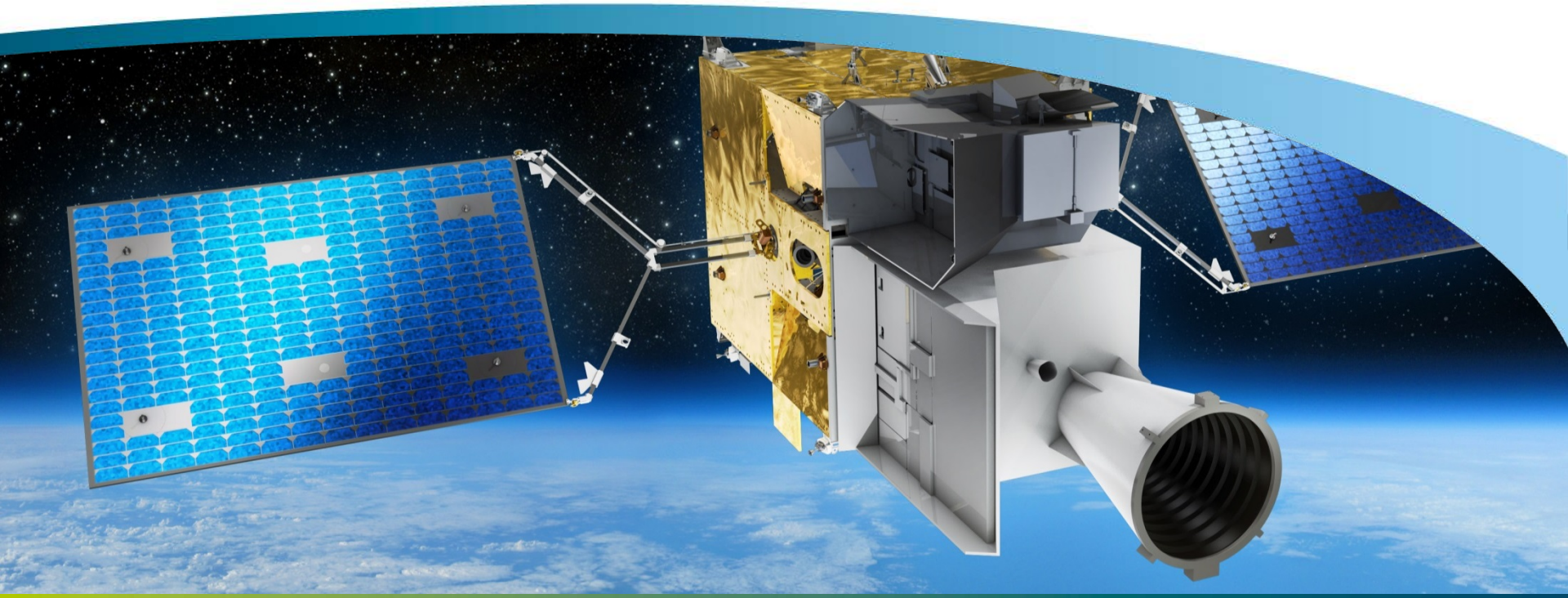
OHB System AG
Gerrit Proffe
24.10.2017, Clean Space Industrial Days 2017,
ESTEC



SPACE SYSTEMS

OHB Space Tug

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Agenda

- Objectives
- Potential Use Cases for a Space Tug
- Space Tug Concepts
- Business Case Assessment
- Combination of Use Cases
- Conclusion
- Next Steps

Space Tug

- Space Tugs have already been discussed and analyzed for a long time on industry as well as on agency side
- OHB is into the tug topic and related activities for at least 10 years now
  - ROKVISS (Robot Components Flight Verification on ISS)
  - DEOS (DEutsche Orbital Servicing mission)
  - VIBANASS (VIsion BAsed NAvigation Sensor)
  - OLEV (Orbit Life Extension Vehicle)
  - ADRS (Service Oriented Approach to the Procurement and Development of an Active Debris Removal Mission)
  - e.deorbit
- Internal assessments and studies
- Worldwide several companies are working on this topic
  - MDA just started a new attempt in satellite servicing in cooperation with fleet operator SES

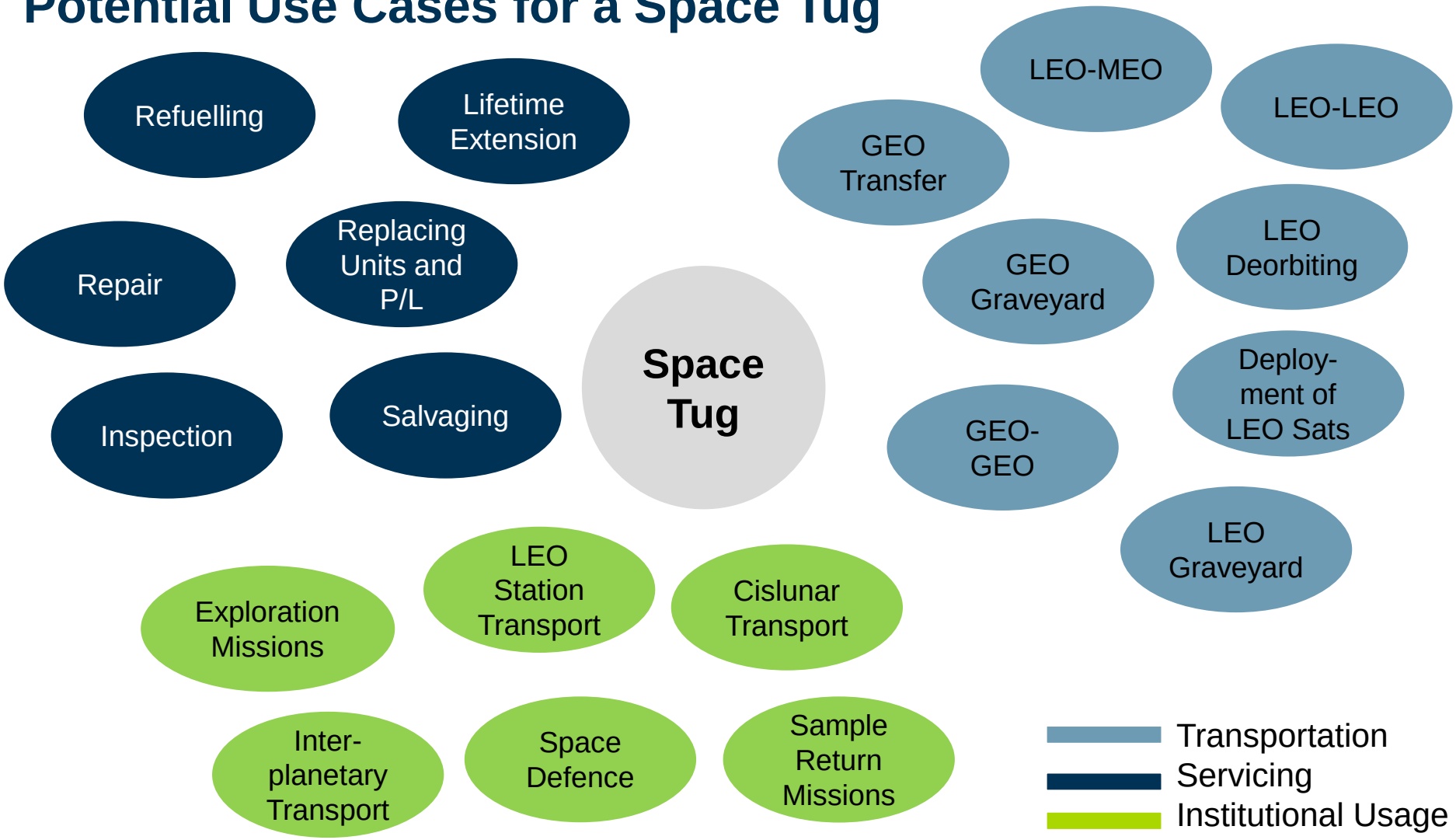
Space Tug Market

- Who is interested in tug concepts (ADR as one field of application)?
  - Periodic users, e.g. commercial provider or constellation operators
  - Institutional customers e.g. for already existing debris

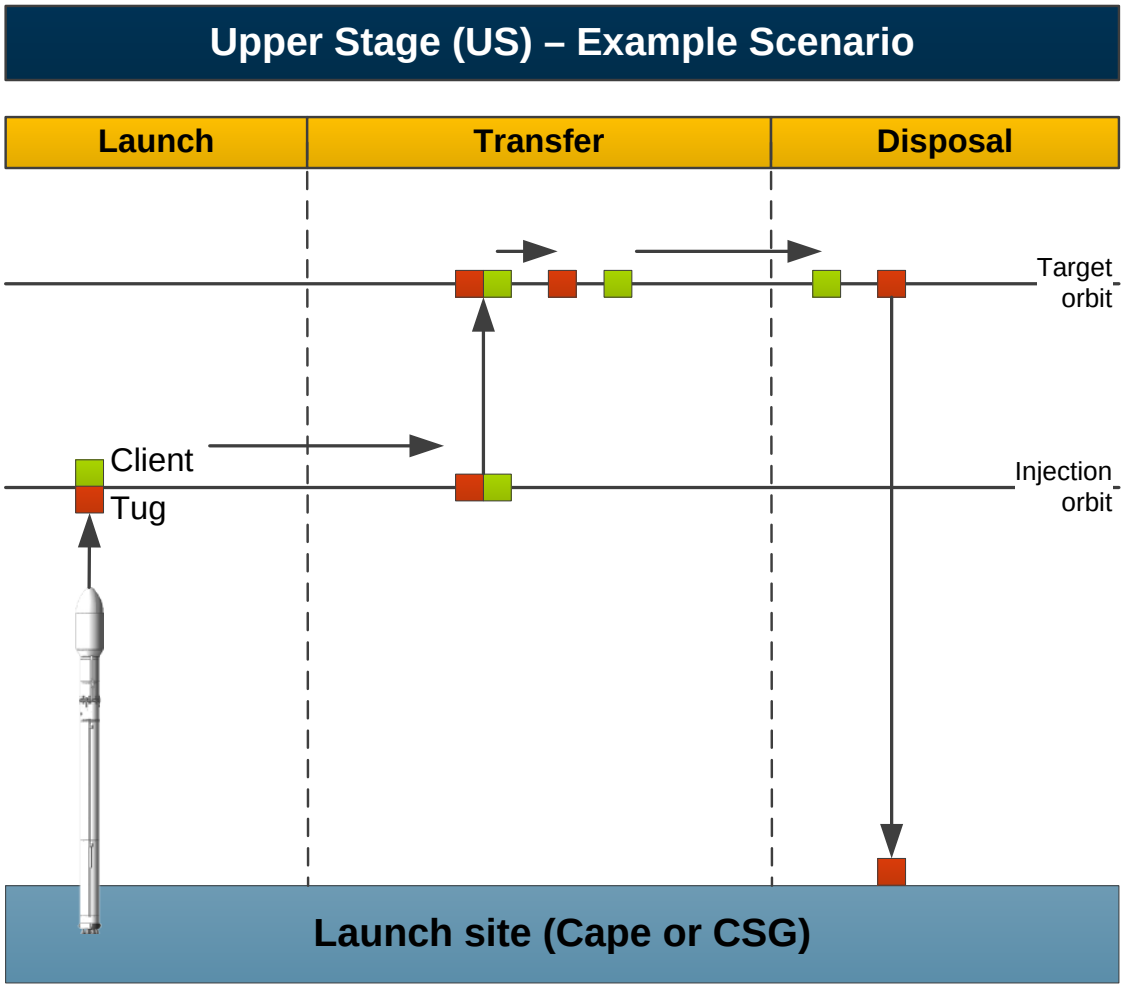
- Three critical aspects have been identified:
  - **technical**
  - **legal**
  - **financial**

- Establishing the initial mission is always difficult and pose a financial risk
  - Development effort
  - Unclear future prospect

Potential Use Cases for a Space Tug

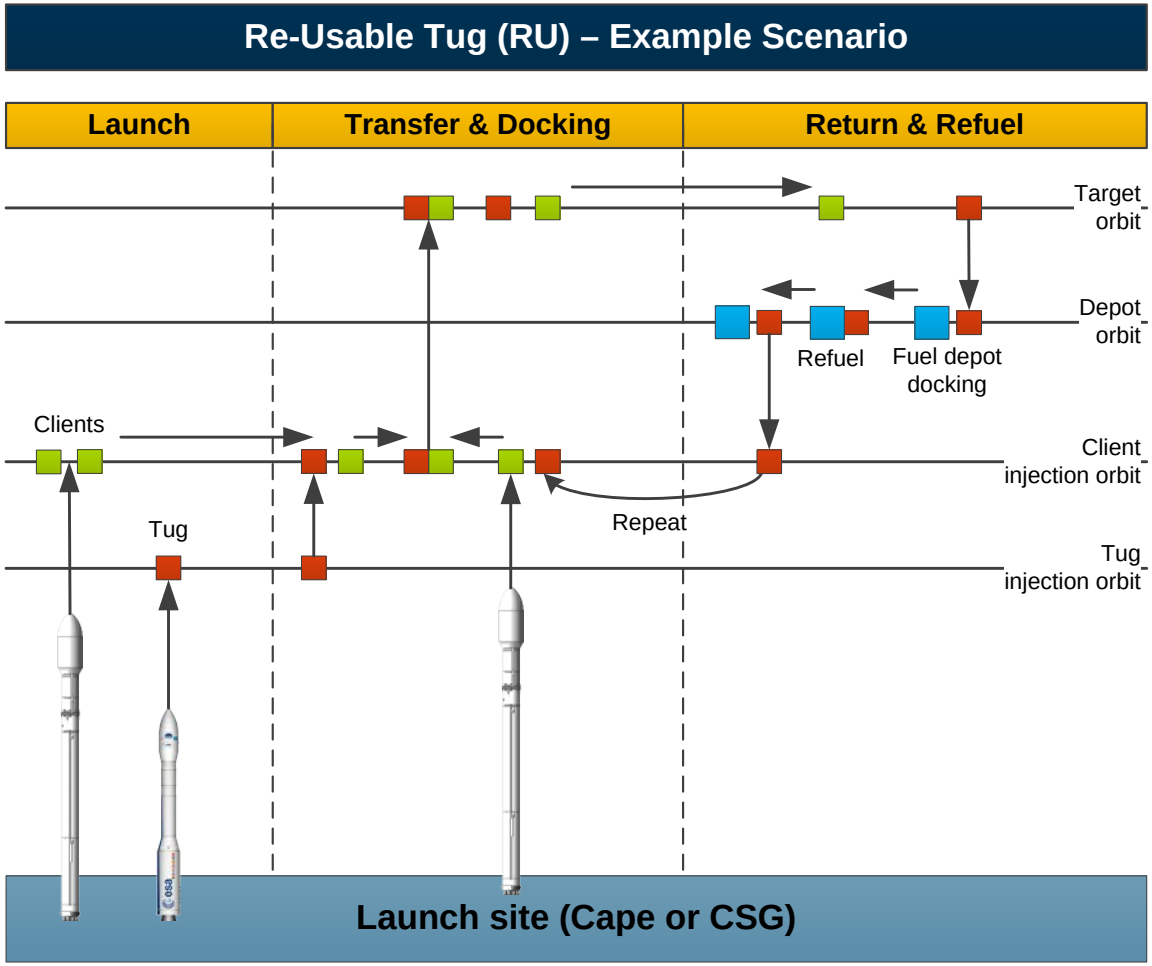


Upper Stage (US) – Example Scenario



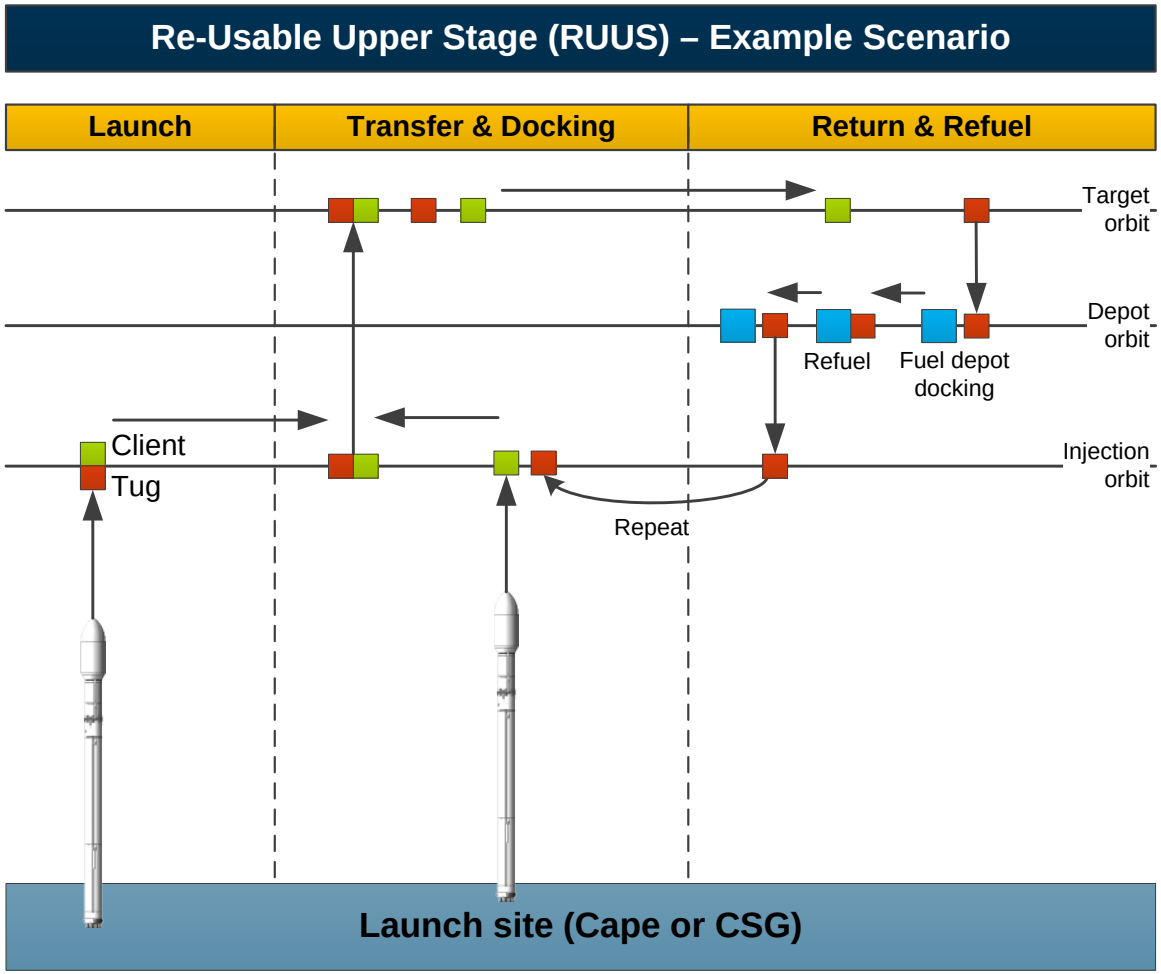
- Client and tug launched on same vehicle
- Tug performs only one mission and is disposed afterwards
- Intention: save costs on client by eliminating propulsion system

Re-Usable Tug (RU) – Example Scenario



- Client and tug launched separately
- Tug and clients dock, tug flies multiple missions
- Fuel depot resupplies tug

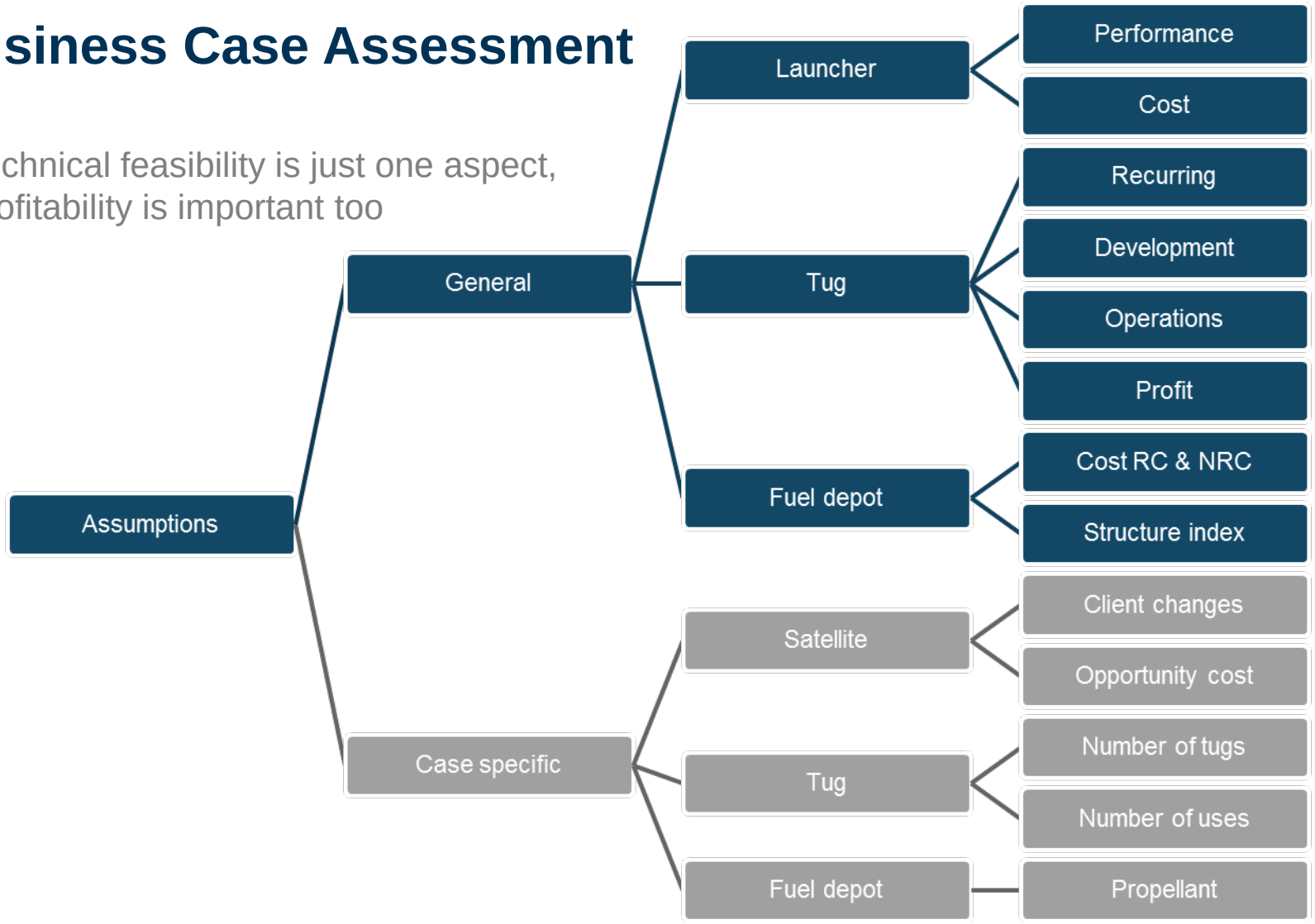
Re-Usable Upper Stage (RUUS) – Example Scenario



- Client and tug launched on same vehicle
- Tug performs multiple missions
- Fuel depot re-supplies tug

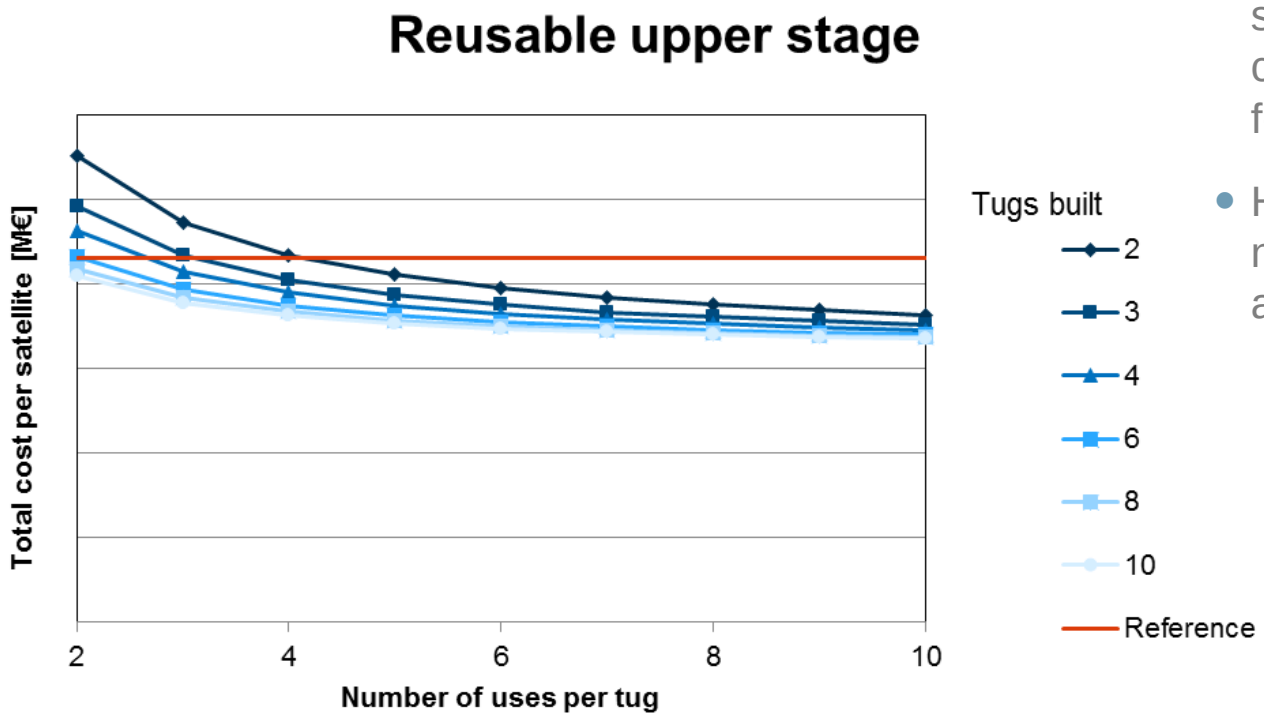
Business Case Assessment

- Technical feasibility is just one aspect, profitability is important too



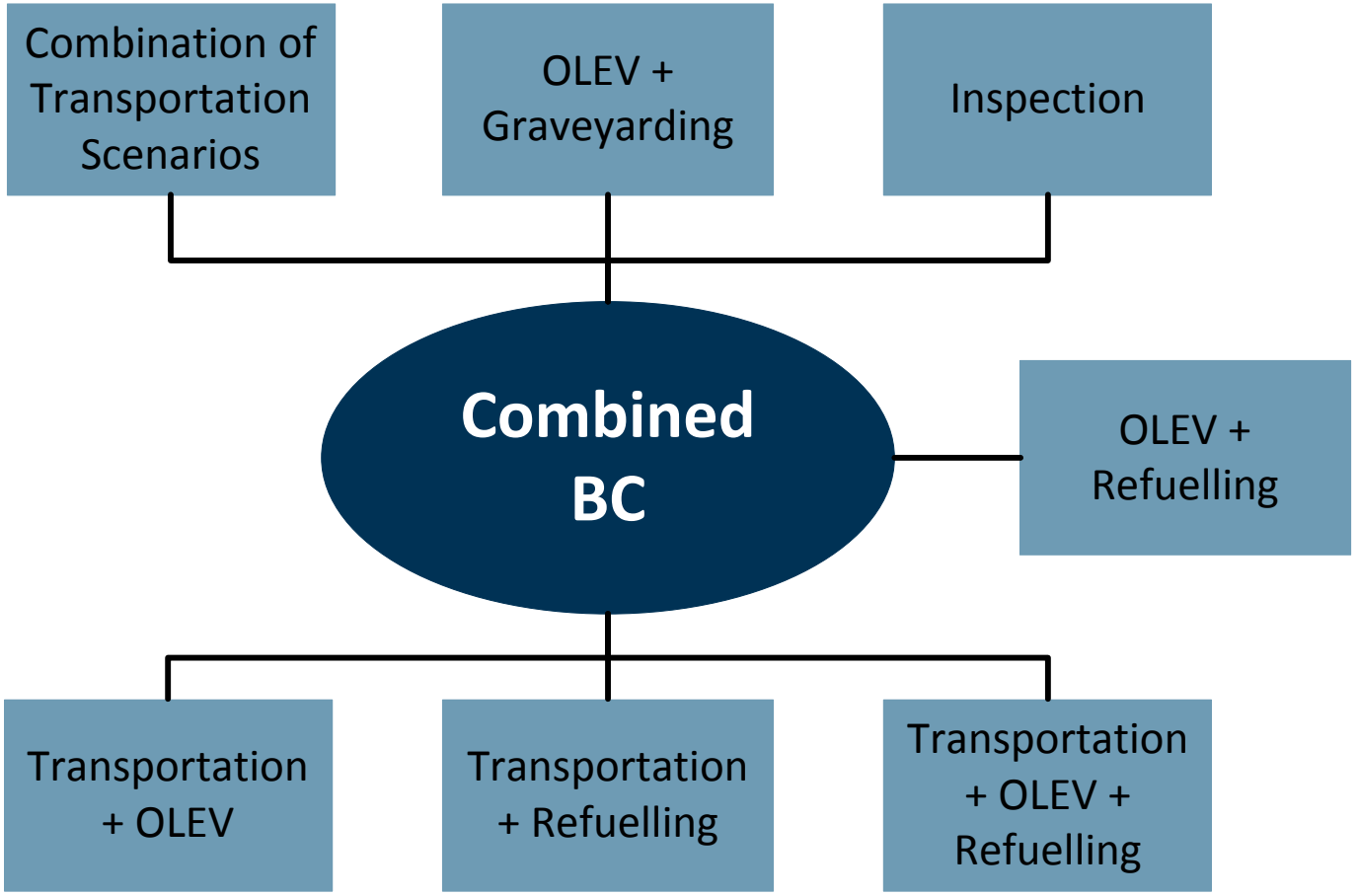
Business Case Assessment

- Results change e.g. by varying the number of built tugs or the number of uses (see below)



- Many influencing factors
  - not trivial
- Business case assessments for single task tugs reveals challenges in the financial feasibility
- High risks, especially as there is no established market and the acceptance is not clear

Combination of Use Cases



Combination of Use Cases

- One option to address a higher number of potential customers
  - The general cost problems and technical challenges remain
- Combining use cases increase the technical complexity
- Just adding functionality to the tug does not guarantee that there is a market
- The „all-in-one device suitable for every purpose“ how the space tug is often promoted is not realistic

Conclusion

- The Space Tug concept is no new idea, it has been discussed and analyzed for decades
- However, none of the existing concepts has ever become reality
- Critical aspects might be
  - Founding for development and initial mission
  - Uncertain acceptance (if at all) on the market
  - (Technical challenges)
- Public funding of first mission, e.g. by an Agency Program, might be the key to establish a tug service or to establish the needed know-how

Next Steps

- Despite the uncertainties and open points mentioned before, some sweet spots have been identified
  - Transportation and institutional usage
- Internal OHB study activities are continuing
- OHB is working on technical concepts for selected use cases
  - Making use of existing heritage e.g. by using electric propulsion for transportation use cases
  - Looking into the future by involving the next generation space architecture (Deep Space Gateway and Orion) e.g. for Mars and/or Lunar Sample Return missions

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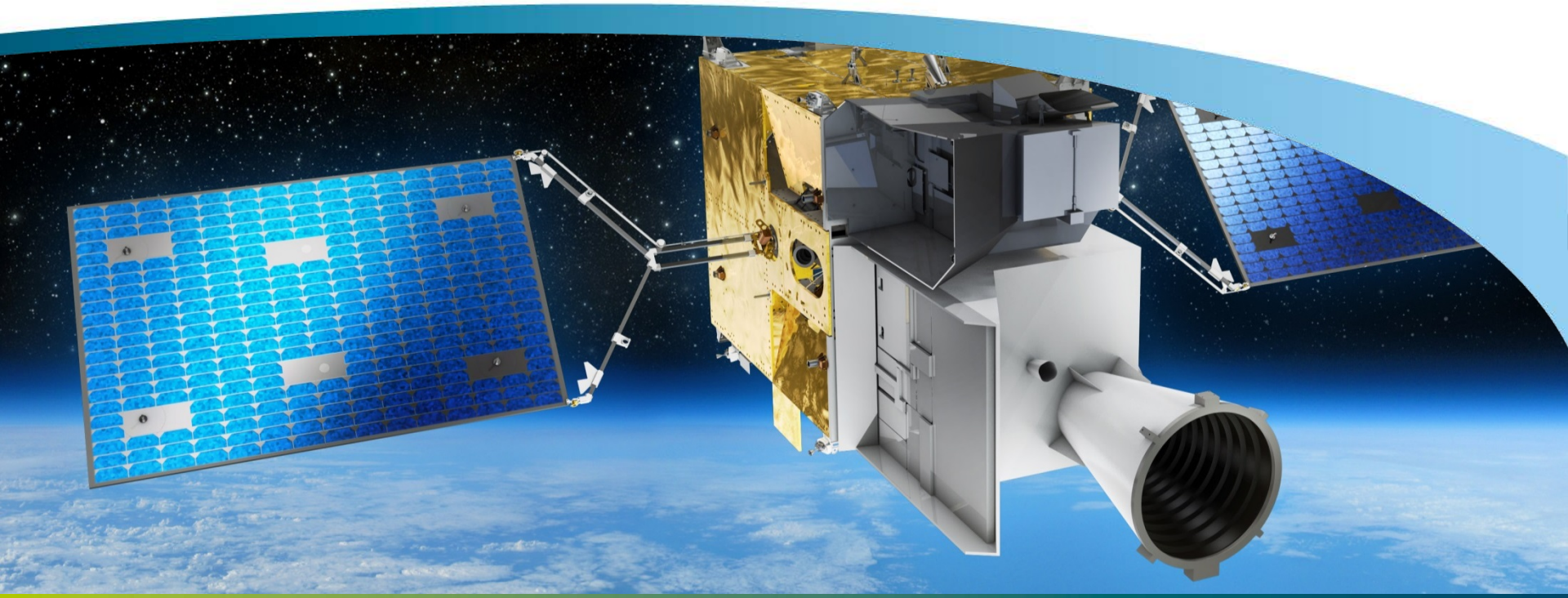

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