TABLE OF CONTENT

In Orbit Servicing
Maturation Phase

Customer

Provisional service agreement

Contractual roles and responsibilities

Provisional service agreement

- **Customers status :**
  - Both Customer 1 and Customer 2 have provided letters of interest stating their wiliness to go forward with the Space Alliance
  - A 3rd customer issued a letter of interest after starting discussions in September 2022

- **Service specifications:**
  - Duration: minimum 36 months contract with at least 2 customers
  - Spacecraft: identified by 2 customers (last one flexible)
  - Type of service: identified for all customers
- From a **technical point of view**, considering that for the START-€ mission the Client spacecraft is produced by TAS, no particular issue has been raised regarding the pre-launch engineering phase and interfaces.

  ⇒ the mission profile, technical design compatibility for docking have not been altered since last presentation
- Complementary approaches on **infrastructure, operations and service:**
  - For the involvement in the infrastructure definition :
    - Customer 1 wants to be involved in the development phase of the infrastructure itself (servicer)
    - Customer 2 considers an involvement in the service development, not in the infrastructure, and they have provided useful insights due to their background experience
  - From the financial point of view:
    - No target figure for the cost of such a service has been provided by either Customer

Contractual roles and responsibilities

- **Role and responsibilities:** based on the complementary approaches for operations and service, 6 service phases are identified:
  1. Manufacturing of the servicer: until delivery on the launch pad. End: intentional ignition
  2. Launch: from intentional ignition until injection (separation from launcher)
  3. Positioning maneuvers + docking: from injection to confirmation of successful docking (creation of the composite)
  4. Operations: from confirmation of successful docking to End of operation
  5. End of operation: deorbitation of the customer sat / arrival at graveyard. End: de-docking. End of composite
  6. Transfer of the servicer: departure for a new service

In Orbit Servicing
Maturation Phase

Consortium definition

- Main consortium
- Suppliers list
- Potential geo-return
- RFI/RFP process planning
- Co-engineering plans

Main consortium

Service Provider
Telespazio

- Business development
- Contract, legal
- Service mission engineering
- Service operation

Space Segment Provider
Thales Alenia Space

- Space segment architecture
- Servicer design and manufacturing
- Management, product assurance and contingencies
- AITV
- Engineering support
- Servicer transport to launch pad

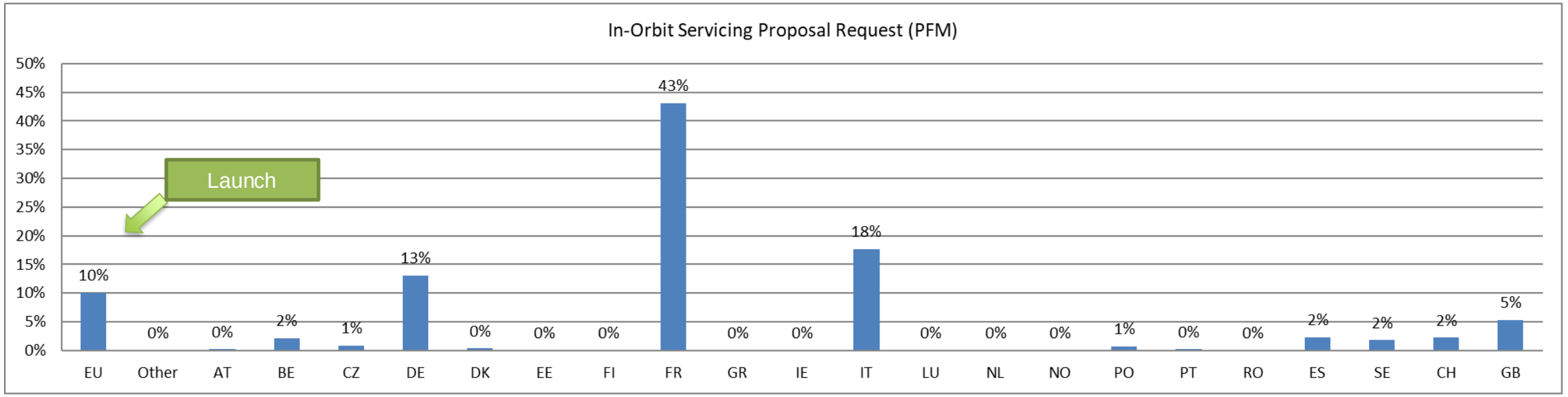
Ground Segment and Operations Provider
Telespazio

- Ground segment maintenance and evolution
- Management, product assurance and contingencies
- AITV
- Ground communication network
- Servicer operations

Launch Service Provider

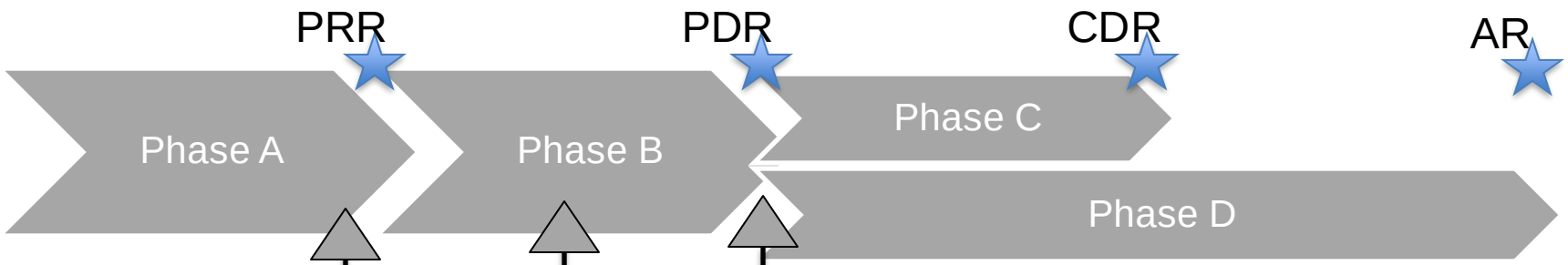
- Baseline Ariane 6

Potential geo-return



- The current geo-return includes the Telespazio co-funding. The geo-return with only the European participation could be very different.
- For instance, the major part of the geo-return for France can be supported by the Telespazio co-funding.

RFI/RFP process planning



- Finalization of partnerships with core team (see co-eng)

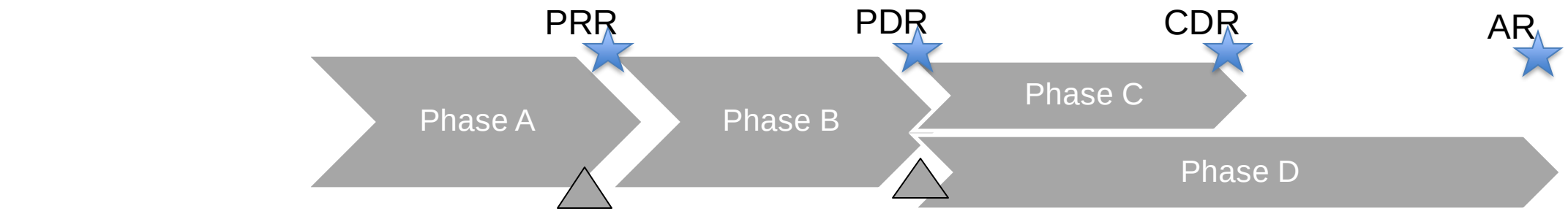
- Preliminary list of Items to be supplied
- List of potential suppliers for all Items => RFI

- Final list of Items to be supplied
- formal issue of RFPs – starting with Long-Lead Items
- Before PDR: selection of suppliers for space segment

- PDR – Contracts with suppliers for space segment – starting with Long-Lead Items
- From PDR to PDR + 6/12 months: selection of suppliers for ground segment (according to item Lead Time)

Note: the global process follows the ECSS standard as a well-proven methodology
Technical activities may however follow a more streamlined process, with PDR and CDR being « check points »

Co-engineering plans – Space segment



Discussion of Customer's requirement

Data exchange // Servicer & Client

- Issue of URD

Detailed definition of Servicer + Operations

Coordination with Client's Operator

Finalization of partnerships with core team

ECSS tailoring

- Partnerships signature

Agile development

SW + avionics

- Specs for suppliers

Important in order to enable the opportunity of a new space approach

In Orbit Servicing
Maturation Phase

Technical overview

- Requirements flow down
- CONOPS
- System technical summary
  - Space segment
  - Ground segment (GS)

esa TELESPAZIO ThalesAlenia Space

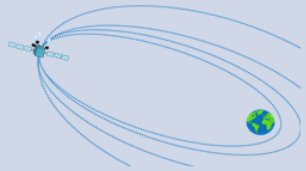
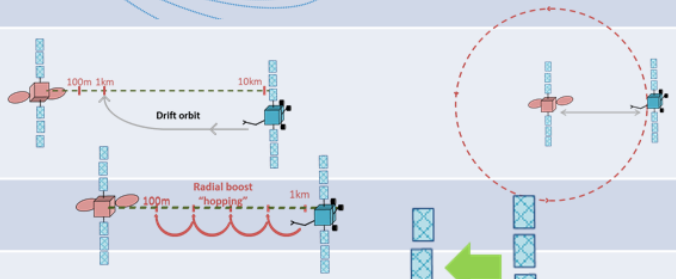
Requirements flow down

#	Type	Requirement	Rationale
1	M	Rendezvous and capture an operational in-orbit Customer Spacecraft(s).	IOS-01
2	M	The Start€ Service shall perform Customer GEO satcom life extension.	IOS-02
3	R	The Service shall comply to the space debris mitigation requirements stated in "Space sustainability. Adoption of Notice of ISO 24113: Space systems – Space debris mitigation requirements. (3rd of December 2019)"	IOS-03
5	D	The onset of the service shall occur by the end of 2028.	IOS-06
7	D	The system development shall implement a tailoring of ECSS standards. Note: If other standards are proposed, the Respondent shall provide an equivalence analysis with respect to ECSS standards.	IOS-08
8	D	A minimum TRL of 6 for critical technologies shall be reached by the end of 2023. Note: In the event it is not possible to achieve TRL 6 by 2023, then a development plan is required to demonstrate how IOS-06 can be achieved. 3	IOS-09
9	M	The Start€ Service shall propose to its Customer a flexible mission duration, depending on the Client satellite status and the Start€ satellite remaining ressources.	
10	O	The Start€ Service shall not interrupt its Client mission except during rendez-vous phase for a maximum of a 2 hours.	
11	F	The Start€ Service shall not affect the Client satellite mission performances.	
12	F	The Start€ Service shall not generate RF interference to the Client satellite.	
13	F	The Start€ Service shall not damage the Client satellite.	
14	O	The Start€ Service shall not put the Client satellite in a hazardous situation in any mission phase, including separation at decommissioning.	Do not place the Client on a risky orbit. Avoid predicted collisions.
15	O	The Start€ Service shall be interrupted or stopped upon Customer request.	
16	O	The Start€ Service shall respect the station-keeping slot of the Client satellite.	
17	R	The Start€ Service shall respect the RF band granted by ITU in the slot of the Client satellite.	

M	Mission
R	Regulatory
D	Development
O	Operation
F	Functional and performance

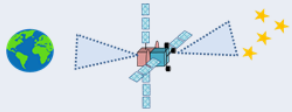
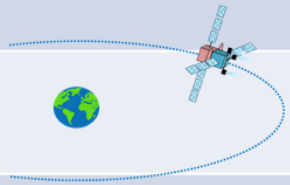
CONOPS (1/3)

Compliant to future French LOS on IOS

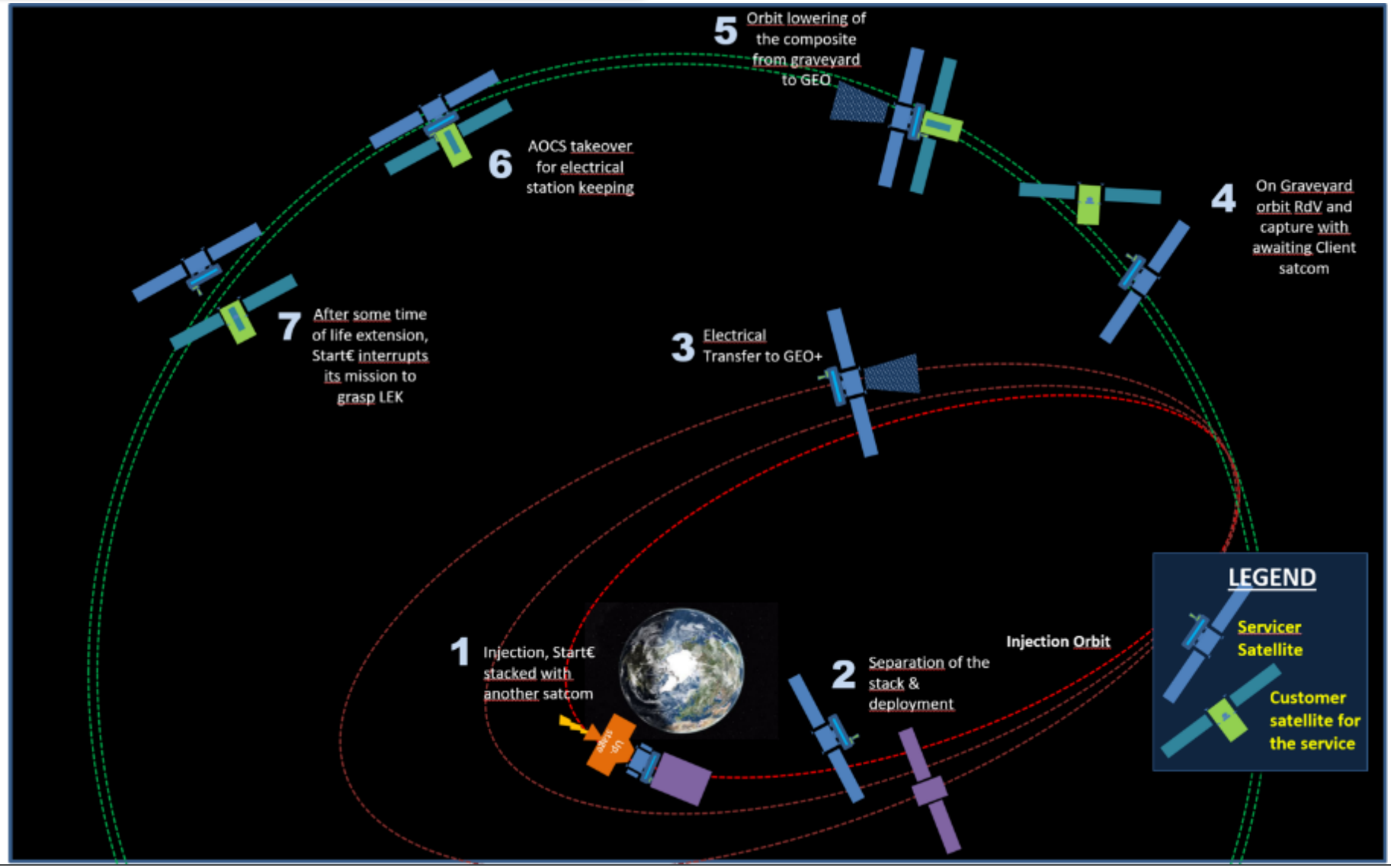
Phase	Duration	Illustration
Launch and orbit acquisition	T0 to T0+5h	
Demonstration mission: With a collaborative Customer spacecraft waiting for the demonstration in the GEO + 300 km		
Transfer from GTO to GEO + 300 km Progressive transition from absolute to relative navigation	T0+5h to T0+270d	
IOT and inspection	T0+270d to T0+285d	
Approach rehearsal (including CAM test)	T0+285d to T0+300d	
Final approach operations + Capture	T0+300d to T0+301	
Electrical transfer of the composite (Start€ + Customer) to GEO orbit	T0+301d to T0+310d	

CONOPS (2/3)

Compliant to future French LOS on IOS

Phase	Duration	Illustration
Primary commercial mission : AOCS takeover for lifetime extension		
AOCS take-over Combined operations	5 years	
End-of-Life first Client		
Re-orbiting of the Client Start-€ and Client separation		
Secondary commercial mission : AOCS takeover for lifetime extension		
Optional waiting phase Second commercial life extension mission		
End-of-Life for Start-€		
Start-€ end of life		
Option: refuel of the servicer		

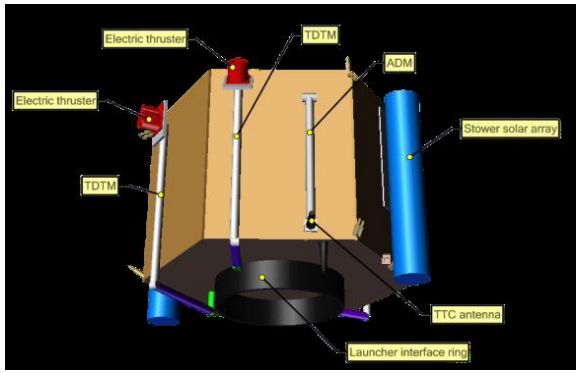
CONOPS (3/3)

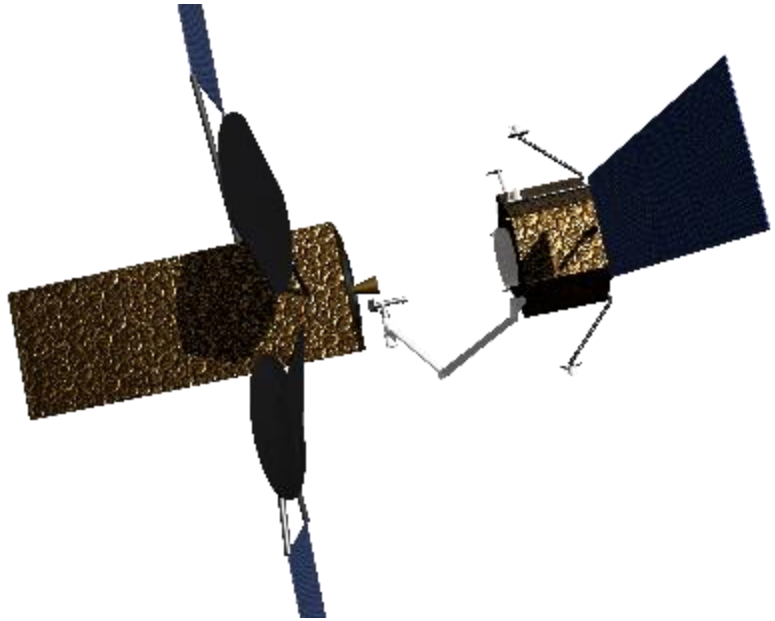


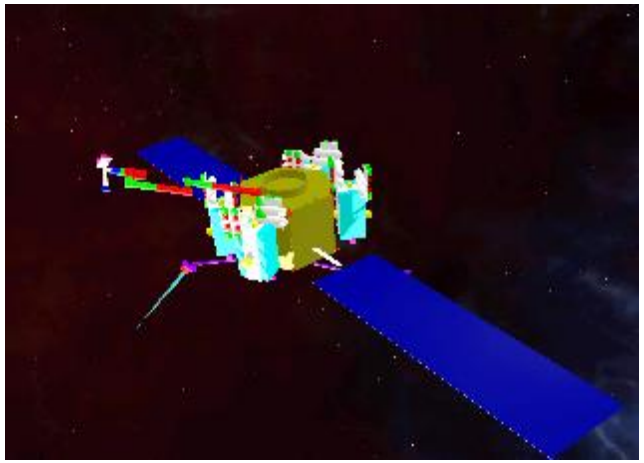
System technical summary – Space segment

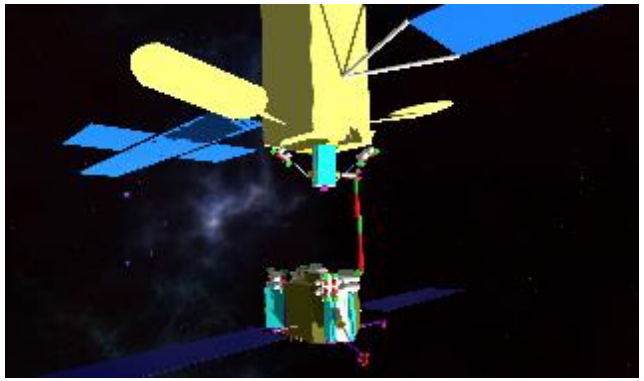
Servicer description

- Overall same typology as in the proposal
- Docking performed by the robotic arm









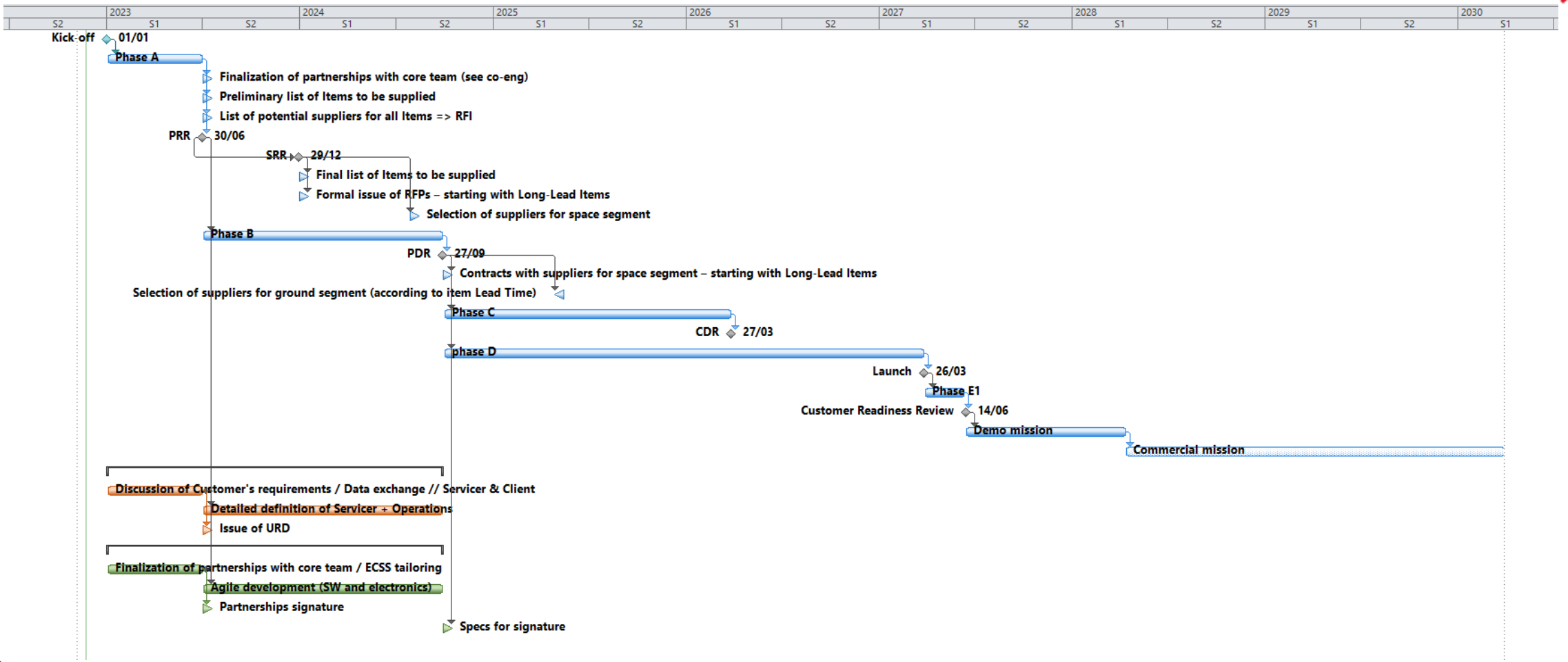
System technical summary - GS

- The Ground Segment is composed by:
  - The Ground Control System (GCS). It is composed by the following elements
    - One main and one backup Satellite Control Center (SCC) in charge of TM processing and monitoring as well as execution of satellite operations.
    - One Flight Dynamics Centre (FDC) in charge of orbit determination, manoeuvres, attitude guidance law parameters and antennas ephemeris computation
    - One Network Control Centre (NCC). It is in charge of the control of the ground stations used for the operations.
    - One Ground Control Network (GCN) performing data routing and sites inter-connection and management among the different sites of the Ground Segment.
  - One Dynamic Satellite Simulator (DSS) used to validate the ground system and to qualify the operations team.
    - Including one Mission Simulator (MS) used to validate the operations from mission and payload perspective
  - A Ground Station Network (GSN) based on TT&C stations located around the Earth to permanently monitor and control the satellite.

In Orbit Servicing
Maturation Phase

Master schedule

Master schedule



In Orbit Servicing
Maturation Phase

Business plan

Business case justification

Business plan synthesis

esa TELESPAZIO ThalesAlenia Space

Business case justification

Market

- **Market opportunities** of In Orbit Servicing are forecasted to grow generating a potential multi-billion-dollar market achieving **$ 5.1 bln*** over the **next ten years**
- Even though the business growth is forecasted across all services and applications in all orbits, **life extension applications** as well as **deorbiting services** are projected to be the main market segments especially in **GEO orbit**

Total market

Total **Active** satellites & **EoL** satellites

- Application of **adoption %** and **sats mass constraint**
- Application of **anomalies %** only on **Active sats**

Addressable market

- Application of **market penetration %**

Target market

GEO IoS Services

According to market reports, below a list of potential IoS applications/services:

- **Life extension services**
  - Orbit raising and positioning
  - Relocation and positioning
  - Station keeping
- **Decommission service**
  - Deorbiting
- **Life enhancement**
  - Refuelling
  - Robotics

According to **customers' requirements** and at least in the **short-term** (from 2027), the Station Keeping would be the **most attractive and potentially profitable** IoS service

Business plan synthesis

Operational scenario

Station Keeping with chaser and with kits (after 2033):

- Up to 2032: The chaser can address one customer, providing Station Keeping services for 2 years. Then the chaser moves to another customer
- From 2033: The chaser does not address any customer, but “plugs” a kit into the target customer asset. Each kit can provide Station Keeping service for 3 years

Main assumptions

- Chaser lifetime: 15 years
- Opex: between up to € 10 mln per year
- Capex: between up to € 500 mln
- Launch cost: between up to € 30 mln

Main results

- In the timeframe between 2027 and 2041, potential number of Station Keeping provided would be up to 30 missions
- Total cumulative revenues would be up to € 700 mln
- Average ROS > 30%

In Orbit Servicing
Maturation Phase
Final Review

IOS Maturation Phase Conclusion

Next Steps until ITT

esa TELESPAZIO ThalesAlenia Space

Next Steps until ITT

- Collect CMIN conclusion and ESA strategy concerning the ITT
- Reconsider or confirm the consortium structure
- Determine the involvement conditions for Customers

THANK **YOU**
FOR YOUR ATTENTION