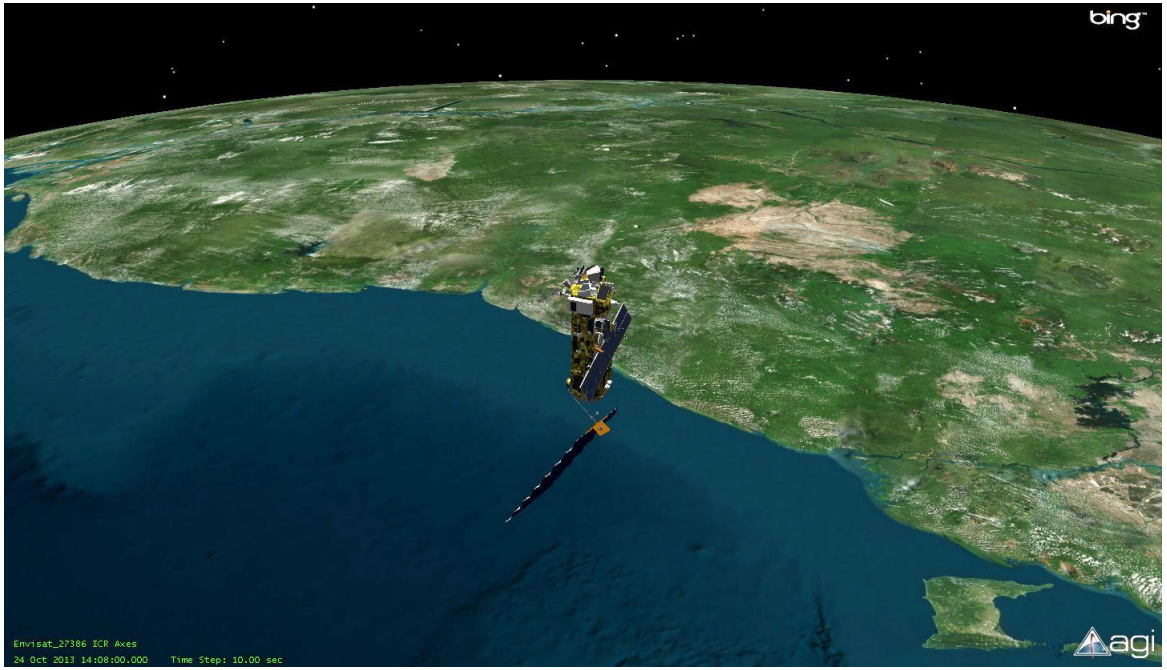
Timeline of de-orbit studies



e.Deorbit: Envisat as design case

Why?

- ESA owned
- Heavy mass (> 4000 kg)
- Large shape (body dimensions similar to many upper-stages)
- In busy orbit (SSO 800 km)



- Issues:
  - Very high mass (8000 kg) leads to high propellant consumption
  - Solar panel locked in 'worst case' position
  - Future attitude unknown (assumed 3.5°/sec and 5°/sec worst case)
  - Information about little details hard to find ('old design'; no digital info, retirement of staff etc.)
  - Assumed non-passivated

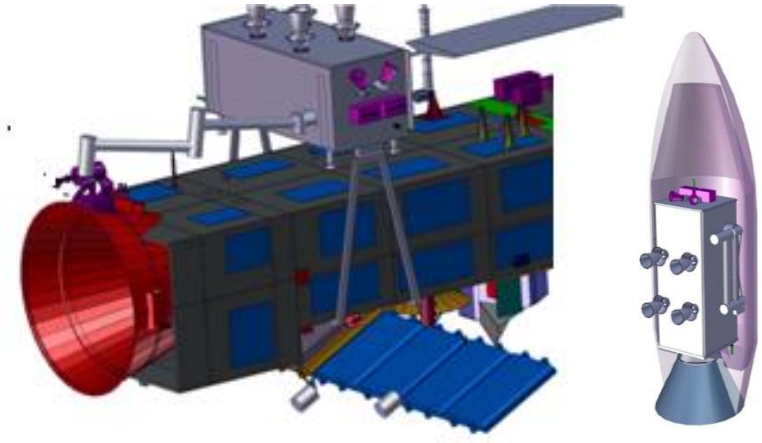
2012: e.Deorbit CDF study results

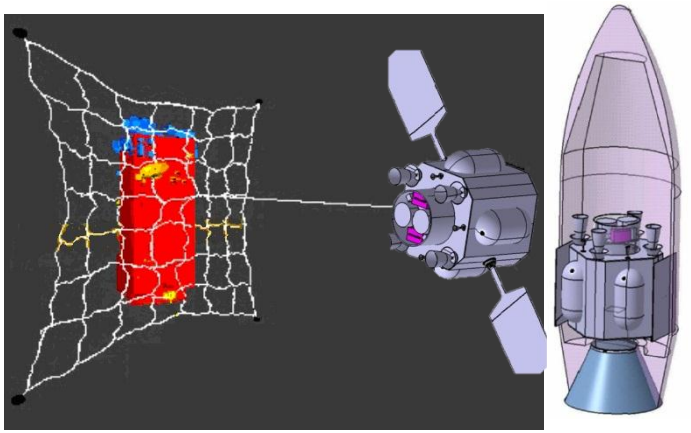
Clamping Mechanisms ('tentacles')option

- Clamping mechanisms + pushing rods
- May need robotic arm (baselined in CDF study)
- VEGA launch (1590 kg)
- Chemical Propulsion (2 x 425N)
  - 52% of total mass is propellant
- LIDAR, Far field & near field, RW's + thrusters
- Controlled re-entry (3 + 1 burns)

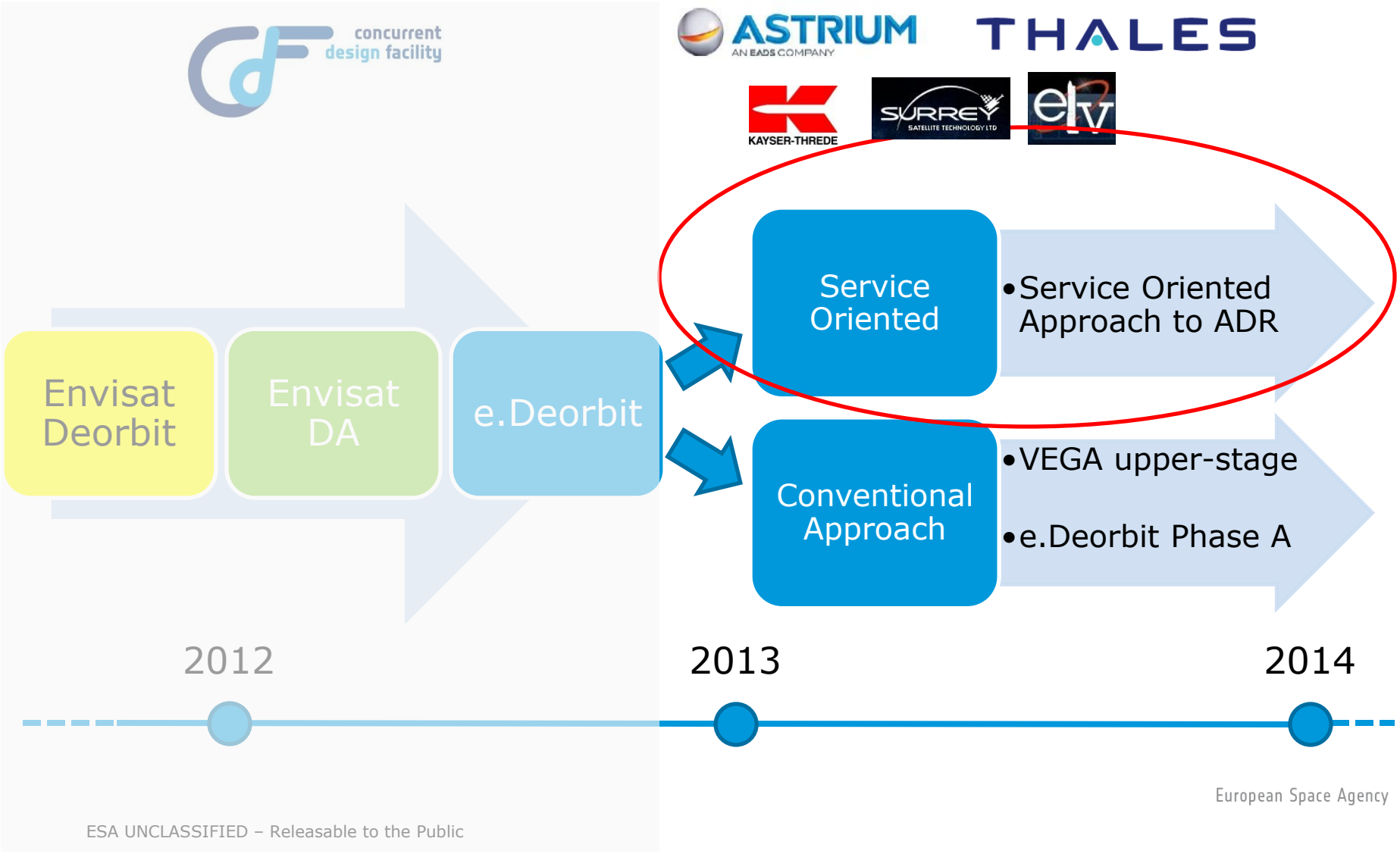
Net option

- Net shot towards target
- 1 net + 1 redundant
- VEGA launch (1560 kg)
- Chemical Propulsion (2 x 425N + 2 x 220N)
  - 56% of total mass is propellant
- LIDAR, Far field, thrusters
- Controlled re-entry (3 + 1 burns)



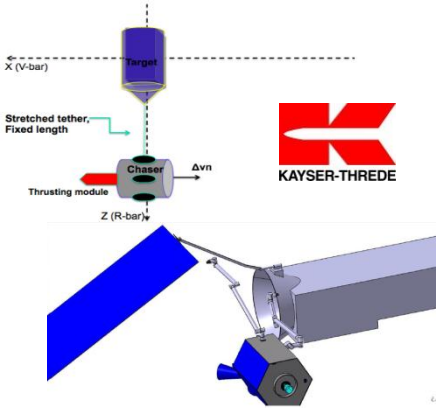


Timeline of de-orbit studies

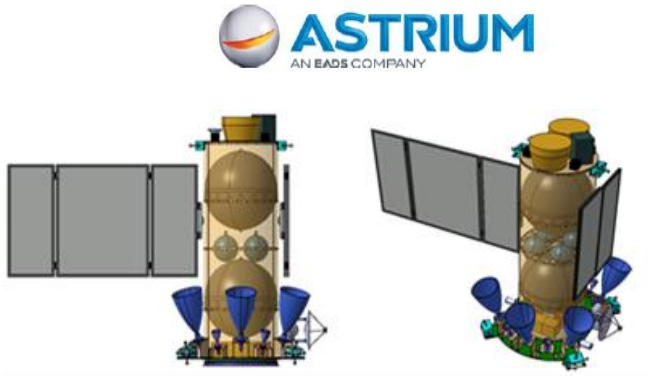


2013: A service-oriented approach

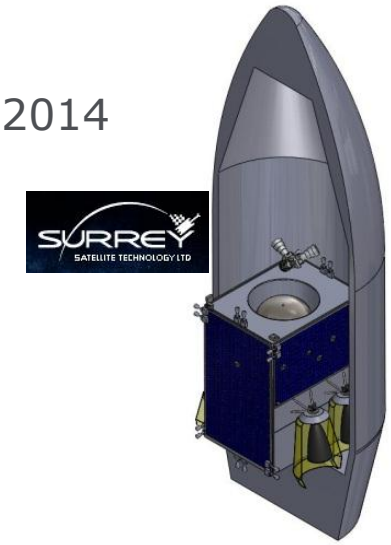
- Objectives of this study were to address the feasibility of an Active Debris Removal mission, to define a **business model** for the implementation of the ADR mission:
    1. ESA buys **'a service'** for the first ADR mission
    2. to define a **business plan** for future ADR missions and technology roadmaps for the removal of large debris from space.
- Final presentations end of 2013. Presented to TAWG in 2014



Credits: Kayser-threde / OHB system / Polimi

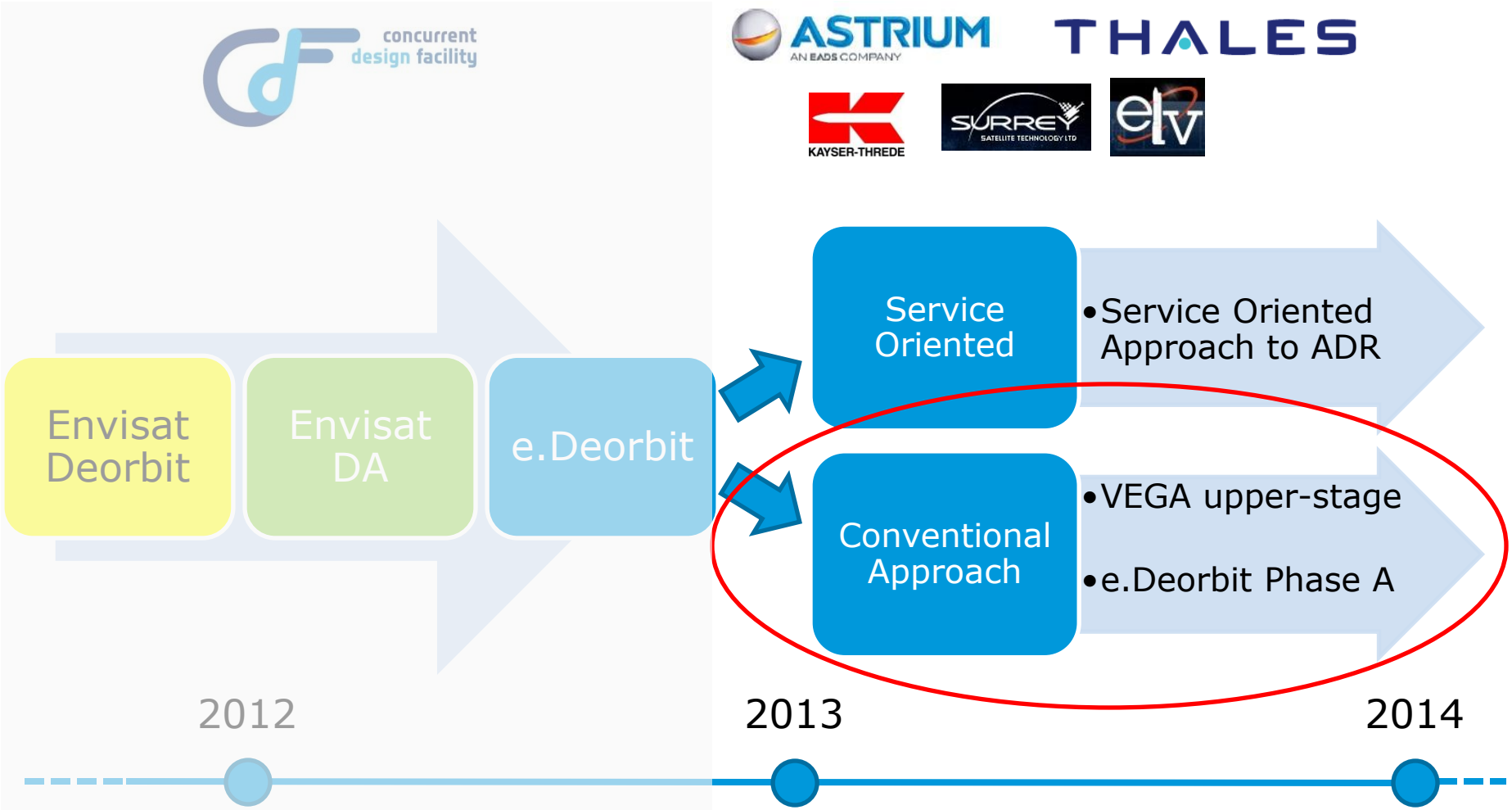


Credits: Astrium / DLR



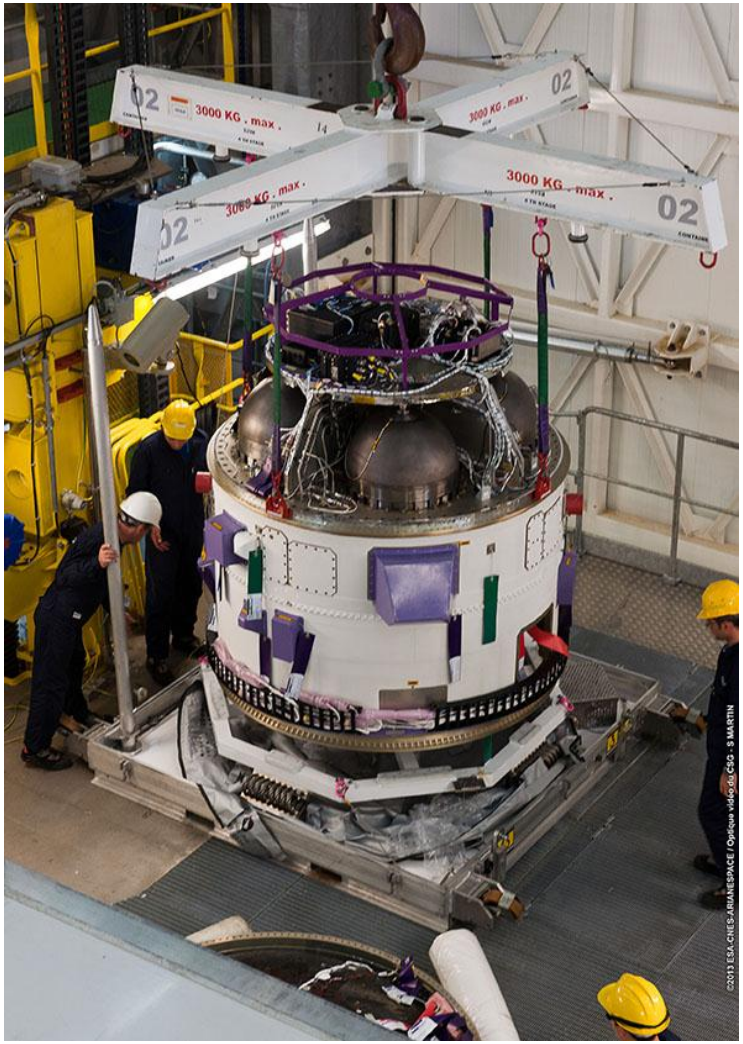
Credits: SSTL / Aviospace / Deimos

Timeline of de-orbit studies

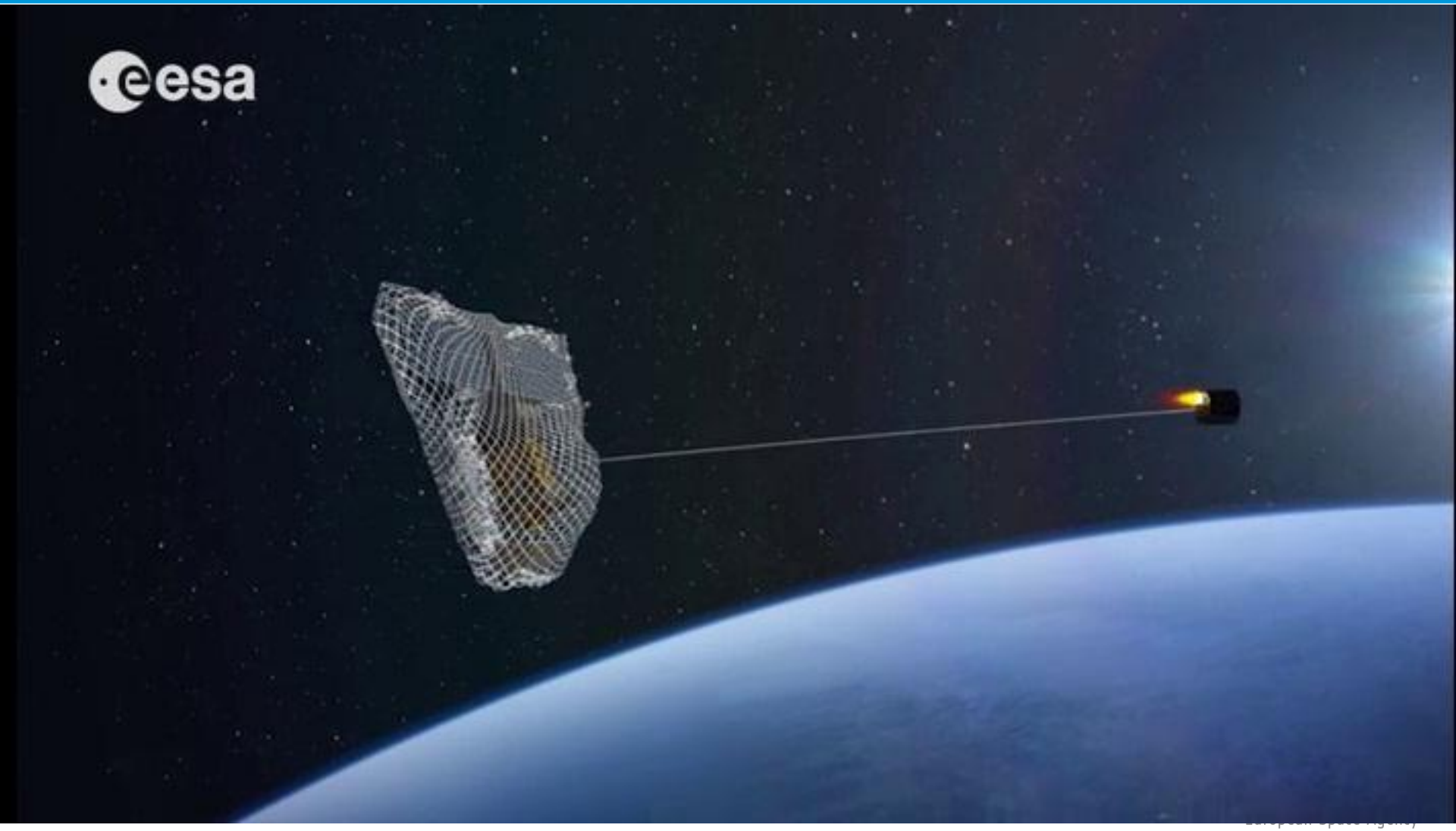


Using AVUM as platform

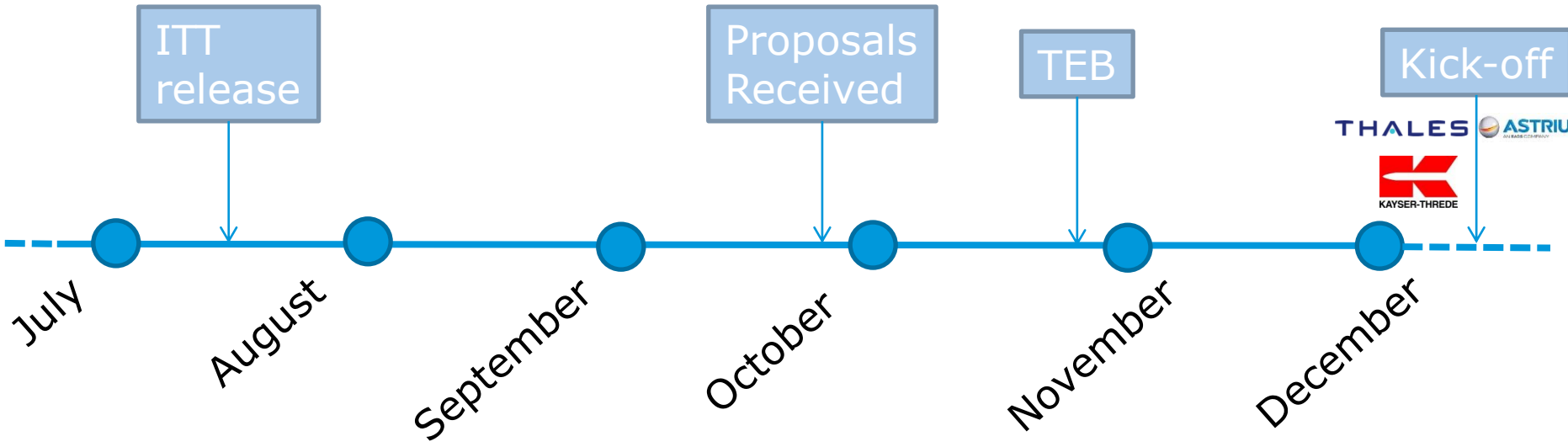
1. Propulsion and GNC typically high % cost of total platform (estimated at 45%)
2. Cost reduction could be envisaged when the GNC & propulsion system of the launcher upper-stage are modified
3. Contract give by ESA to ELV to perform a phase-0 assessment of a mission to de-orbit a large ESA-owned debris by means of adapting VEGA's upper-stage
    a. Rigid connection
    b. Flexible connection
4. Final presentation 12 Dec 2013
5. CDF review in March 2014



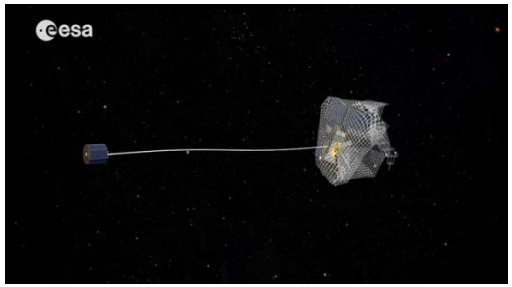
e.Deorbit Phase A



e.Deorbit Phase A status

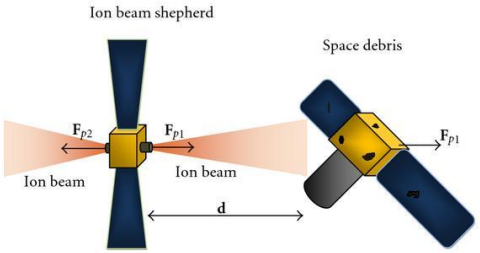


Option 1: flexible



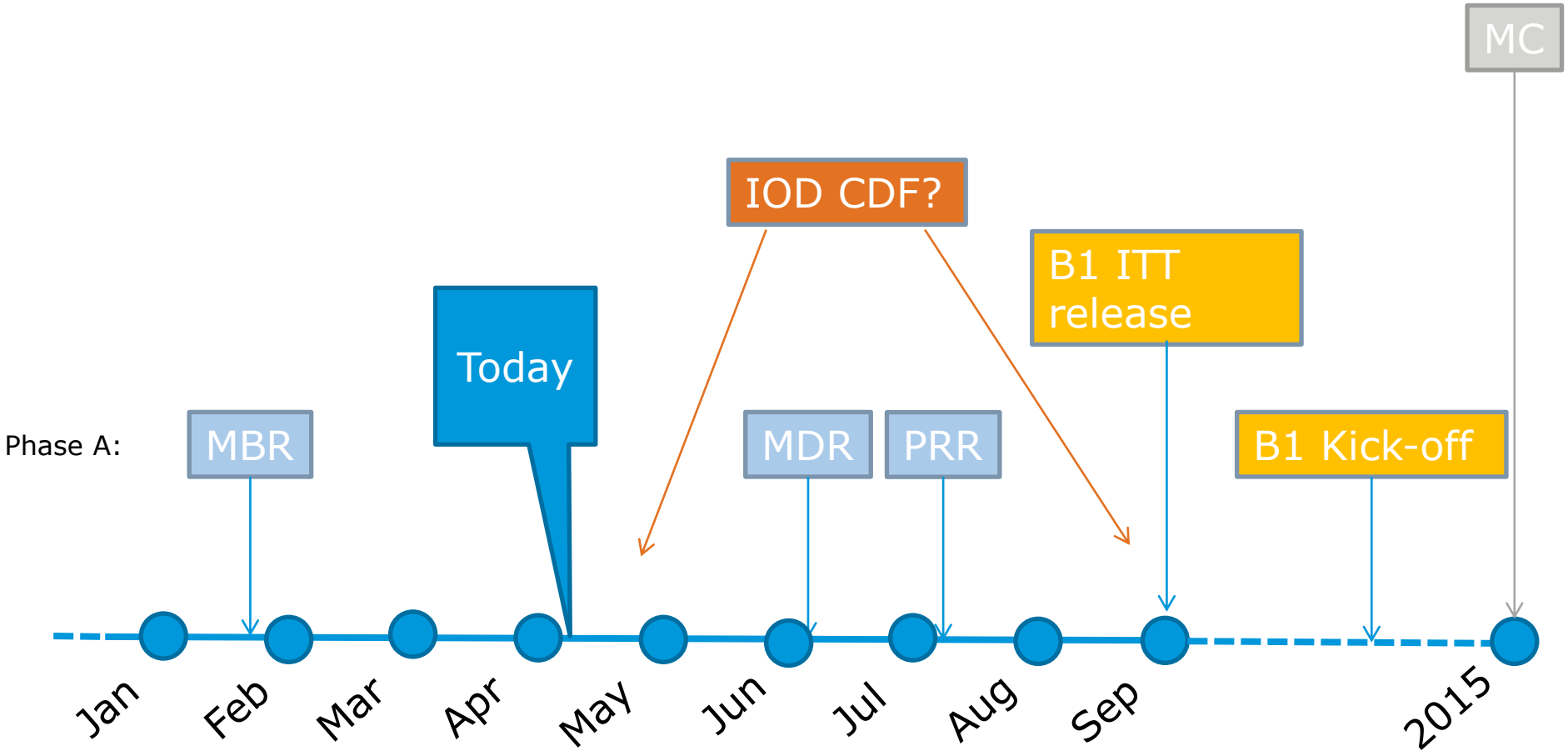
Option 2: rigid

Option 3: re-orbit

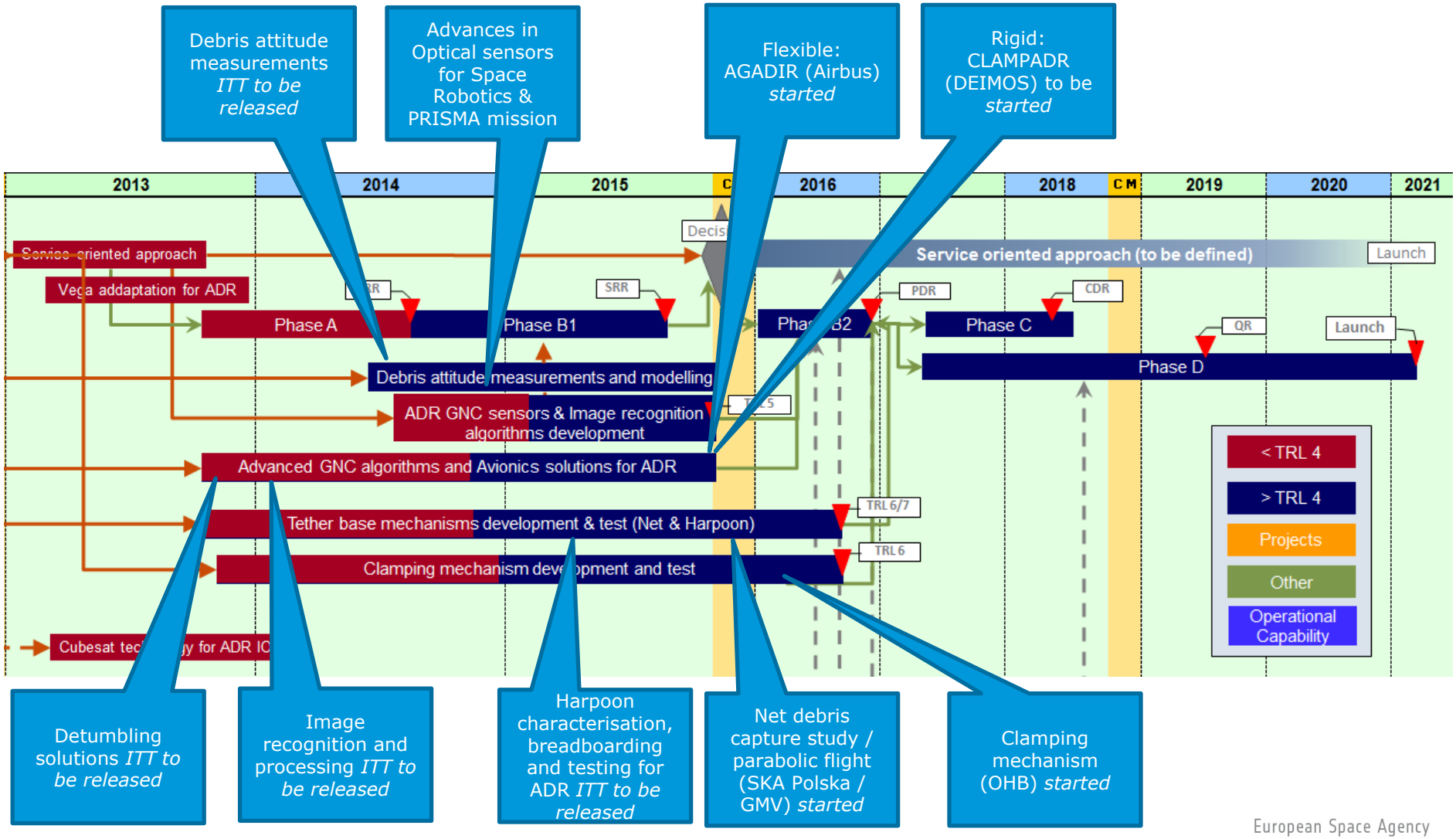


Credits: Hindawi Publishing, 2012

Outlook



Technology developments



European Space Agency