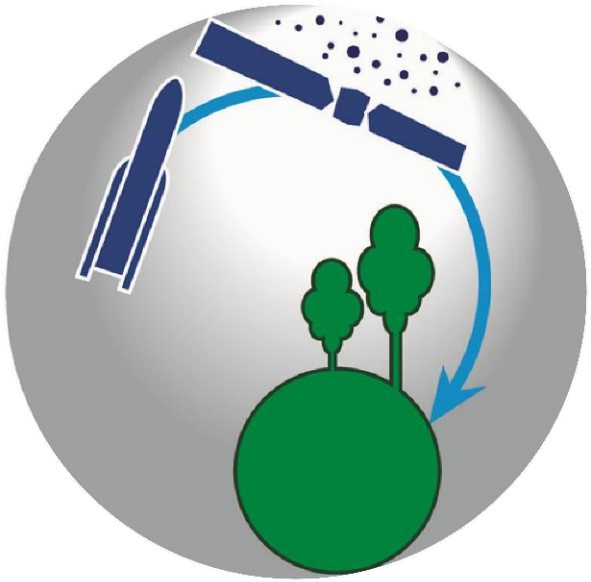
CleanSat

technologies for space debris mitigation



European Space Agency

Motivation

Mandatory Requirements						
		IADC	UN Space Debris Guidelines	ISO 24113	Code of Conduct	National Law
Countries	Austria	✓	✓			
	Belgium	✓	✓	✓		
	France					LOS
	Germany	✓				
	UK		✓	✓		
Institutions	ASI				✓	
	ESA			✓		
	CNES					
	DLR	✓				
Voluntary Requirements						
Countries	Netherlands					
	Spain		✓		✓	
	Italy	✓				
Institutions	Spain		✓			

Mandatory Requirements						
		IADC	UN Space Debris Guidelines	ISO 24113	N/A	National Law
Countries	Japan	✓				
	China	✓	✓			✓Requirements for Space Debris Mitigation (QJ3221-2005)
	Russia					✓General Requirements on Space Systems for th eMitigation of Human-Produced near-Earth Space Population
Institutions	JAXA	✓				
	NASA		✓			✓U.S. Government Orbital Debris Mitiga tion Standard Practices
	Roscosmos		✓			✓General Requirements on Space Systems for th eMitigation of Human-Produced near-Earth Space Population
	CNSA/CAST	✓	✓			✓Requirements for Space Debris Mitigation
Voluntary Requirements						
Countries	USA		✓			✓U.S. Government Orbital Debris Mitiga tion Standard Practices

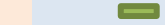
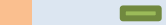
New technologies compliant with SDM requirements will foster **innovation** and global **competitiveness**

Impact of SDM Requirements in LEO

LEO S/C also need to re-enter with limited on-ground casualty risk

Altitude	<500kg		
	Passivation	EOL Disposal Manouevre	Controlled Re-entry
<600km			
600 - 1250km			
1250 - 2000km			

Altitude	500-1500kg		
	Passivation	EOL Disposal Manouevre	Controlled Re-entry
<600km			
600 - 1250km			
1250 - 2000km			

Altitude	1500kg +		
	Passivation	EOL Disposal Manouevre	Controlled Re-entry
<600km			
600 - 1250km			
1250 - 2000km			

	Technology not required to be compliant
	To be assessed on a case by case basis
	Technology inpmementation required

ESA Living Planet Program

EarthCARE

2012

2013

2014

2015

2016

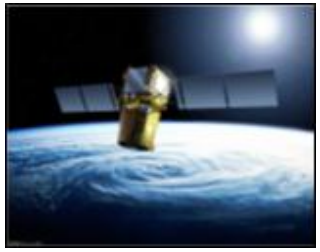
2017

2018

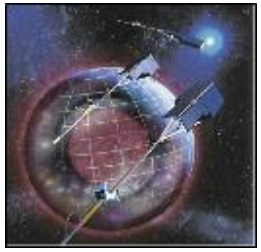
2019

2020

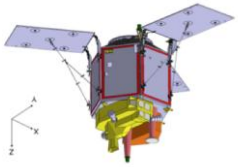
ADM-Aeolus



Swarm



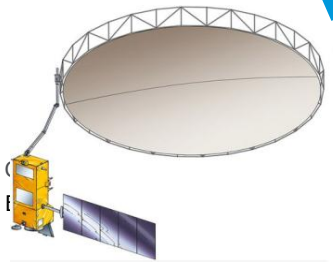
FLEX



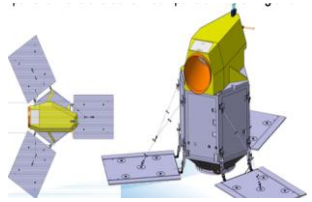
EE8

EE7

BIOMASS

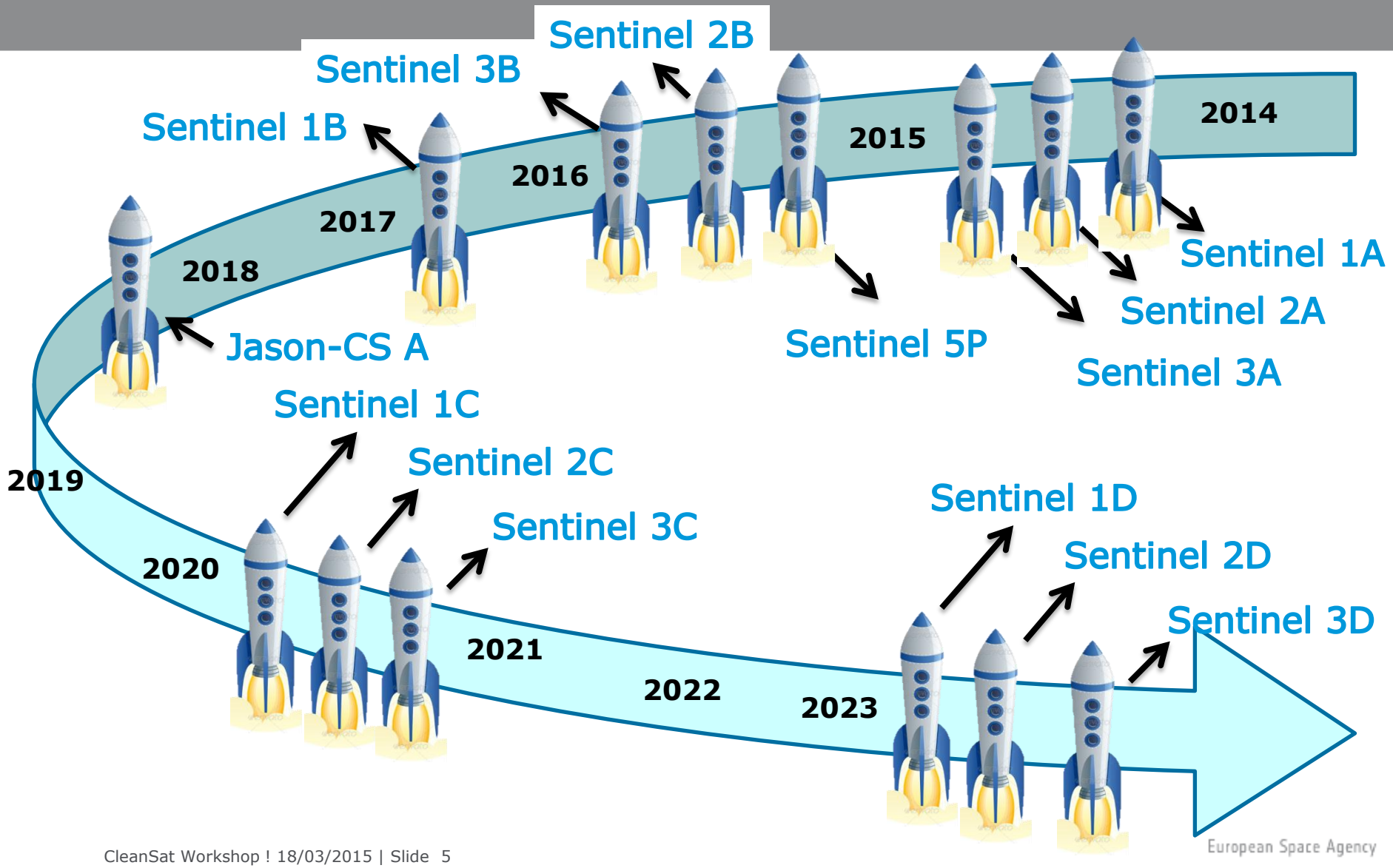


CarbonSat



European Space Agency

4.4.2. Copernicus/GMES Program



Why CleanSat?

- There is a worldwide demand for SDM compliant solutions, upcoming ESA missions shall be compliant.
- SDM requirements have an **impact on the overall system**.
- **Medium and Large LEO S/C** are specially affected due to the need to re-enter with limited on-ground casualty risk.
- May **imply design changes** in different elements of the S/C.
- **Modifications in the recurrent elements of platforms** can help mitigating the impact on the payload design that is normally more constrained.
- It is not feasible to go on carrying out parallel developments for different platforms → Need for a **coordinated European approach**.

Challenge accepted!

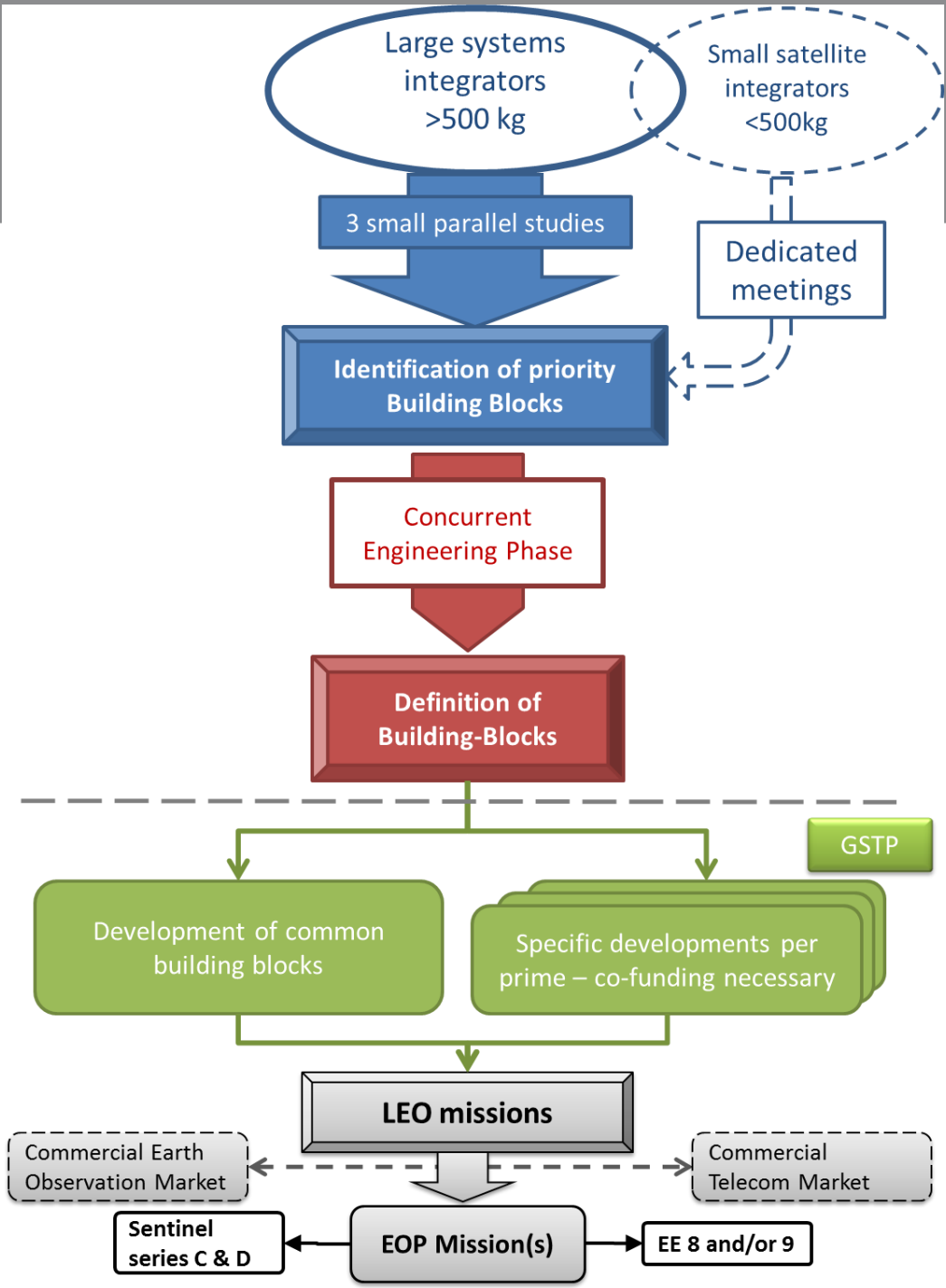
CleanSat

CleanSat embodies the Agency technologic and programmatic response to support European industry complying with the SDM requirements.

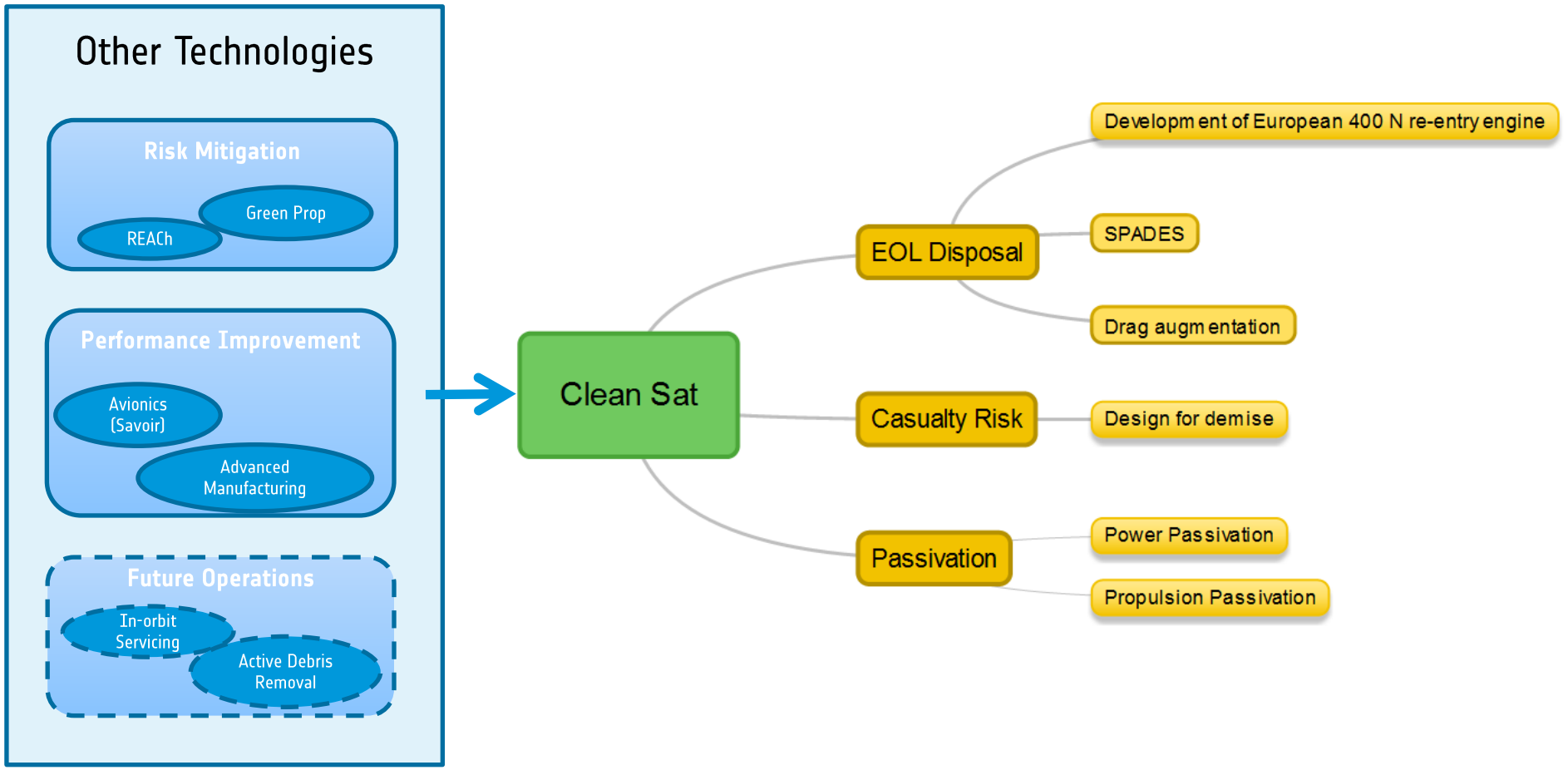
CleanSat drivers:

- Technologies for the evolution of LEO platforms to comply with SDM requirements, in a coordinated European approach.
- create an efficient framework for the fast implementation of innovative technologies in upcoming EOP missions.
- development of building blocks and stimulate the creation of shared supply chains, lowering development and recurrent costs.

CleanSat implementation

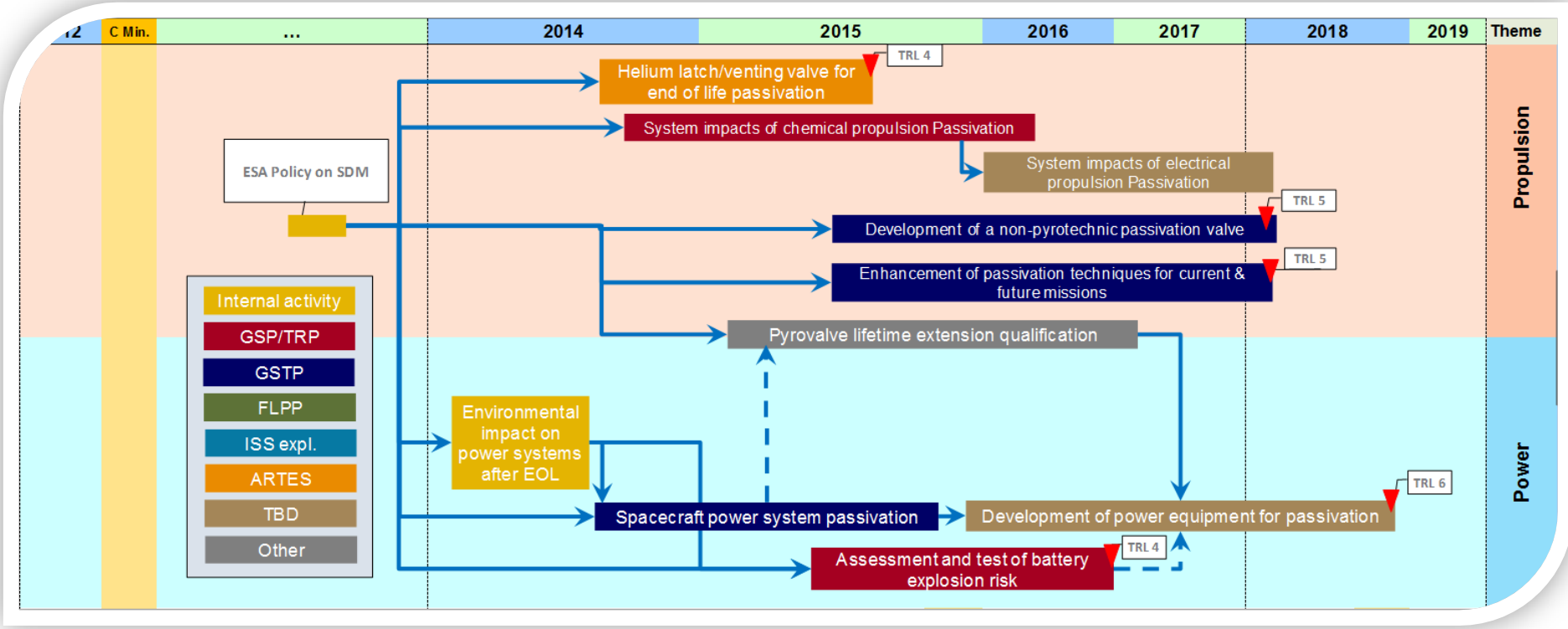


Technical content

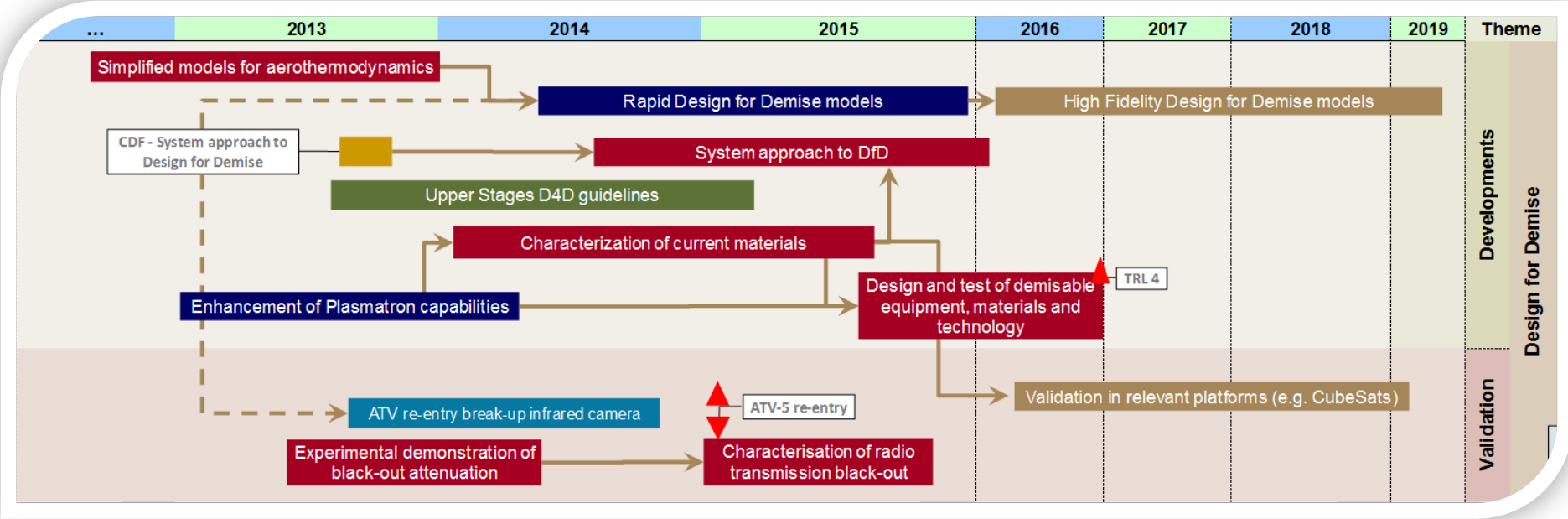


Clean Space – Branch 3

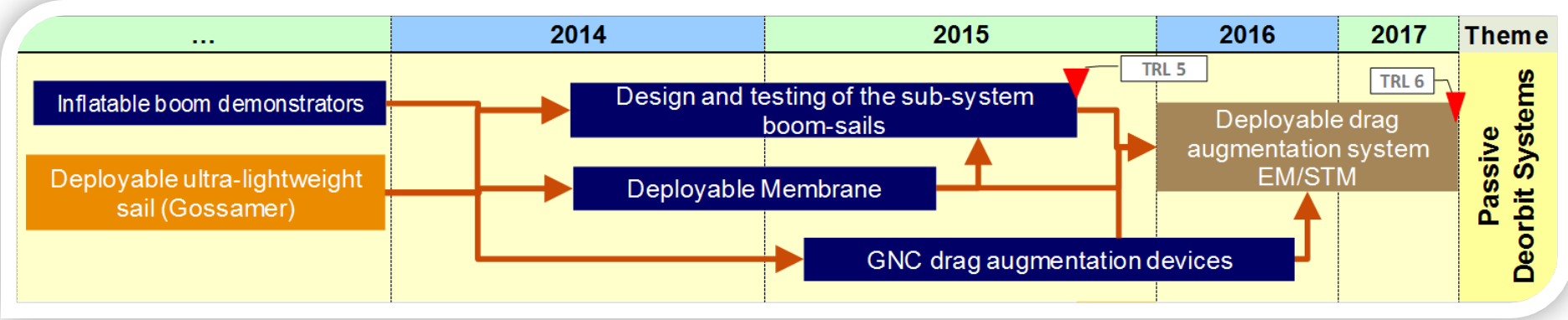
Passivation



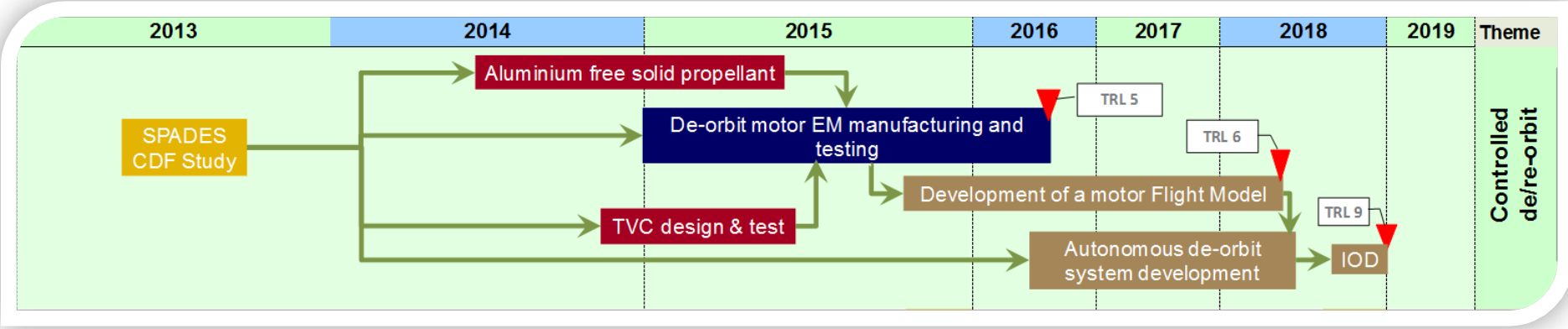
Design for Demise



Drag augmentation sails



Solid propulsion Deorbit system



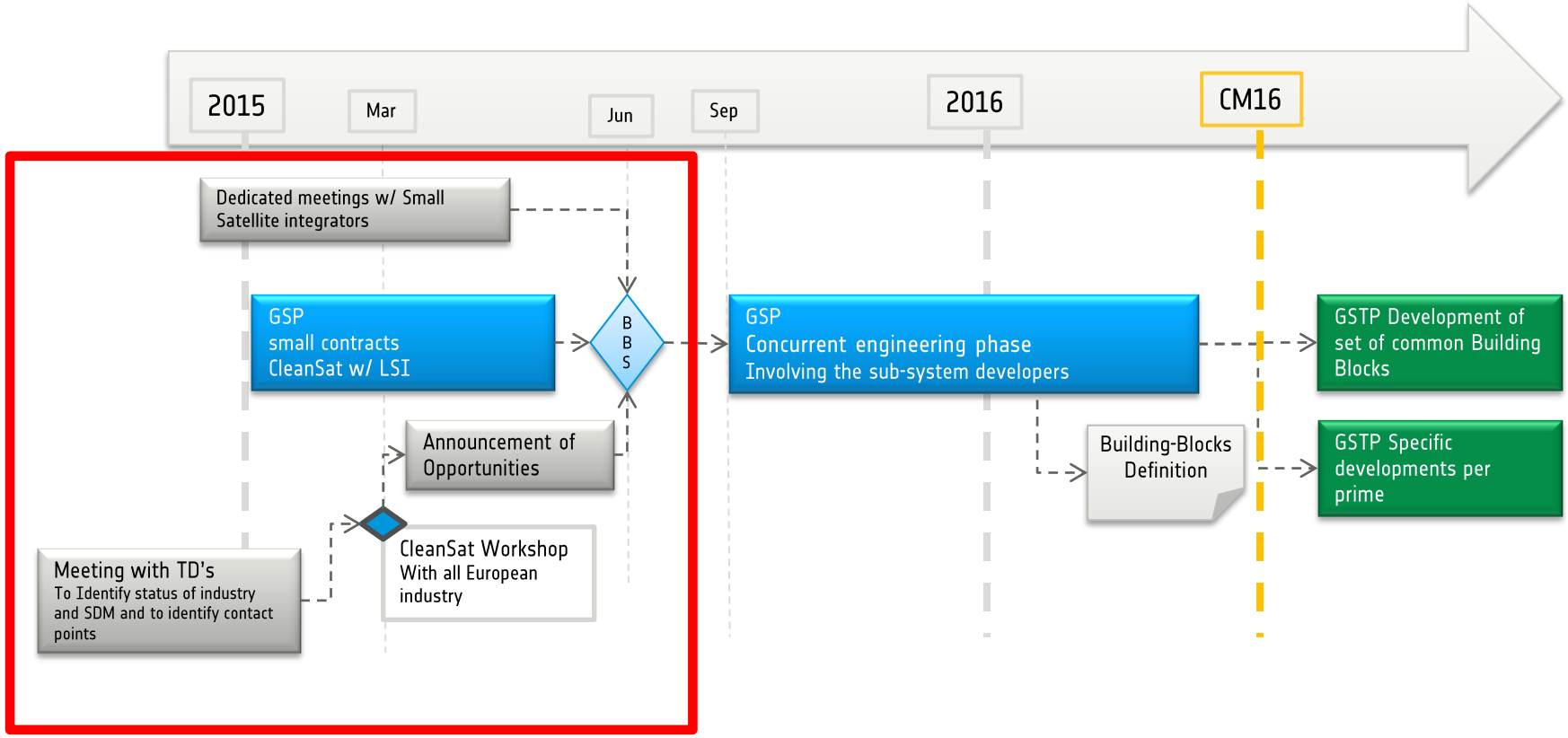
CleanSat Preparation Phase 1:

Building-Blocks Identification Phase

Objectives

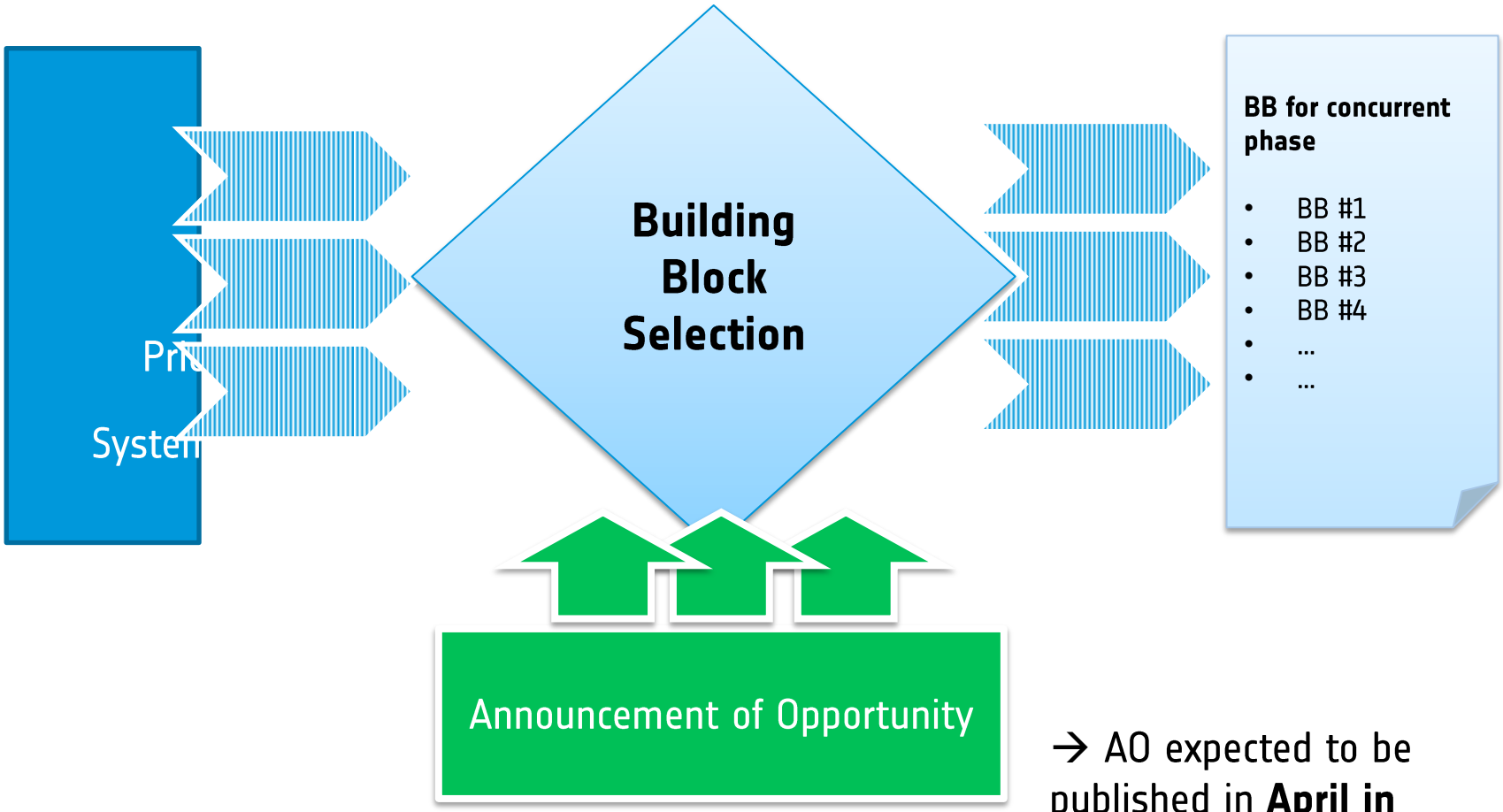
- Initiate a coordinated European approach to develop technologies to support the evolution of the LEO platforms in compliance with SDM requirements.
- Identify together with the LSIs high priority technology Building-Blocks and define high level sub-system requirements.
- Improve knowledge of the impact of SDM requirements on the different S/S design across the industrial chain.
- Involve S/S developers and equipment suppliers in the technology identification process.

Schedule planning



As a result of the GSP contracts a preliminary list of priority building blocks will be identified. The results of the Call for Ideas shall be integrated in the WWS and evaluated by the LSIs

Building Block selection



→ AO expected to be published in **April in EMITS**.

Announcement of Opportunity
Key Areas of interest

1 - Compliance with SDM requirements

- **End-of-Life Disposal**
  - ***Targeted re-entry systems*** e.g. development of autonomous deorbit systems, development of high thrust re-entry engines
  - **Active or Passive Uncontrolled de-orbit systems** e.g. drag augmentation systems

- **Passivation**
  - **Power passivation** e.g. solar array isolation system.
  - **Propulsion passivation** e.g. pressurant or propellant venting systems

Announcement of Opportunity
Key Areas of interest

1 - Compliance with SDM requirements

- **Design for Demise** *e.g. demisable tanks, demisable structures, demisable magneto-torquers, demisable reaction wheels, demisable elements or designs for payloads, mechanisms to enhance heat-flux on internal equipment during re-entry, payload modules separation mechanisms*

Announcement of Opportunity
Key Areas of interest

2- Compliance with new regulation *e.g. due to REACH or RoHS, green propulsion*

3 - Increase platform performance e.g. advanced avionics, high efficiency power generation and storage, Micro Electro-Mechanical Systems (MEMS), high performance harness, high efficiency CAMs

4 - Increase platform competitiveness e.g. low-cost technologies, advanced manufacturing, support to in-orbit servicing (e.g. Design for Removal to support in case of a satellite failure: attitude stabilization, traceability from ground, capture and deorbit)

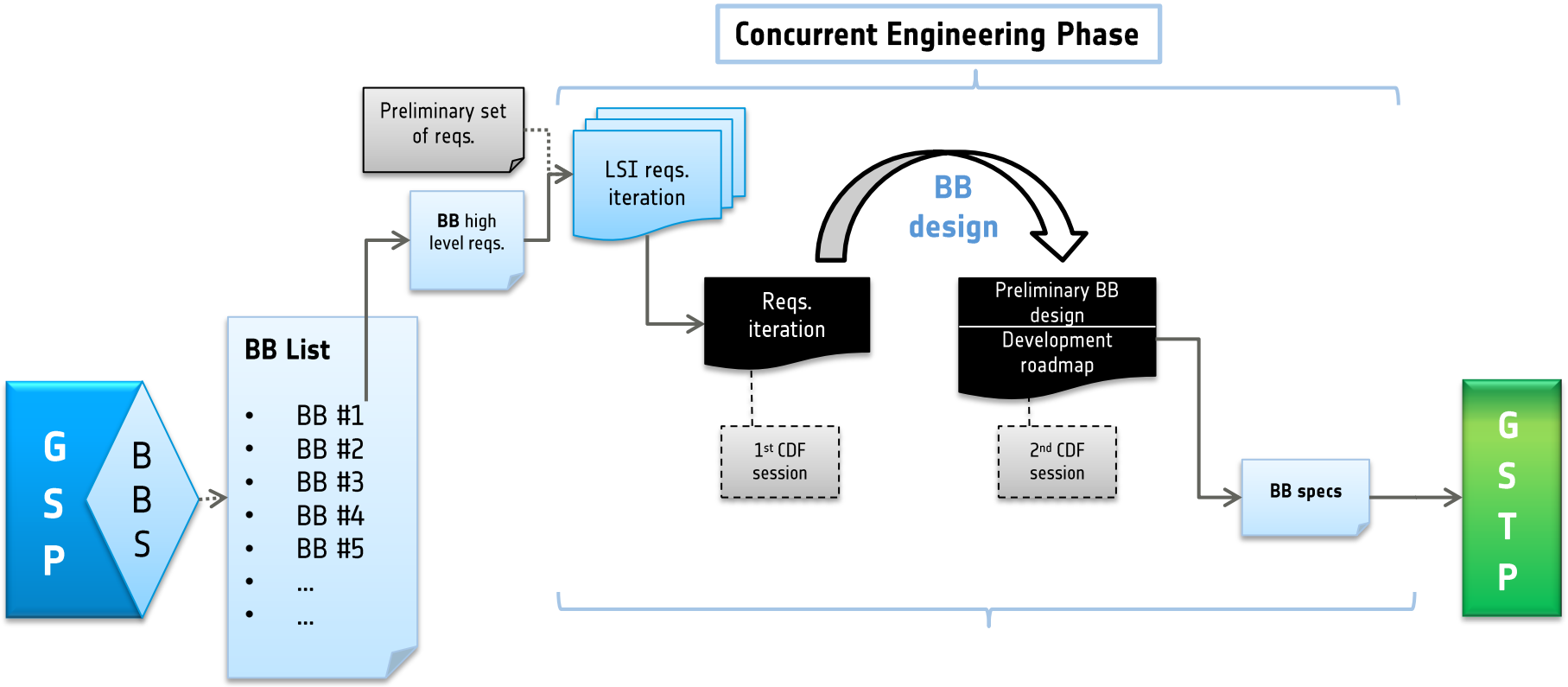
CleanSat preparation Phase 2:

Concurrent Engineering Phase

Objectives

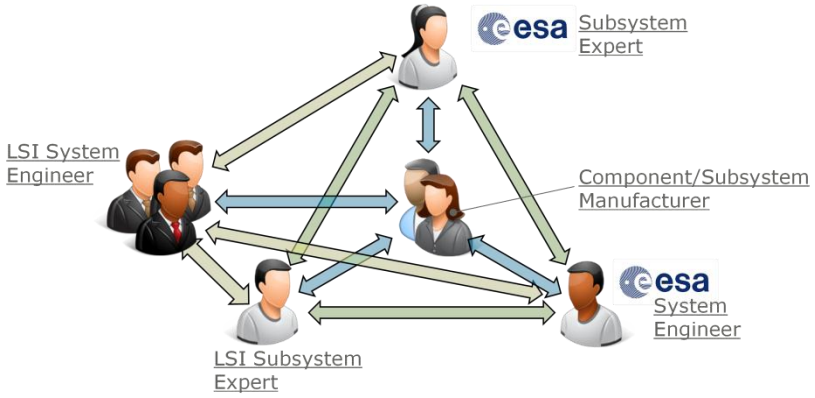
- Increase maturity of the identified building blocks
- Promote communality and the development of shared supply chains for the new LEO platforms
- Identify industrial partners and involve the sub-system developers from the beginning in the building block definition
- Help defining the business case for the follow up GSTP phase

Concurrent Engineering Phase



Concurrent Engineering Phase

- Concurrent Sessions will be hold at ESA CDF with the participation of:
  - systems integrators
  - sub-system/equipment supplier(s)
  - facilitated by ESA systems engineers and technical experts



- The duration of the CE phase should be of about 1 year. Target KO in September 2015

Conclusions

- CleanSat is a technology programme to develop building blocks to support the evolution of LEO platforms to comply with SDM requirements.

- ESA is implementing a coordinated European approach, involving Agency, system integrators, sub-system and equipment suppliers.

- CleanSat tries to capitalise on ideas and technology developments from the whole European space community, taking into account the systems integrators priorities. Key knowledge areas:
    1. Compliance with SDM requirements
    2. Compliance with new regulation
    3. Increase platform performance and competitiveness

Your participation is essential !

For further information

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Thank you