MASTER'S PROGRAMME

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GE SCAN

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CENTRAL CASE PROJECT

SpaceTech 2020/21 Participants

July 2021

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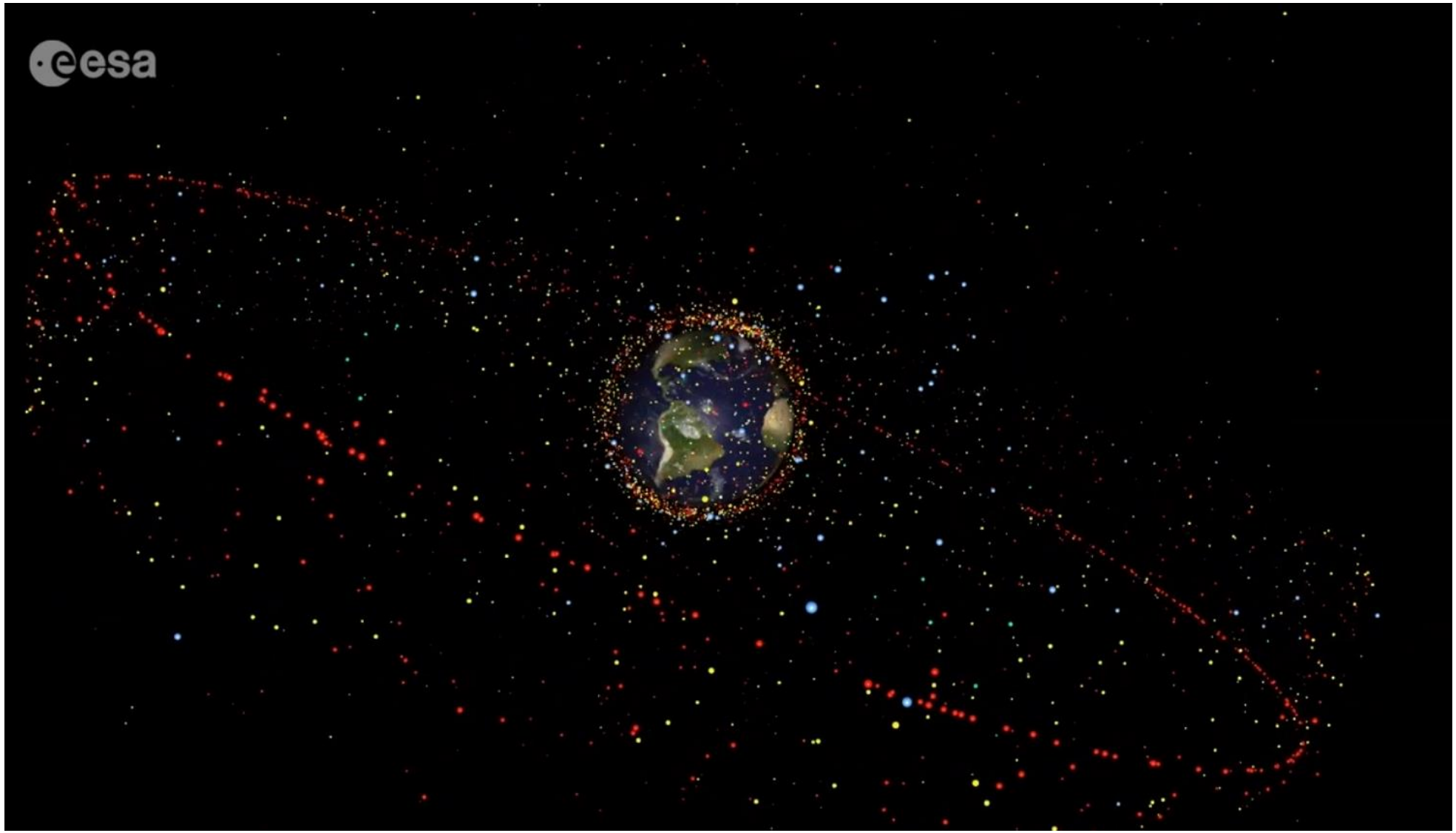
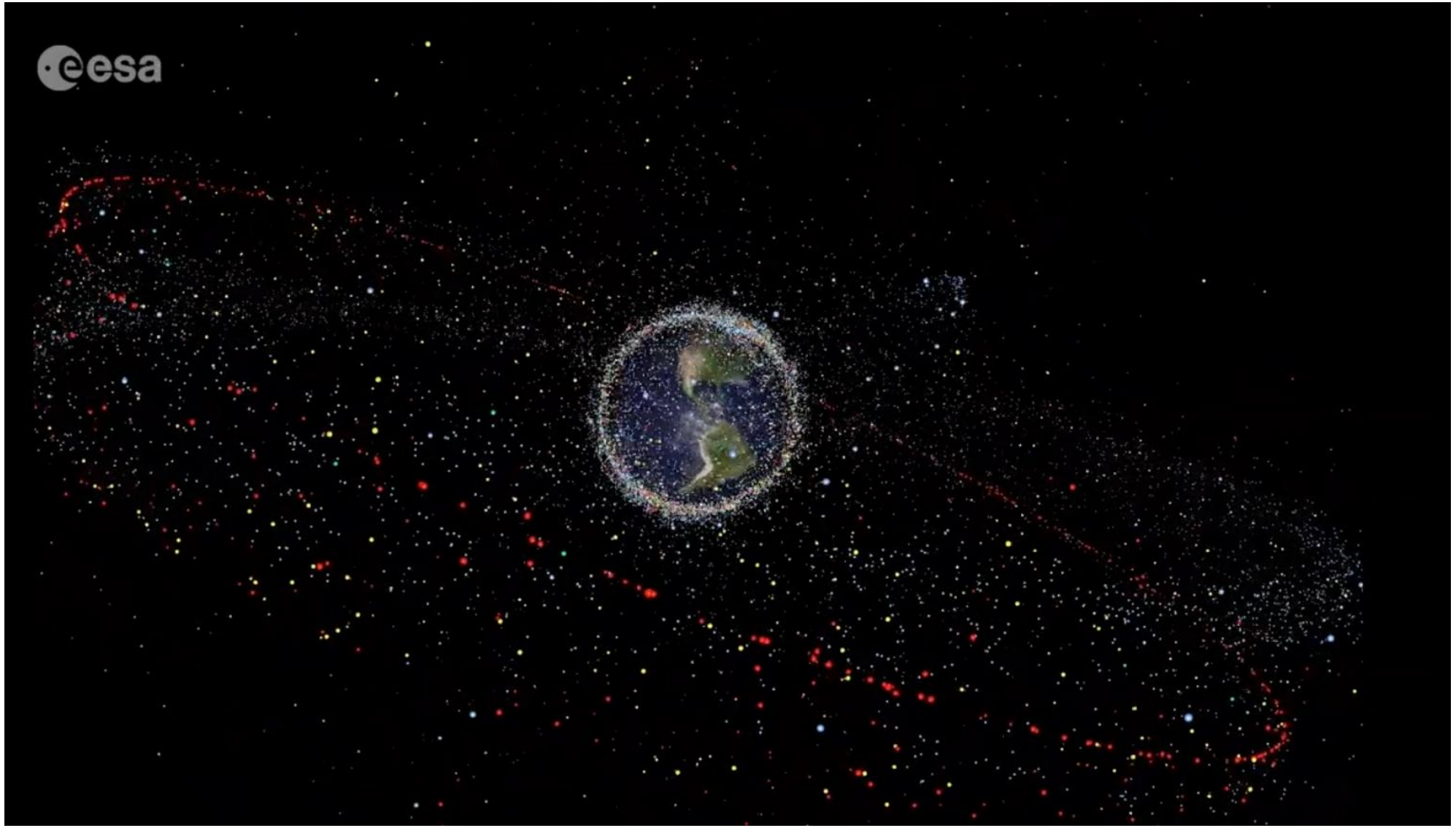
Space Objects – Increasing

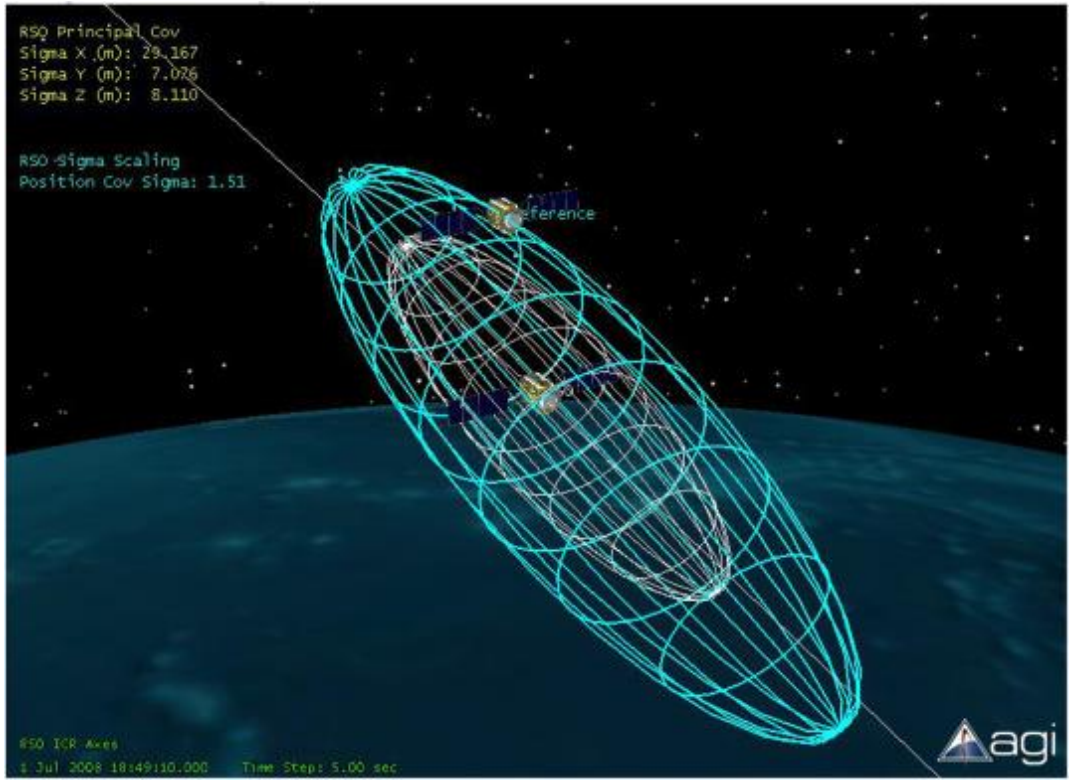
Space Objects – Size vs Risk in GEO

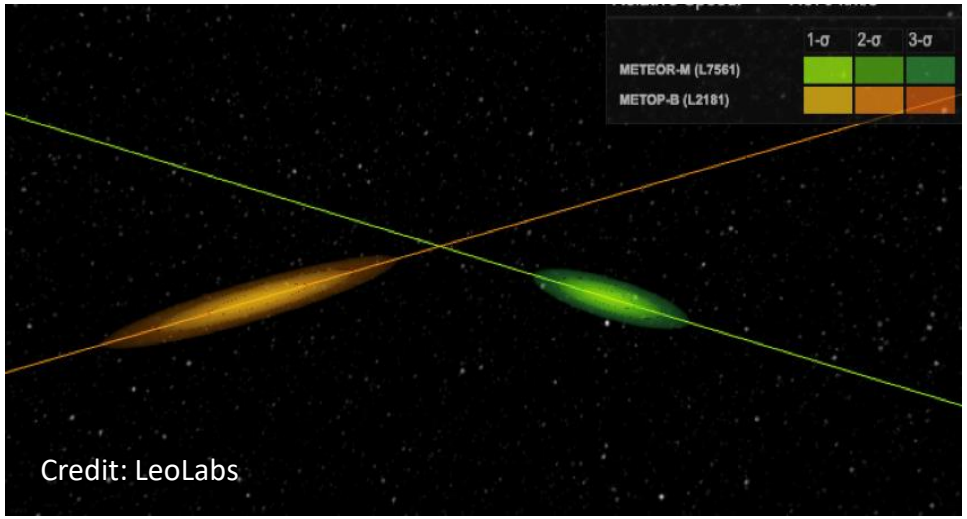


Space Objects – Size vs Risk in GEO

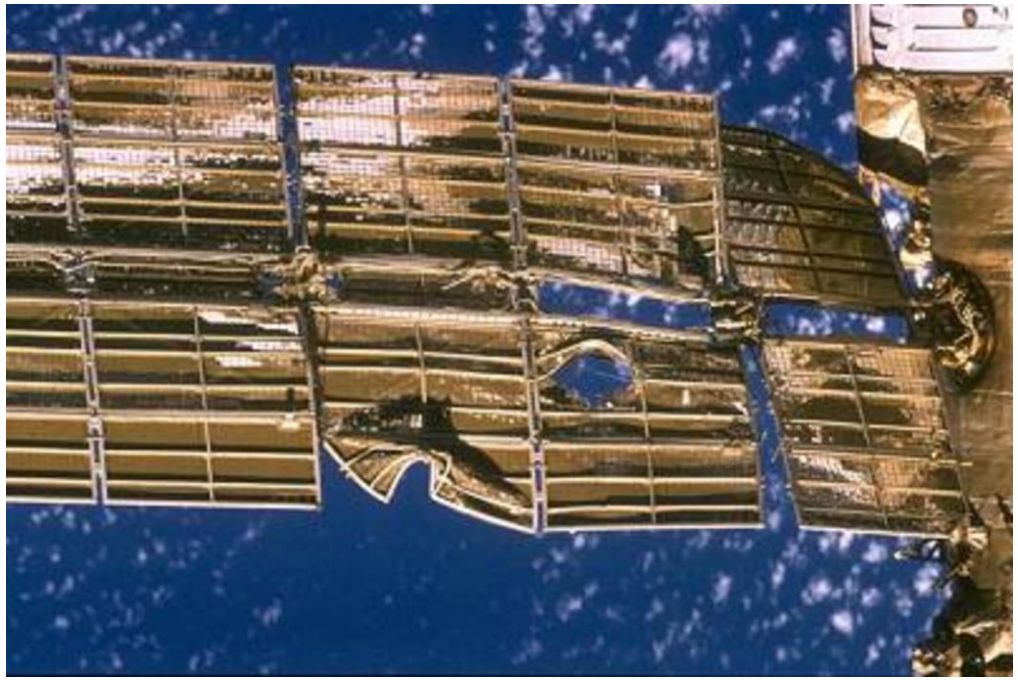


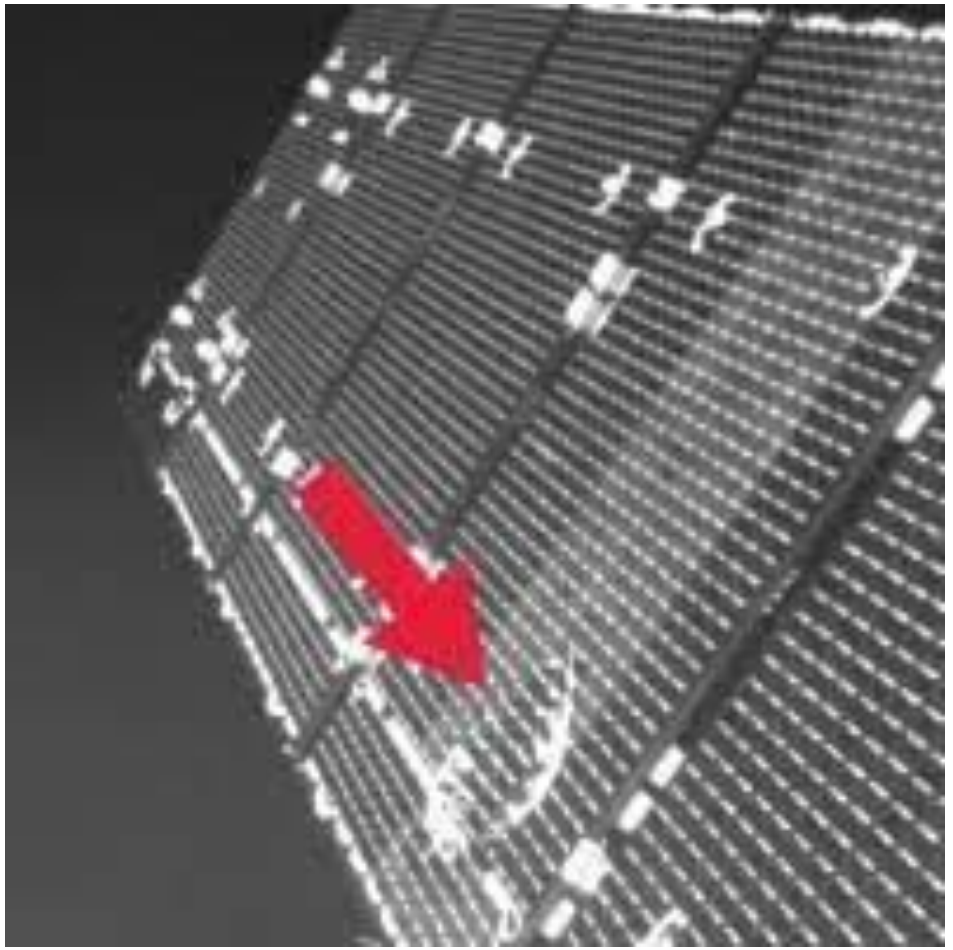
Space Objects – Covariance



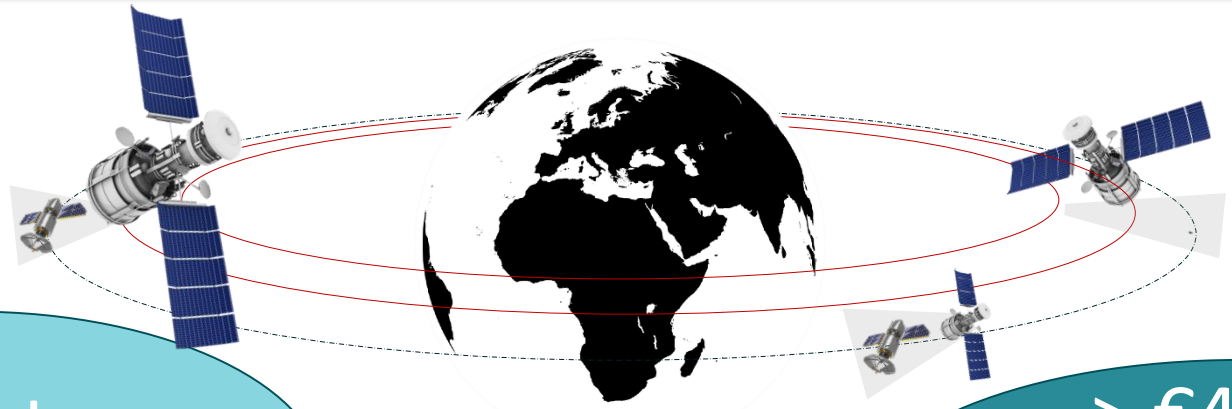


Space Objects – Anomaly Identification





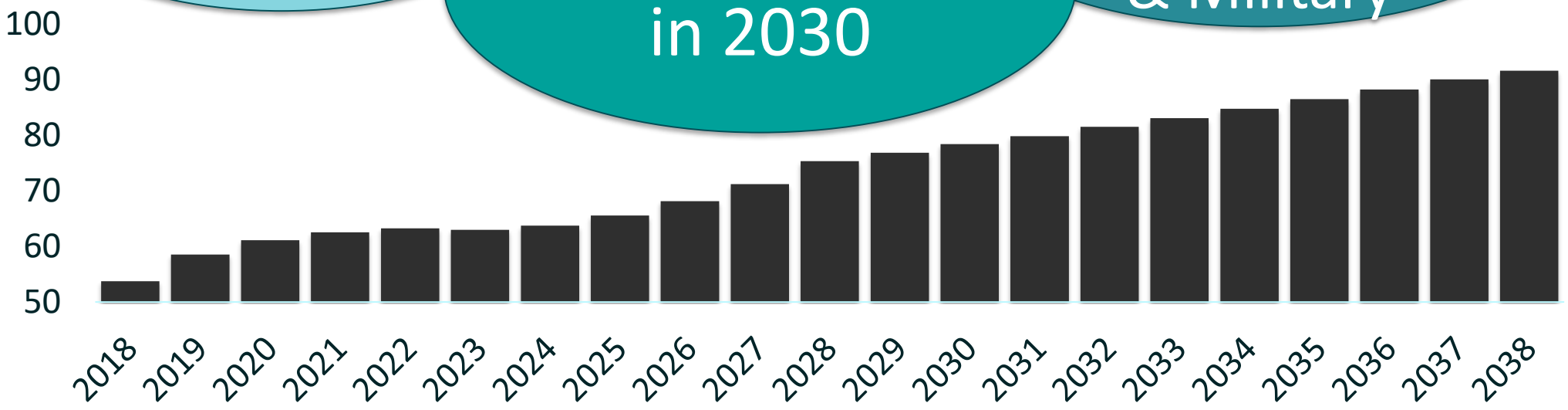
Value of GEO Market



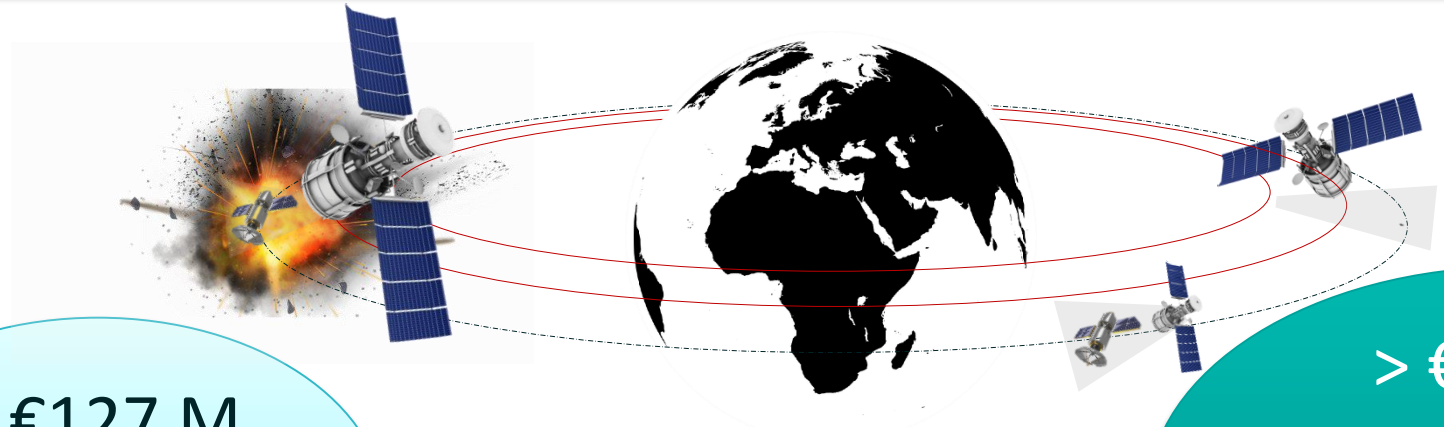
> €38 bn Commercial

€78 bn Value in 2030

> €40 bn Government & Military



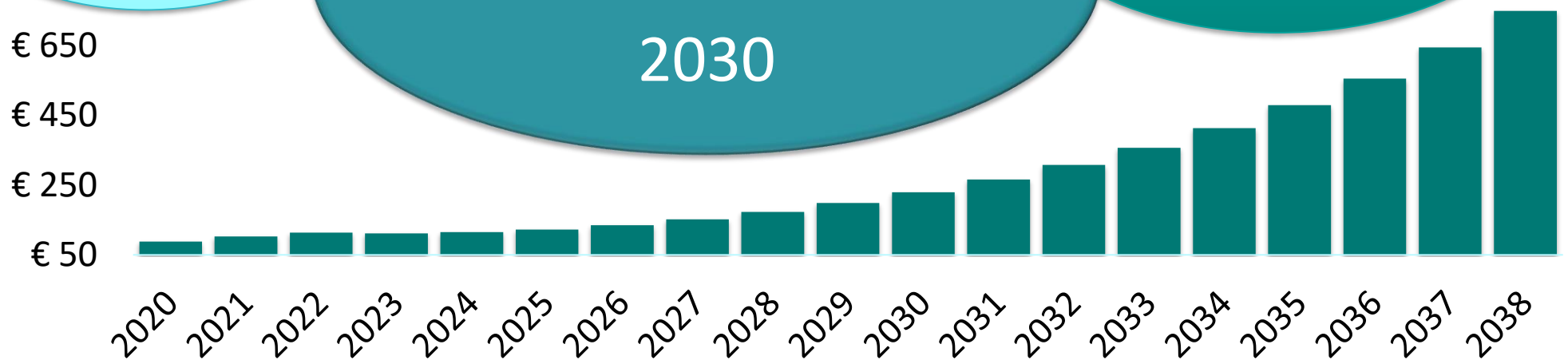
Value of Collision Risk (GEO)



> €127 M Commercial Operators

> €230 M Combined Risk in 2030

> €103 M Government/ Military Operators



GEOScan Products

DETECT&TRACK → Detect objects >10 cm
Conjunction Data Messages

CHARACTERIZE → Orbital Change Behaviour
Precise Physical Measurements

INSPECT → High-Resolution Images
20 cm Resolution

Mission Requirements

DETECT & TRACK

Detect **objects >10 cm**

- Orbital parameters accuracy:

Axis	Target	After 48 h
Radial	**60 m**	80 m
Along-track	**150 m**	200 m
Cross-track	**15 m**	20 m

Frequency:

- maneuverable spacecraft: **24 h**
- > 90% of other objects: **48 h**

CHARACTERIZE

Characterize objects

- **Flight Attitude**
- **Tumbling rate**
- **Maneuver behavior**
- **Optical Signature**
- **Imaging with 2 m (1 m) resolution**

Frequency:

- **Every 30 days**

INSPECT

Inspect spacecraft

- Take images with a spatial resolution of **20 cm**

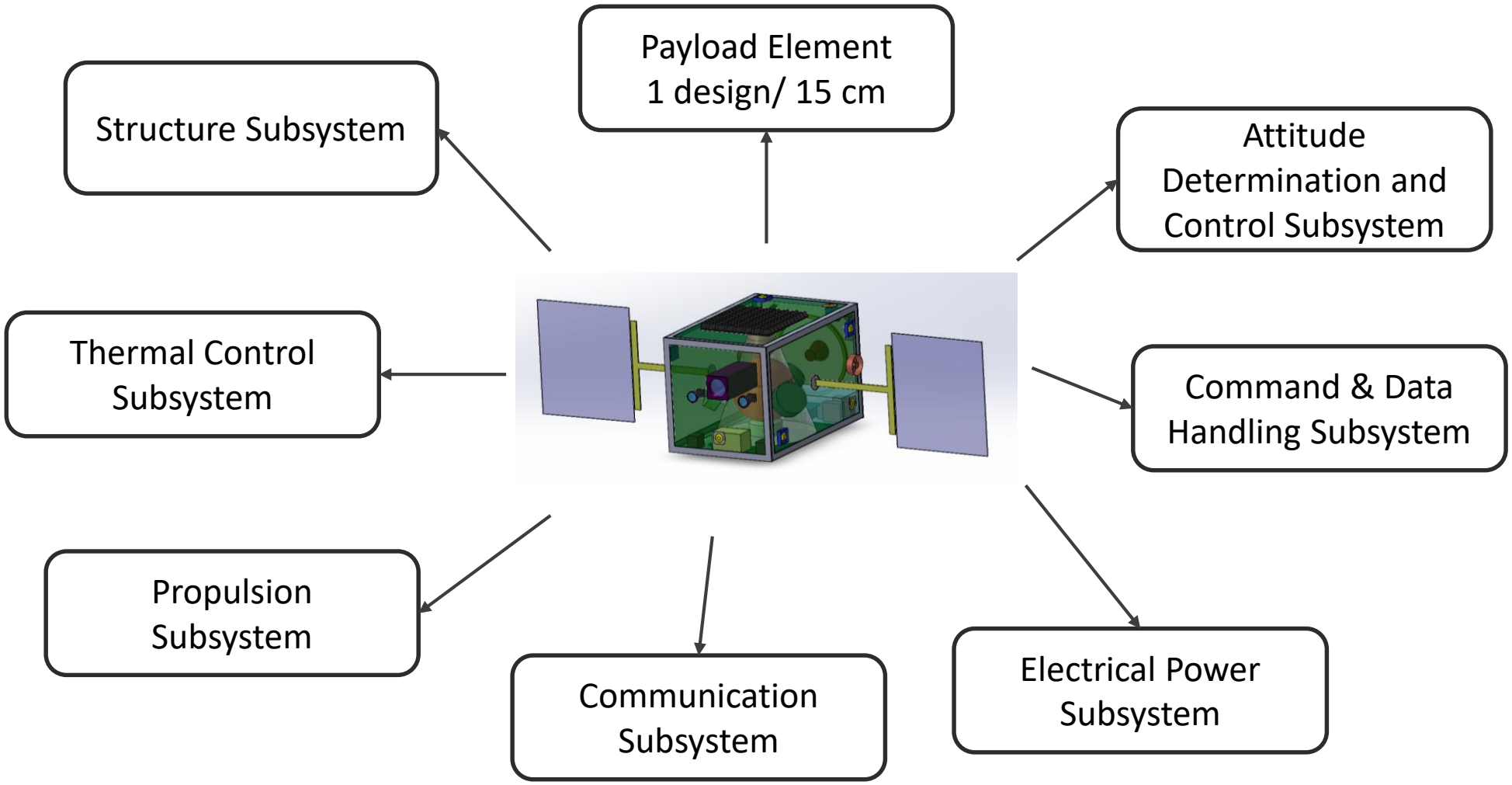
Frequency:

- **Response time < 48 hours**
- **Budget 4 times per year**

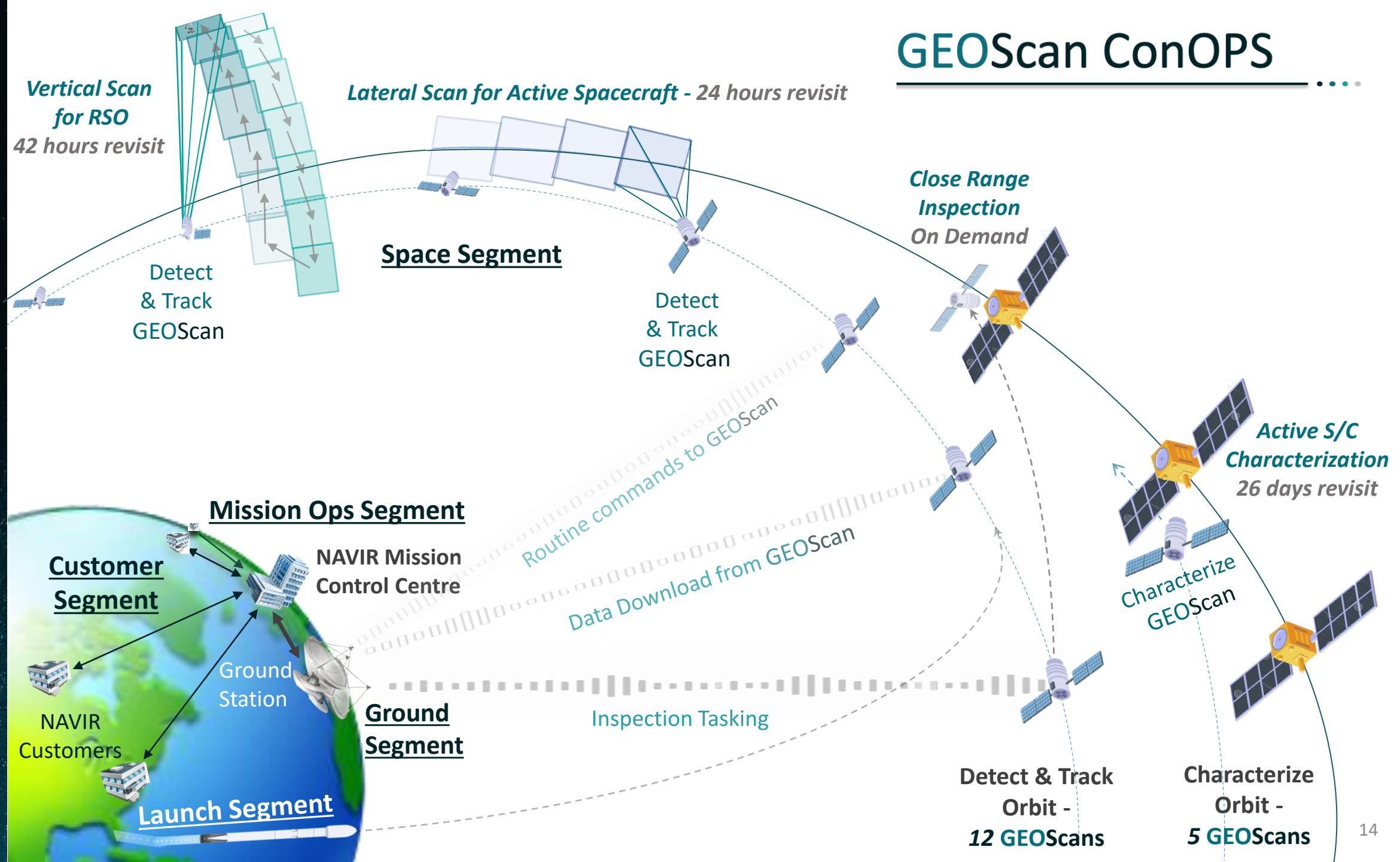
Mission

Mission Lifetime: 10 Years, Mission Lifecycle Cost: < €500 M

Space Segment - Physical Architecture



GEOScan ConOPS

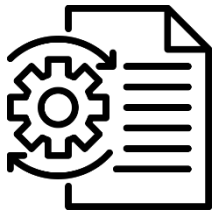


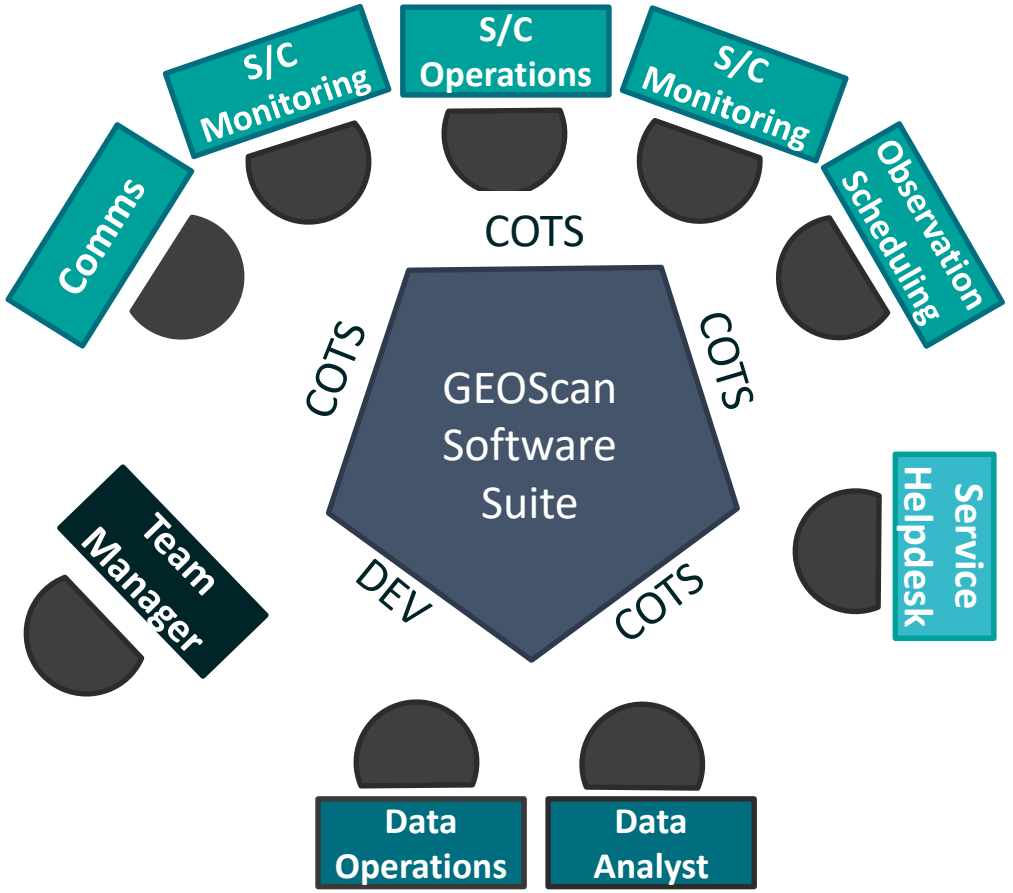
Ground Segment - Mission Control Centre (MCC)

operations

- Total of 40
- 4 shift teams

Main functions



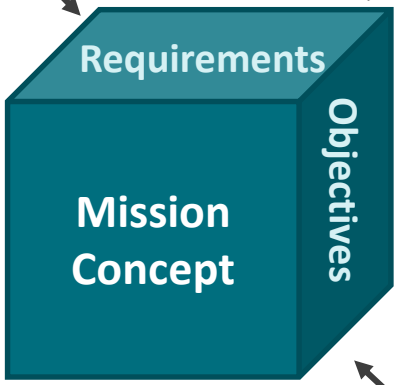


GEOScan Mission Overview

Subject:
- Objects in GEO > 10 cm
- Sun illuminated

Orbit and Constellation:
- Prograde, Circular
- 12 spacecraft in 1200 km sub-GEO
- 5 spacecraft in 140 km sub-GEO

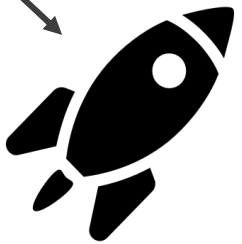
User Segment:
- Graphical user interface



Space Segment:
- 159 kg dry-mass
- 71kg propellant
- 113 W avg. power
- 1.4 x 4 x 0.9 m deployed

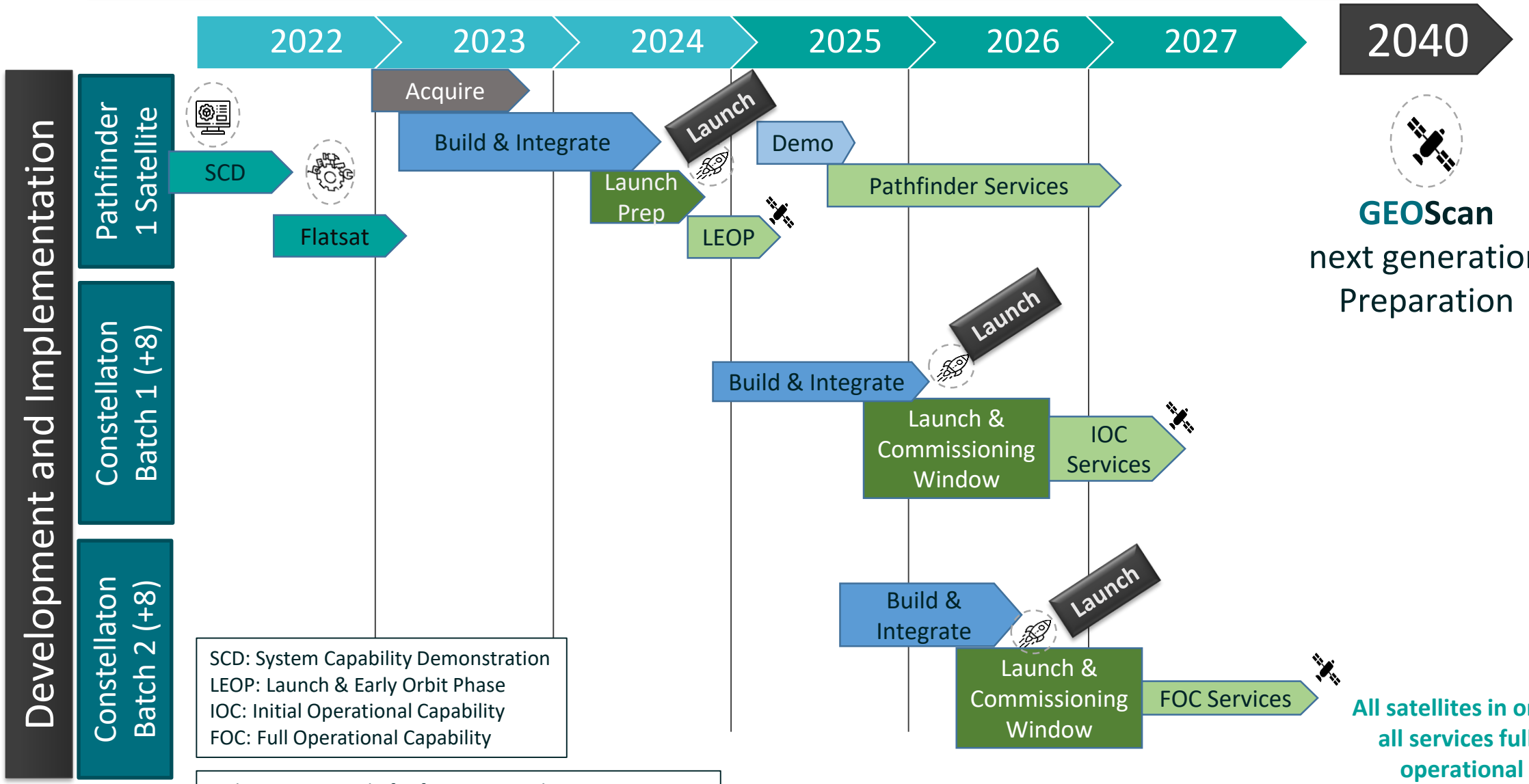
Mission Control:
- 24/7 operations
- Data Processing

Ground Stations:
- Commercial
- Telecommand and mission data



Launch Segment:
- Direct insertion to GEO (operational orbit)

Mission Development & Implementation

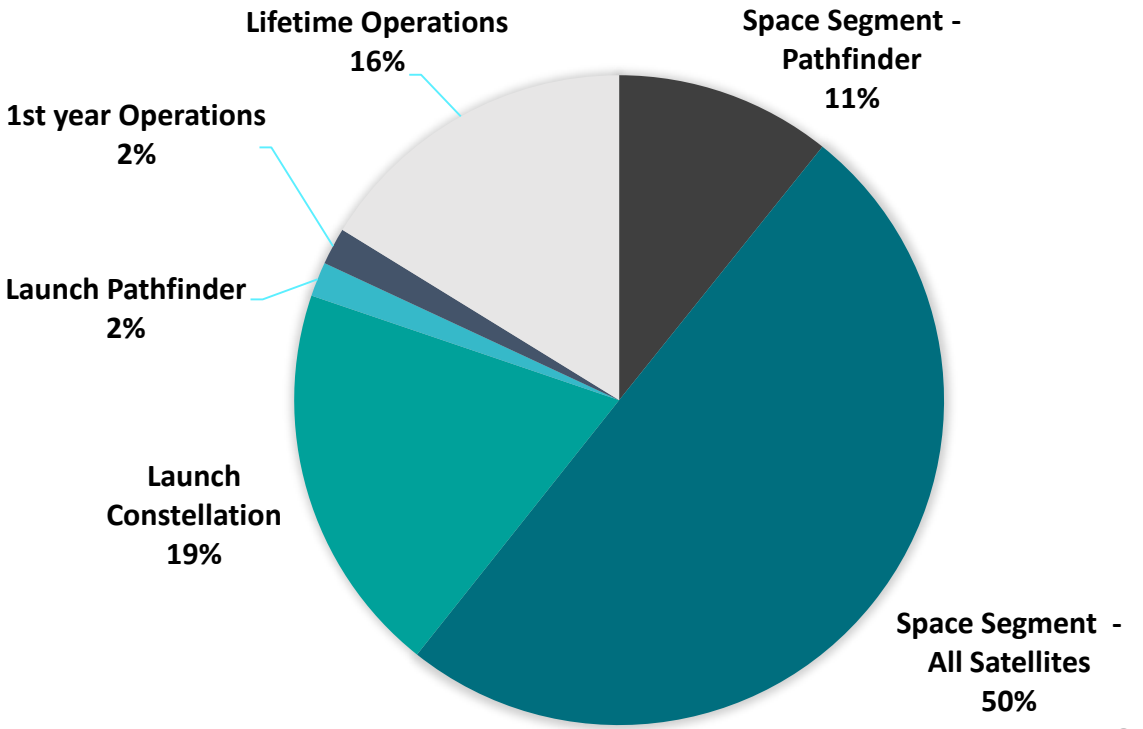


SCD: System Capability Demonstration
LEOP: Launch & Early Orbit Phase
IOC: Initial Operational Capability
FOC: Full Operational Capability

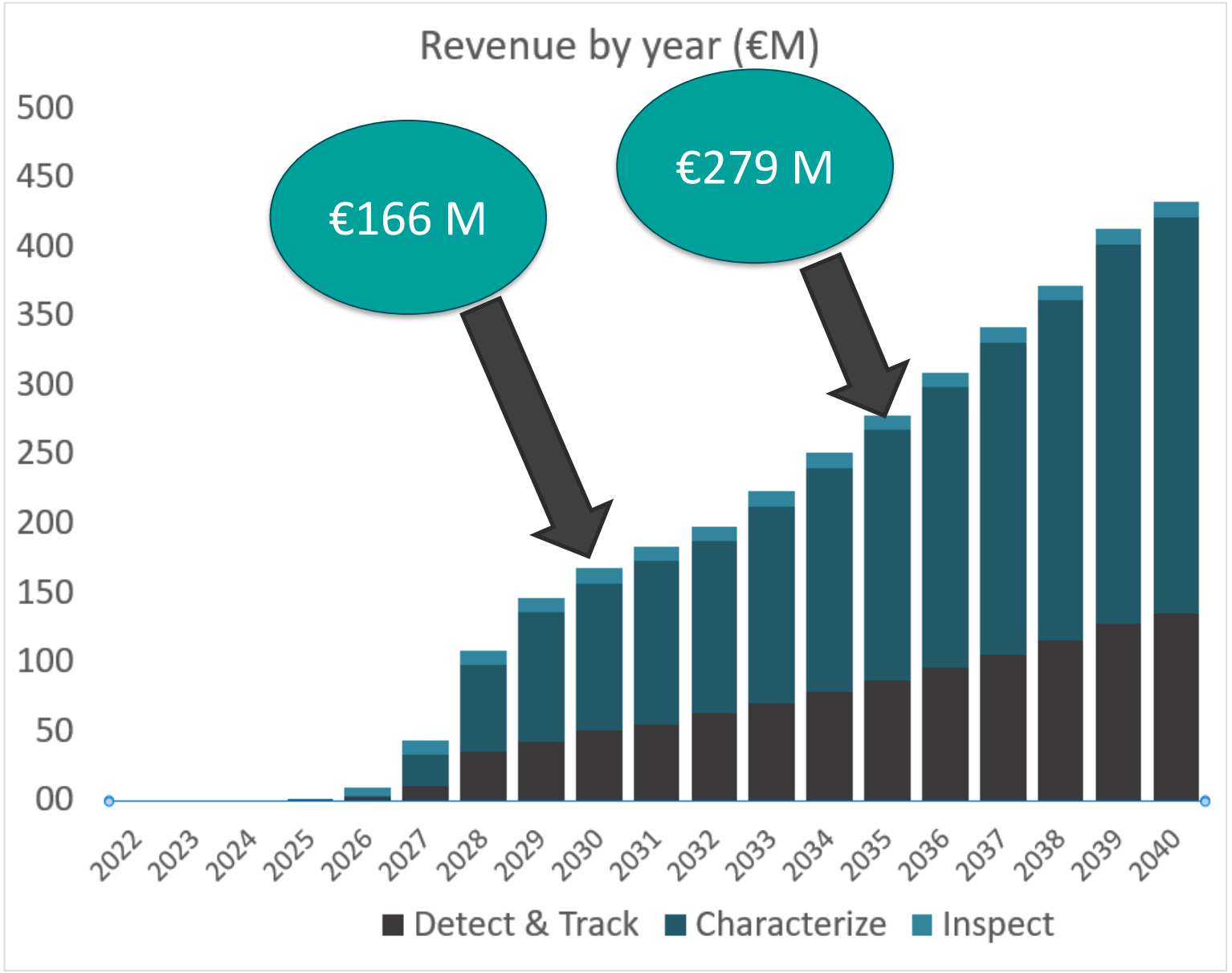
Risk Mitigation: File for frequency with ITU @ 2024 (Pathfinder), Critical Design Review for Pathfinder

GEOScan System Lifecycle Cost

Activity	M €
Space Segment - Pathfinder	50.1
Space Segment - All Satellites	232.6
Launch Constellation	91.0
Launch Pathfinder	8.0
1st year Operations	8.6
Lifetime Operations	75.6
Total System Lifecycle Cost	**466**



Revenue



Net profitability

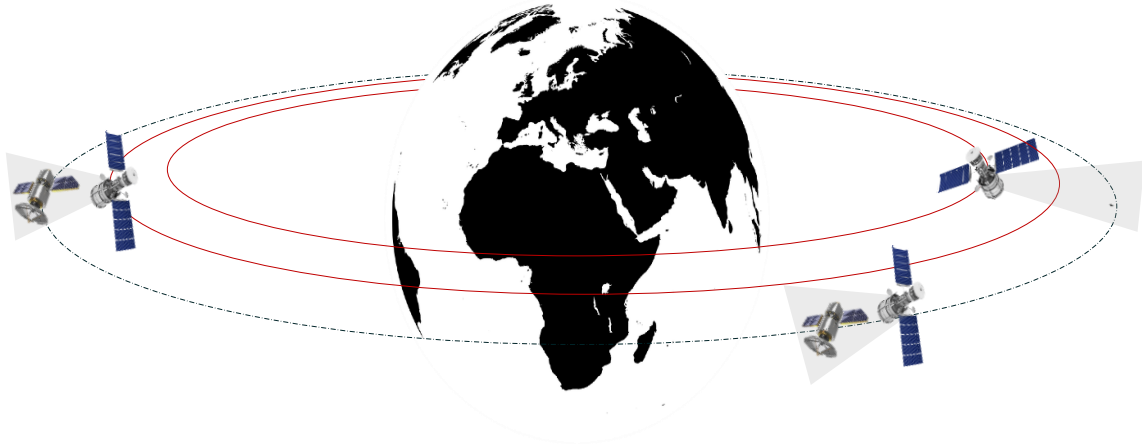
Finance – Funding Process

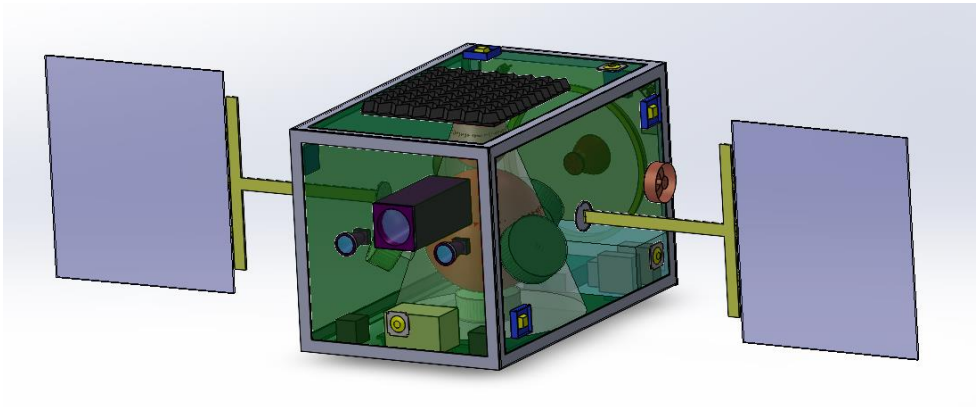
	2022 €9.66 M	2023 €33.77 M	2024 €50.16 M	2025 €196.50 M	2026 €132.50 M
	€0.11 M				
	€0.55 M				
esa	€4.00 M	€16.77 M	€11.00 M		
Public	€5.00 M	€17.00 M	€14.16 M		
			VC 1: €12.00 M VC 2: €13.00 M	VC 1: €80.00 M VC 2: €85.00 M	VC 1: €49.00 M VC 2: €57.00 M
				BL 1: €16.50 M BL 2: €15.00 M 5% interest	BL 3: €14.00 M BL 4: €12.50 M 4% interest

VC: Venture Capital BL: Bank Loan

Summary

1. IMPROVE SAFETY
2. REDUCE OPERATOR COST
3. ENSURE SPACE SUSTAINABILITY





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Thank you!

Questions?