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| BLUEsat UNSW Student Satellite Project  Document BLUE.2011.6.0 |
| Product Point Breakdown |
| Identification of all work points that need to be addressed for Balloon Launch, referencing the Product Tree. |
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# Introduction

This document builds upon the product tree in drawing GENN0004. The intention is that all pending design, testing, integration and documentation tasks according to product points identified in drawing GENN0004 are identified. The aim of this document is to provide a base list of work points from which a comprehensive work breakdown schedule (WBS) can be worked out and to provide a list of product points that are significant enough to require their own folder of documentation.

The product tree in drawing GENN0004 breaks the satellite into functional subsystems, with each system and subsystem being assigned product points according to their structure. This document will refer to subsystems by their name and product point as designated in drawing GENN0004.

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# Design and Testing Tasks

The following points require further design and testing before full functionality is confirmed and integrated into the rest of the satellite.

## Pending Investigation

These systems are still be investigated for feasibility on the satellite and have not yet been confirmed as being final inclusions on BLUEsat for the 2013 balloon Launch

1. **4 Standalone Camera**
2. **5 Namuru**

## Requiring Design

These subsystems require further design and checking before being considered as finalised and proofed designs. Whilst the groundwork and concept for the points below are considered ‘solid’, they require further checking and basic proof of concepts before being accepted as final designs for the satellite.

1. **B1.1.1 Solar cells** – Changed design due to change in requirements in balloon flight and exorbitant GaAs cell costs for original design
2. **B1.1.2 Battery Charging** – never had a working prototype. Current design is more well suited to task, but requires finalisation and testing
3. **B2.1.1 Voltage** and **B2.1.2** **Temperature sensors** – no circuitry designed for monitoring power yet, though base is laid down in MAX127
4. **B5.1.1 Temperature Sensor Mounts** – Discussed but not documented adequately
5. **B5.1.2** **Battery Mounts –** Not yet fully drawn up
6. **1 LTP**
7. **3.2.2 L4 Linux**

## Pending Testing

The following subsystems have been designed, checked and proofed and are awaiting characterisation and performance testing, such that simulation data can be generated. These systems are also awaiting full integration testing with other subsystems in the satellite.

Note that below only lists the subsystems that require testing, and not to what level testing is required. This testing will be confirmed in a later document, which will also work out a full integration testing plan.

1. **B1.2.1 Power Regulation**
2. **B1.2.2 Power Storage (batteries)**
3. **B2.1.3 Temperature Sensors** – Need Calibration and testing procedure to be written up
4. **B3.2.1 Receivers** and **B3.2.2 Transmitters** - pending delivery and testing
5. **B3.2.3 Antenna Array** – Test signal strength and power dissipation
6. **B4.2 Data Storage** – Need to test which mode of memory is most appropriate for the satellite
7. **2 Bent Pipe RF –** requires working radios in order to test properly
8. **3.1 and 3.2.1** – need to test all functionality of the beaglebone once L4 linux has been ported

# Documentation Tasks

The following is a list of all subsystems on the product tree which require full documentation including testing data, system analysis and simulation. The intention is that an expected file and folder list be drafted up in order for BLUEsat logically organise the documentation of the design and testing of all systems.

## System Overview files

The following major systems need specification documentation, nominal interface documentation and brief explanation to introduce the separate subsystems

* B1 Power
* B2 Telemetry
* B3 Groundstation Link (Coms)
* B4 Command, Control and Data Handling
* B5 Mechanical
  + B5.1 Thermal Functional Chain
  + B5.2 Structural Functional Chain
* 1 LTP
* 2 Bent Pipe RF
* 3 Extensible Payload Support
* 4 Standalone Camera
* 5 Namuru

## Detailed files to be generated

This includes a list of all subsystems which require a Design file, AIT file, production file and testing procedures. ‘Children’ in the product tree that are not significant enough to require their own file will be covered by the closest ‘Parent’ file.

* B1.1.1 Solar Cells
* B1.1.2 Battery Charging
* B1.2.1 Power Regulation
* B1.2.2 Batteries
* B2.1 Telemetry Sensors
* B2.2 Data Conversion and Handling
* B3.1 Demodulation
* B3.2 RF Link
* B3.3 Communications Switching
* B4.1 Processing
* B4.2 Data Storage
* B4.2 Data Bus
* B5.1 Thermal Functional Chain
* B5.2 Structural Functional Chain (covered by CHales Thesis)
* B5.2.3 Launch Interface
* B5.2.4 Antennae Footholds
* 3.1 Payload Bus Interface
* 3.2 Payload Processing and Data Handling

## Functional Tests

The following subsystems require formal functional testing procedures and specifications to be written. These procedures will be used in order to test satellite functionality during and after all qualification testing on the satellite

* B1.1 Power Generation
* B1.2 Power Management
* B2 Telemetry
* B3 .1 Demodulation
* B3.2 RF Link
* B3.3 Communications Switching
* B4 Critical Systems Computer
* 1 LTP
* 2 Bent Pipe RF
* 3.1 Payload Bus Interface
* 3.2 Payload Processing and data handling

# Simulation Tasks

The following details the subsystems which require simulation data to be generated in order to ensure satellite functionality in Balloon Conditions. They pertain to Power Usage, thermal modelling and structural modelling in different circumstances

## Power Modelling

The following subsystems need to be characterised for power generation and provision

* B1.1.1 Solar Cells
* B1.1.2 Battery Charging
* B1.2.1 Power Regulation
* B1.2.2 Power Storage (Batteries)

The following subsystems need to be characterised for power consumption characteristics

* B2 Telemetry
* B3.1.1 AFSK
* B3.1.2 DTMF
* B3.2.1 RF Receivers
* B3.2.2 RF Transmitters
* B3.3 Communications Switching
* B4 Critical Systems Computer (whole system)
* 3 Payload Computer and all Payloads
* 4 Standalone Camera
* 5 Namuru (data to be supplied)

## Thermal Modelling

All of the above systems require thermal characterisation in order to find how much heat is generated by each subsystem.

To analyse head dissipation, two tests must be conducted

* Static Thermal Model – assuming static environmental conditions and constant heat generation from the above systems
* Dynamic Thermal Model – assuming constant heat generation and a mobile satellite in balloon flight conditions

## Structural Modelling

The entire satellite assembly will need to be inputted into a structural model for analysis of vibration and shock. The following must be generated

* Vibrational analysis
* Shock analysis (for landing and recovery).

# Conclusion

The above points detail the work that is required to be carried out over the next 15 months (leading to launch). From these points, a documentation structure and work breakdown schedule will be worked out and delivered.