

# Engineering for Space 1

## Mars-wide Relay Satellite Network (MARSNET)



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## Change record


Issue	Date	Total pages	Page(s) affected	Description of change
1.0	20250908	11	0–11	Copy Initial Template to LaTeX
1.1	20250909	11	0–11	Switch away from Overleaf
1.2	20250909	12	1, 7	Added Title and Mission Description
1.3	20250915	13	9	Added Product Breakdown Structure

## Applicable documents

Reference	Document title	Document #	Issue	Date
[AD01]				


## Reference documents

Reference	Document title	Availability	Issue	Date
[RD01]				

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## Executive Summary

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## Abbreviations list

AD Applicable Document


RD Reference Document

TBD To Be Done

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## 1 Introduction

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## 2 Mission elements

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### 2.1 Mission description


MARSNET is a dedicated telecommunication and navigation relay constellation designed to provide continuous, high-bandwidth, and low-latency communication coverage for human and robotic exploration on Mars. The network will consist of a series of orbiters strategically placed in highly elliptical and areostationary orbits, ensuring global surface coverage and reliable links between Mars and Earth.

#### Mission Objectives:

1. **Enable Human Exploration:** Seamless voice, video, and data transmission for astronauts, including polar and high-latitude regions.
2. **Global Surface Connectivity:** Redundant communications backbone for rovers, habitats, drones, and mobile assets.
3. **Earth-Mars Link Reliability:** Continuous interplanetary data flow with adaptive bandwidth for science, telemetry, and emergency channels.
4. **Navigation Support:** Precise positioning and timing services for surface and aerial vehicles (Mars-analog to GPS).
5. **Scalability for Expansion:** Modular, evolvable network architecture supporting future settlements and missions.

#### Mission Architecture:

1. **Core Constellation:** Three to five relay satellites in areostationary orbit for persistent equatorial and mid-latitude coverage.
2. **Supplementary Satellites:** Highly elliptical and polar orbit relays for polar coverage and redundancy during dust storms.
3. **High-Gain Mars-Earth Gateway:** Satellites with optical and radio high-gain antennas maintaining a robust link to Earth's Deep Space Network.
4. **Inter-Satellite Links:** Crosslink capability enabling dynamic routing of data around outages, creating a true network.
5. **Strategic Importance:** MARSNET provides global communication and navigation, removing critical bottlenecks for surface operations and scientific return, ensuring safe, coordinated, and efficient exploration.

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## 2.2 Requirements

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Create at least 9 different requirements from a 'ECSS Requirement categories" perspective, and 8 different requirements from a 'Product Breakdown Structure (PBS)' perspective. Note that this can be combined, so you could only have 9 requirements in total if you find the right combinations. Also include the type (key, killer, driving, normal), the rationale, the verification method (Inspection, Demonstration, Test, Analysis, By similarity, Simulation and modeling (Design)) and if applicable, an ECSS document reference.

### Reference documents

Req. ID	Description	Rationale	ECSS Req. Category	Type	Applicable PBS level/item	V&V method	ECSS doc. reference

## 2.3 Concept designs

TBD

## 2.4 System and subsystem level trade-offs leading to final concept design

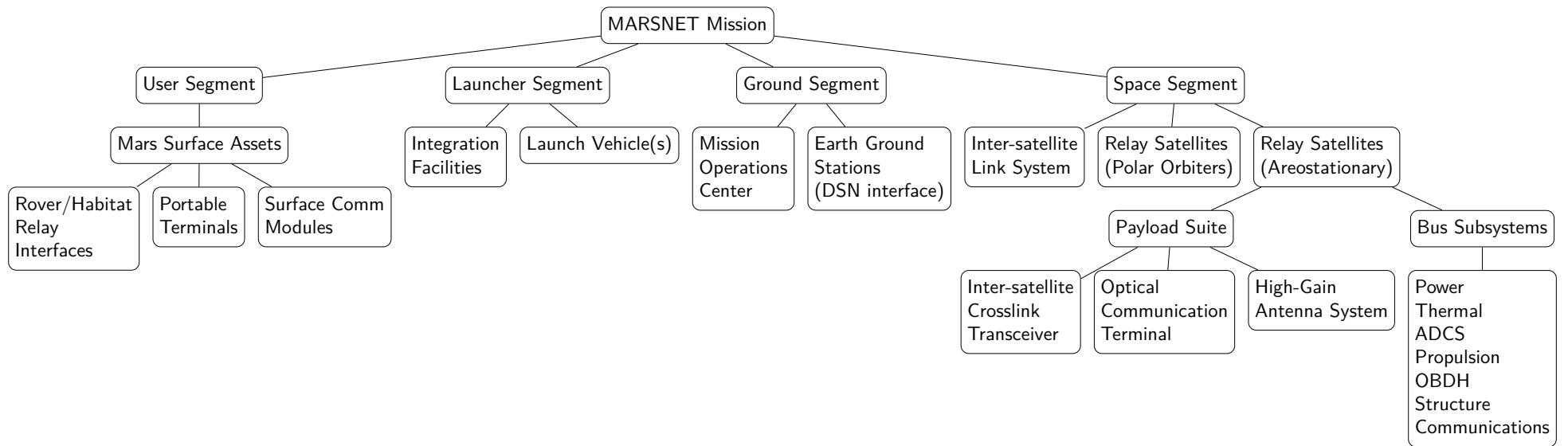
TBD


## 2.5 Description of system elements

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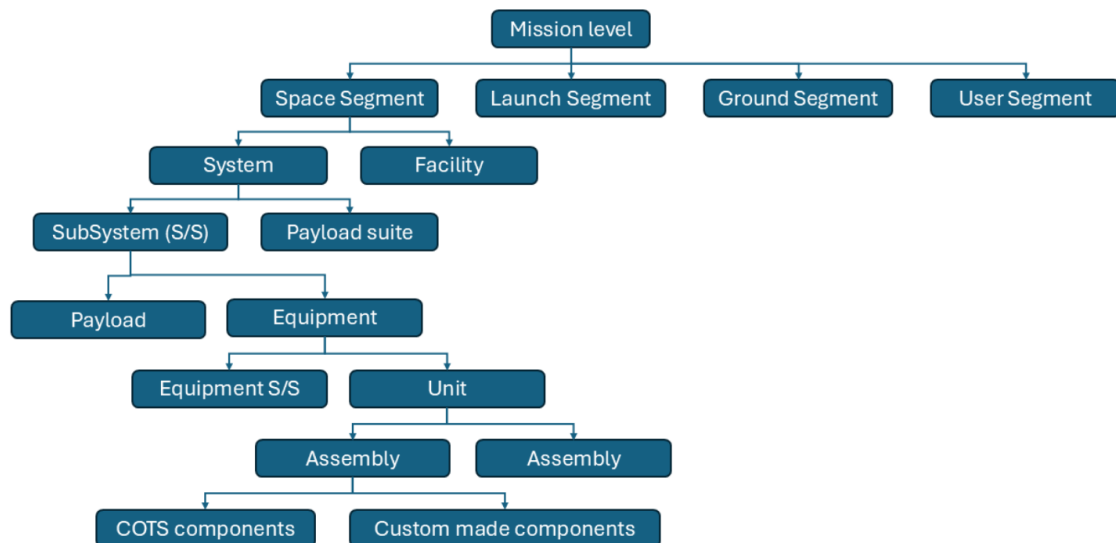
## 2.6 Product Breakdown Structure (PBS)



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Below is an example of an 8 levels PBS with generic names in the boxes. Replace the names with items from your chose concept design, and preferably also the system and subsystem that you do a trade-off for. Give the items a unique number that you can also insert in the requirements table.




## 2.7 Verification and Validation of requirements

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### 3 Conclusions

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## 4 Recommendations

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## Appendix A

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