Manual of the first phase design report

2nd CubeSat Design and Development Competition

Issue 1 – Feb 2022

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0- INTRODUCTION

General

Design phase of second CubeSat design and development competition includes conceptual and detail design. In conceptual design, general systematic and operational parameters of constellation, satellites and ground facilities need to be determined. In detail design, comprehensive determination at the component level will be carried out. This document presents the expected format and content for the conceptual design report of the 2nd Cubesat Competition. Participants should use this document as the template for their report.

It is essential to exclude the following in the report:

- Basic concepts (e.g. the concept of constellation, satellites and ground facility types), historical background, different approaches in design (patterns of constellations), etc.
- Comprehensive comparison of approaches with each other.
- Formulae and relations which are available in reference documents (In case of presenting a formula, final ones may be mentioned).
- The details of algorithms (for instance, it is not required to elaborate the algorithms and providing a general description would suffice).
- Non-final results of the analysis (for instance, in case of several options being analyzed to reach the final features, details of all the analysis are not required to mention).

The items which are readily conceivable in figures and tables are not required to be described verbally. Figures and tabled should be captioned as shown:

Table 1- Sample

Item	Description	---	---	---

Figure 1- Sample

Content of the report

Participating teams are expected to consider brevity. The report should not exceed 100 pages (excluding initial pages and TOCs). Exceeding the mentioned limit will have negative point. The design report should include and be presented in the same order as the following. In case of any simulation for constellation design, it is required that the corresponding files be presented as attachment.

1- PROJECT MANAGEMENT

This section should include:

- List of team members and their resume (in three lines for each member)
- Resume of the team in satellite design and development (if relevant)
- Time plan up to the end of Engineering Model development

2- DESCRIPTION OF THE SATELLITE SYSTEM

In this section, a brief description on how to accomplish the goals and objectives mentioned in the mission statement and the number of satellites, location of the ground stations and any general information regarding the framework of the satellite system should be presented.

Conceptual design of the constellation

Conceptual design of the constellation should include:

2-1-1- Description of the satellite constellation pattern

- Number and layout of the orbit planes.
- Inclination of the orbit planes.
- Number and position of the satellites in orbit planes with respect to a definite reference.

2-1-2- Satellite constellation design method

A brief discussion on the selection of the pattern of the constellation should be presented.

2-1-3- Constellation performance verification

In this section it should be shown that mission requirements are fulfilled by the constellation. To this end, the accessibility of the target area to the satellites be demonstrated. STK software can be used in this regard.

Satellites conceptual design

Satellites conceptual design should include the following:

2-2-1- System

The system section in the report presents a n overall description of the product. This section should include following subsystems. The majority of the items are presentable in the form of tables and excessive description is not required.

- Product tree (down to main component of each subsystem. For instance, a reaction wheel is considered as a main component of the ADCS or an antenna is considered as a main component of communication.)
- Mass budget estimation (down to subsystem).

- Power budget estimation (down to subsystem).
- Cost budget estimation (down to subsystem).

2-2-2- OBC (Onboard computer)

- General architecture and specification of the hardware (block diagram, inputs, outputs, …).
- General architecture and specification of the software (block diagram, inputs, outputs, …).
- Processing power estimation.
- Memory space estimation.

2-2-3- Communication

- Communication system and architecture block diagram
- Conceptual design of communication subsystem (selecting the frequency, type and location of the antennas on the satellite structure and the general radiation pattern of the antenna, …).
- Preliminary link budget (modulation type, bitrate, coding, …).
- Preliminary dimension, mass and power sizing in accordance with the block diagram.

2-2-4- Attitude determination and control

- Selection of sensors and actuators along with relevant hardware specifications (performance parameters estimation).
- Mass and power budget estimation.

2-2-5- Power

- General architecture and hardware specification.
- Solar arrays and batteries sizing and average power production estimation.

2-2-6- Structure and mechanism

- General architecture and specification.
- General description of the mechanisms (if any).

2-2-7- Thermal control

- General description on thermal distribution control.

Conceptual design of ground facilities and stations

2-3-1- User terminals

- Users distribution area.
- Transmission specifications (in accordance with the satellite communication capabilities).

2-3-2- Data reception ground station

- Location of the station.
- Data reception specifications (in accordance with the satellite communication capabilities).

2-3-3- TT&C ground station

- Number and location of the control stations (telemetry, telecommand and mission control)
- Reception and transmission specifications (in accordance with the satellite communication capabilities)
- Minimum services and capabilities of the mission control center

Control stations may be located within or outside Iran.

Provided that standard CCSDS protocols are considered, current available ground station in Iran can be used for operation.

3- PERFORMANCE VERIFICATION

In this section, it should be demonstrated that the expected performance from the satellite system regarding users' coverage and consistency among satellites and ground station capabilities are provided. This section briefly reviews the whole conceptual design process.

4- SUM UP

In this section, issues like teams assessment from the whole process of the competition, lessons learnt, criticisms, suggestions, etc. are provided. This section is not included in the 100-page limit.