4th IAA Conference on University Satellite Missions and Cubesat Workshop
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Building Low Cost Cubesat: Guidelines and Design Approach

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PLAN

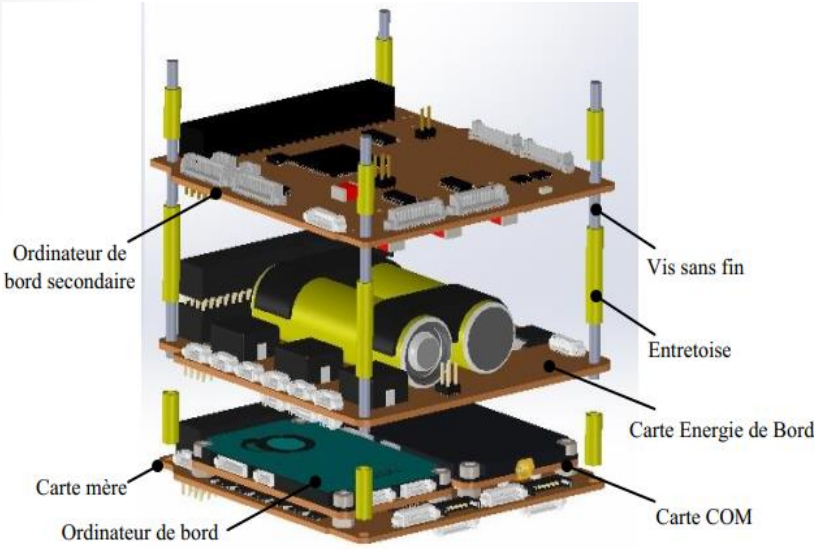
- Introduction
- Methodology
- Mission Analysis Processes
- System Engineering Processes
- Platform: Available Options and Trade-offs
- Management Processes
- Conclusion & Futur Perspectives

Introduction - Why Cubesats?

- The Cubesat model provides almost all of the benefits of a larger program at a fraction cost.

- Cubesats are valuable educational tool to leverage aerospace capacity building since emphasis is put on the "learn-by-doing" process.

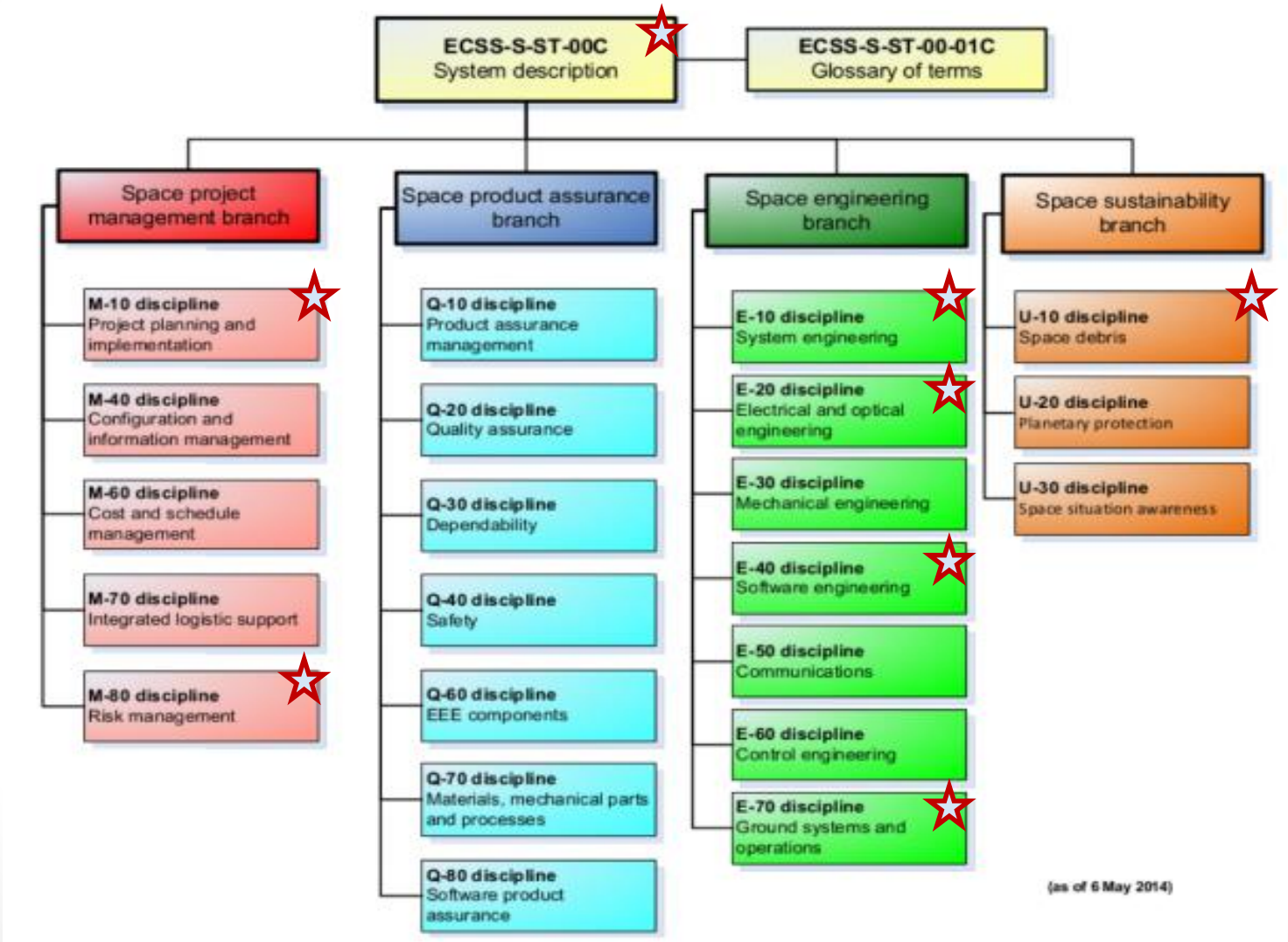
Introduction – MASAT 1



Objectives:

1. Enhance capacity building in space technology and spacecraft engineering through designing and integration of both the space and ground segment
2. Establish a reliable radio link with low-cost mission control ground station for control, command, and telemetry retrieval.
3. On-orbit reconfiguration and testing of the FPGA based secondary OBC.

Methodology – ECSS Framework -



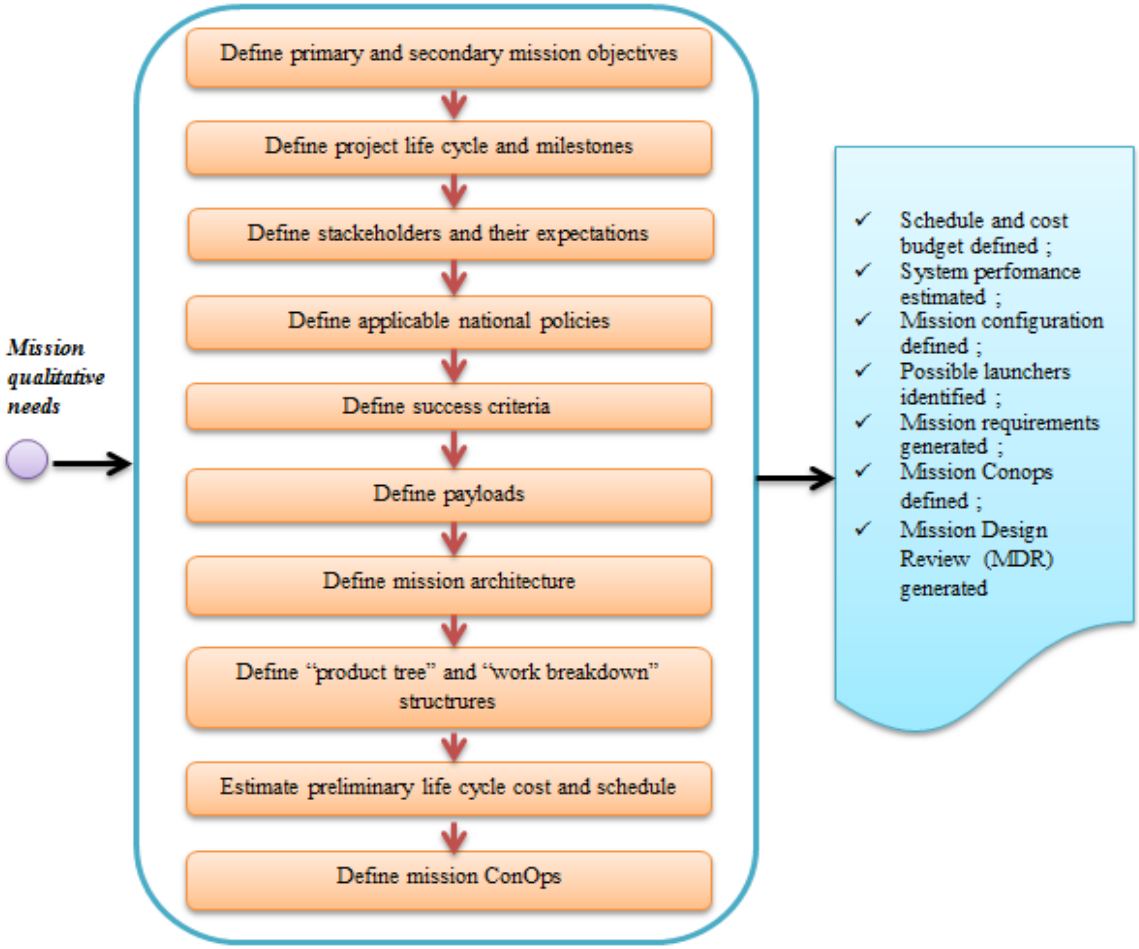
Methodology - Approach –

- ✓ ***Concurrent System Engineering***
- ✓ ***Approach***

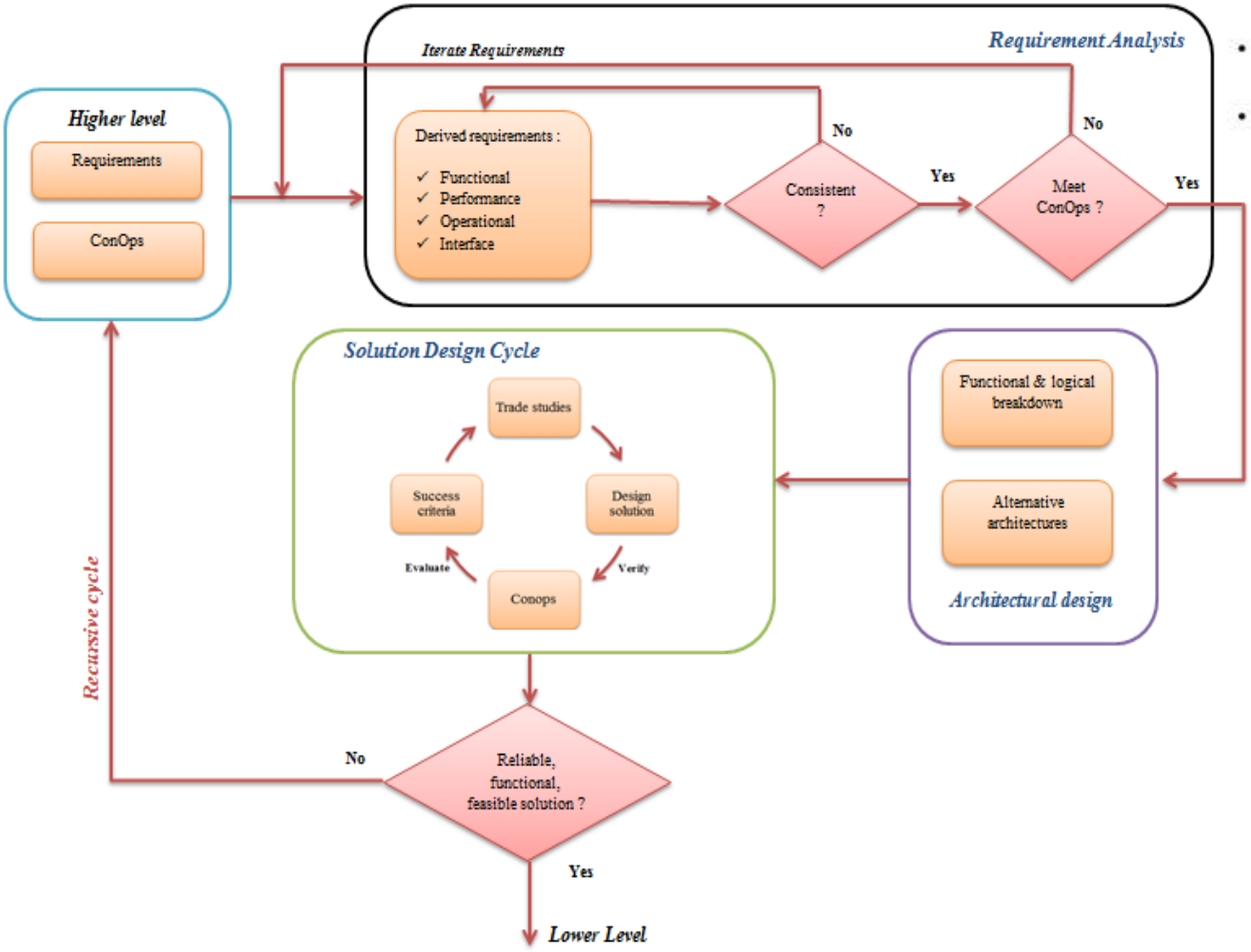
  ➔ Iterative: to cope with eventual requirements changes and all the discrepancies which may arise during the design process,

  ➔ Recursive: to design next lower layer subsystems or to realize next upper layer elements within the system structure

Mission Analysis Process



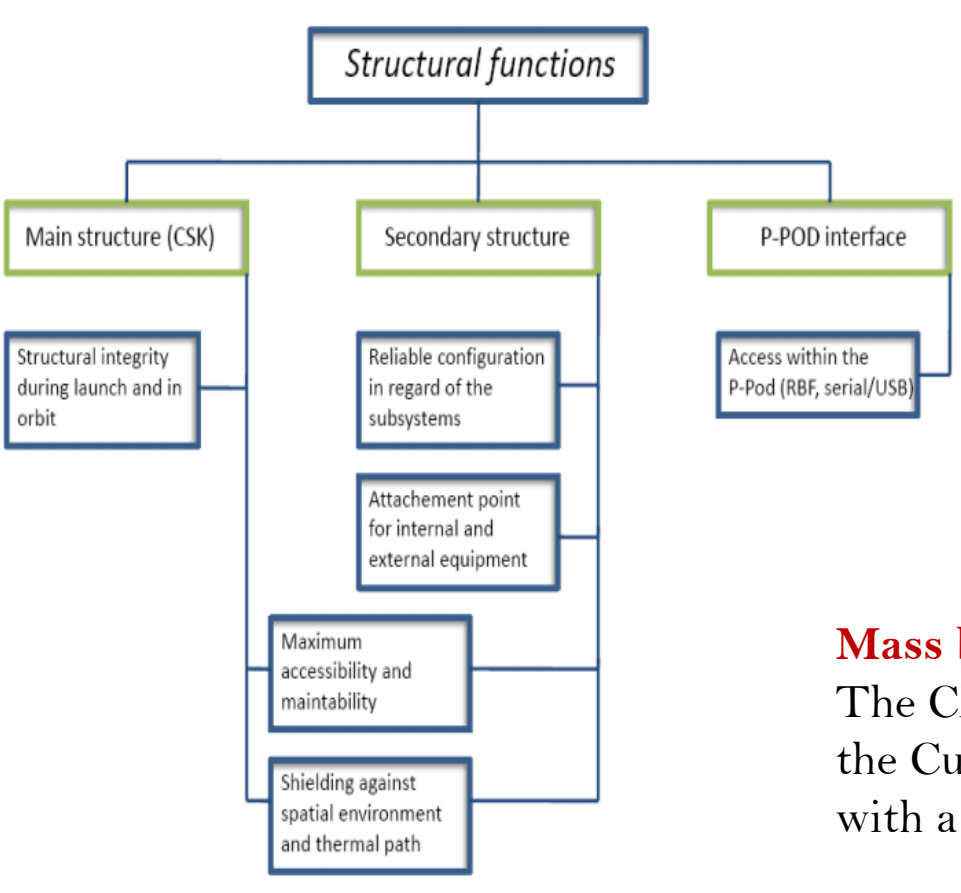
System Engineering Processes



- Form--System Characteristics "what it shall ***be***"
- Fit--System Interfaces "what it shall ***connect to***"
- Function--System Capabilities "what it shall ***do***"

Platform: Structure and SC configuration

Structure



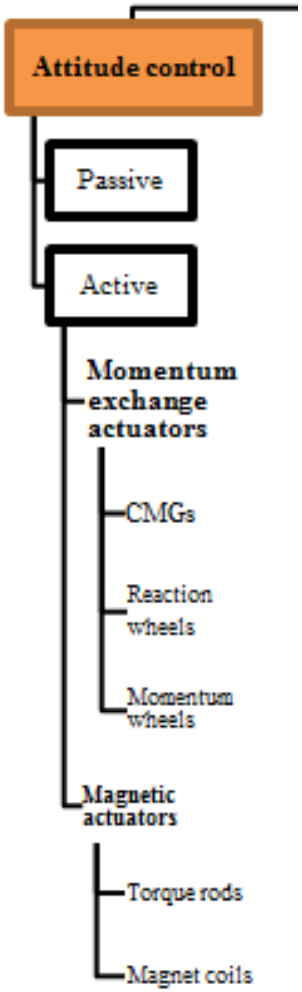
Satellite configuration

- ✓ *Physical configuration:* Layers / Slots
- ✓ *Logical configuration:* Centered / Distributed

Mass budget:

The CDS standard limits the mass of the Cubesat to a maximum of 1.4 kg with a security margin of 10%.

Platform: Attitude Control

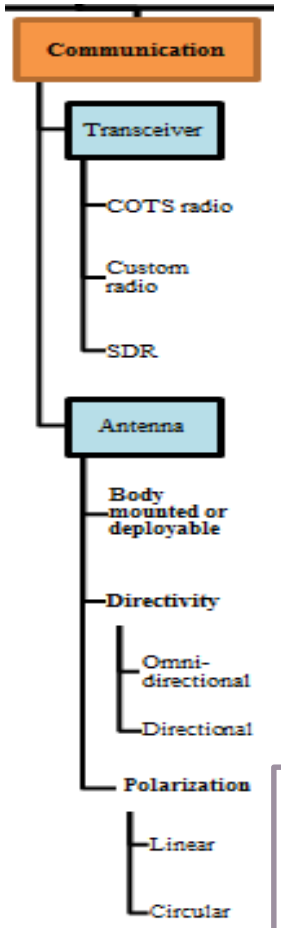


Passive attitude control:

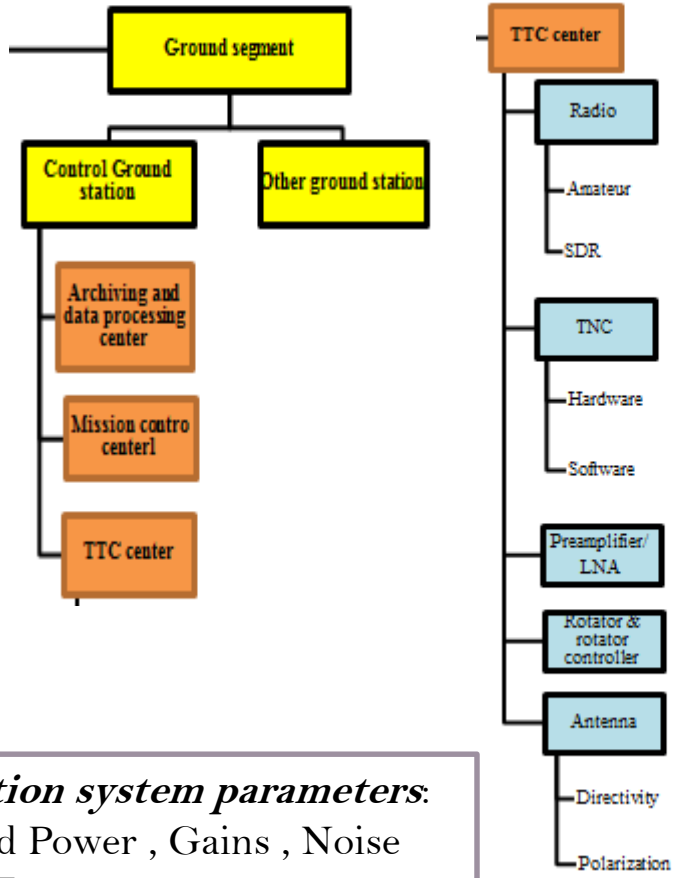
+ No energy consumption
+ No dedicated card slot
+ Easy configuration
- No pointing accuracy

Platform: Communication

Space segment

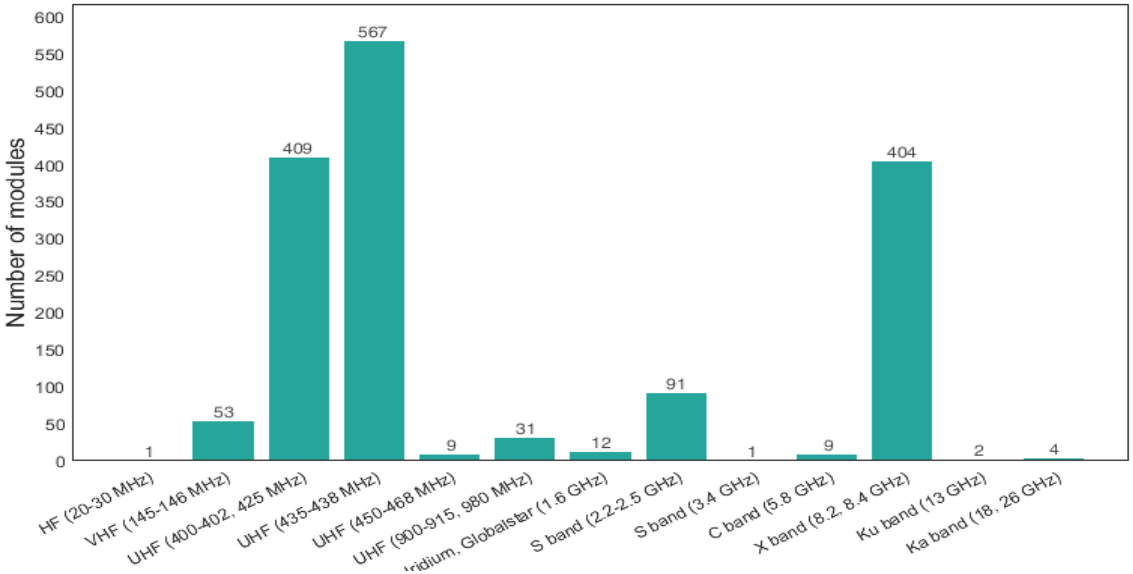


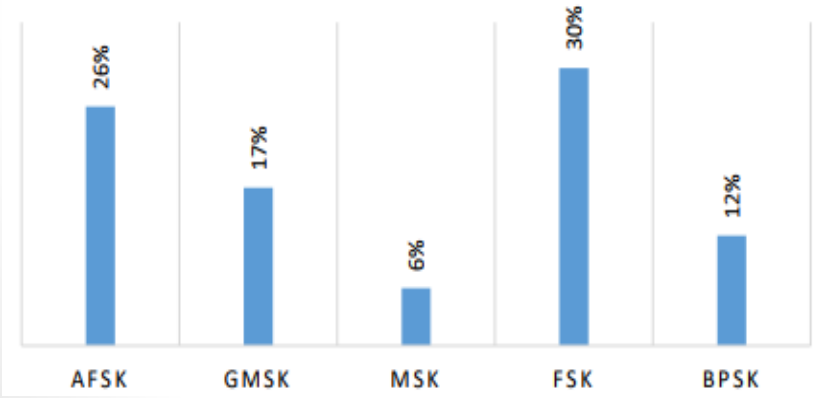
Ground segment



Communication system parameters:
Transmitted Power , Gains , Noise Temperature

Platform: Communication



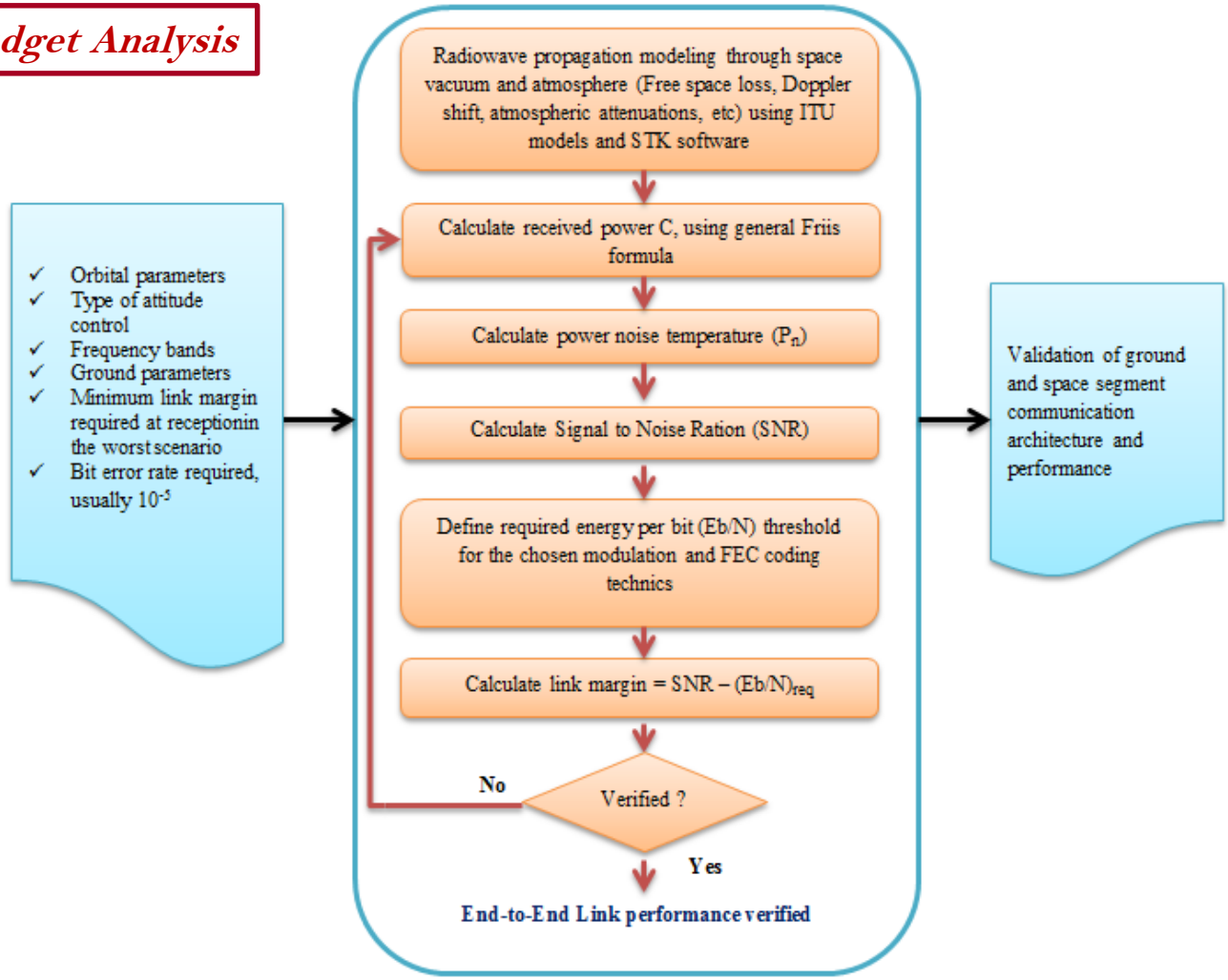


Choice criteria:

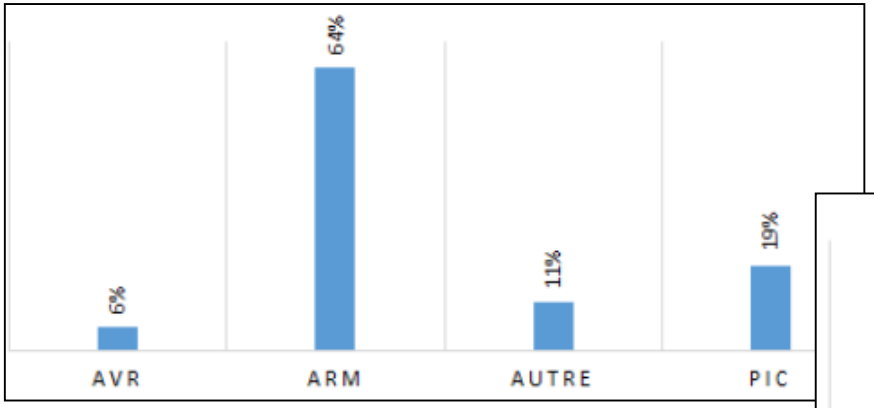
- ✓ Power efficiency
- ✓ Bandwidth efficiency

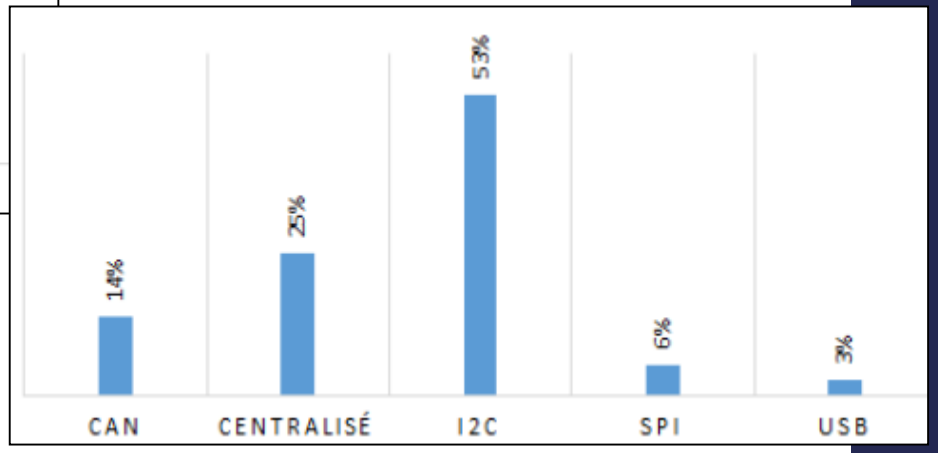
Platform: Communication

Link Budget Analysis



Platform: On-board Data Handling

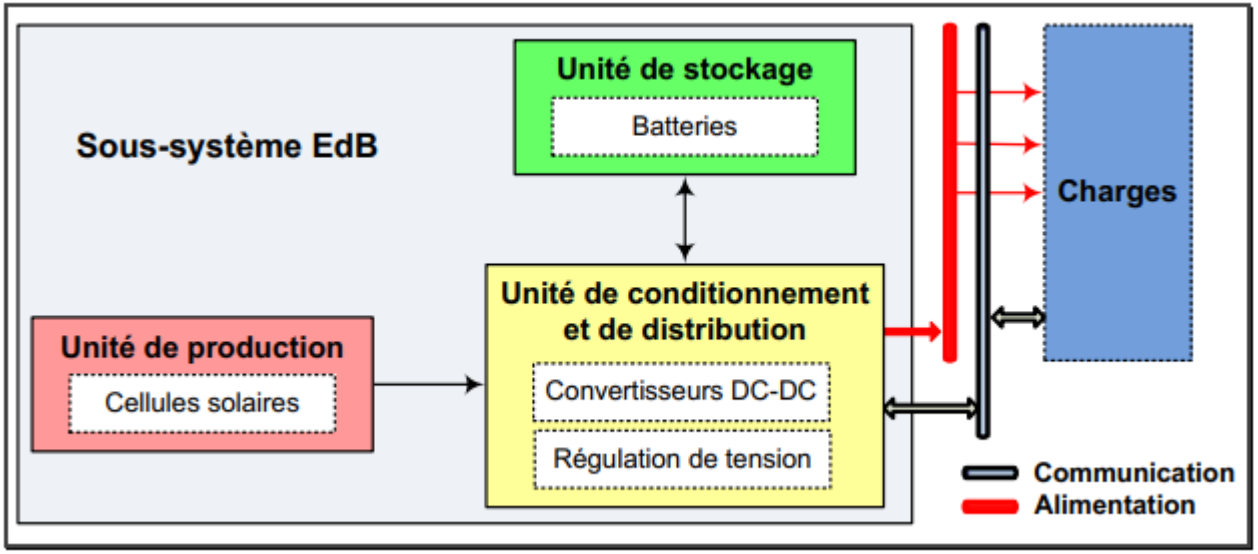




choice criteria are:

- ✓ Resilience against the harsh space environment,
- ✓ High processing power,
- ✓ Power consumption and memory storage.
- ✓ Flight heritage to ensure reliability,
- ✓ Hardware or software redundancy to minimize single point of failures,
- ✓ Price,

Platform: On-board Energy



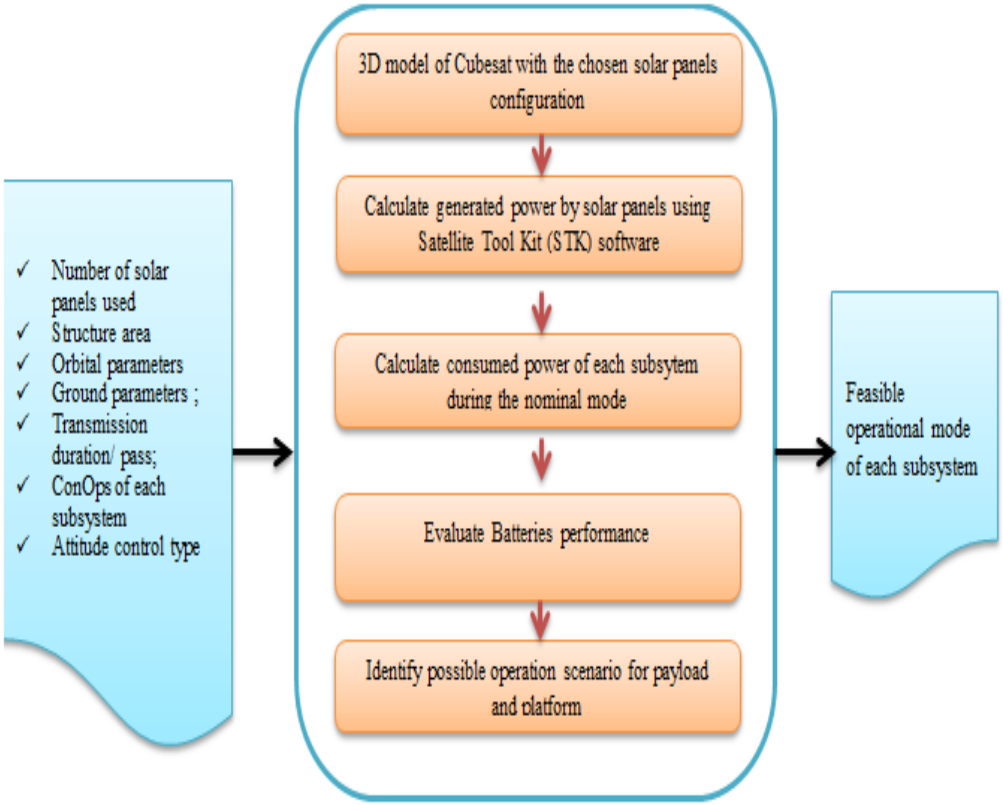
Solar panels:

- Body mounted /deployed
- Simple/ double / triple junctions

Batteries: Low DOD (Depth of Discharge) is recommended for better resistance to radiations, better temperature coefficients, higher levels of delivered power, and hence higher efficiency.

Platform: On-board Energy

Power Budget Analysis



Production and Qualification Processes

Activities:

- Implementation approach : Fabricate/ procure/ reuse hardware and code software.
- Prototype/ protoflight verification, validation and integration
- Run qualification tests such as : vibration, static, mechanisms, thermal vacuum tests
- Run final functional tests
- Packaging

Management Processes

Project Management	***Project organization and planning*** * Definition of stackeholders * Definition of project life cycle and milestones
	Mission architecture definition * Definition of the payloads, * Identification of potential launch vehicles, constraints and proposed services, * Identification of the space segment configuration * Identification of the ground segment locations * Definition of communication link configuration, frequency bands and transmission mode and frequency allocation license * Product Tree and Work breakdown structures
	Cost and schedule management
	Documentation management

Conclusion & Futur Perspectives

- ✓ Keep It Simple Stupid
- ✓ Keep track of interfaces
- ✓ Update risk analysis
- ✓ Team work and respect of management plans and ConOps

Thank you for your attention