|  |
| --- |
| BLUEsat UNSW Student Satellite Project  Document BLUE.2011.5.0 |
| Warrawal Conference Debrief |
| A consolidation of action points raised in the December 2011 Warrawal Consortium Meeting |
| **Authors and Contributors:**  Thien Nguyen – President 2012  **Date:** |
| December 12th, 2011 |

# Introduction

The following presents a thorough debrief of the consortium meeting for the BLUEsat senior and executive team. Contained within this document is a detailed summary of all points raised in the December 2011 consortium meeting and conclusions reached. Attention should be paid in particular to the Action Points raised within this document and the proposed timeline at the end of this document. This action points were raised as deliverables for the project, due by the end of January 2013.

# Table of Contents

[1 Introduction 1](#_Toc311464253)

[2 Table of Contents 1](#_Toc311464254)

[3 Warrawal Consortium Meeting 2](#_Toc311464255)

[3.1 Launch Dates 2](#_Toc311464256)

[3.2 Balloon Launch Environmental Specifications 3](#_Toc311464257)

[3.3 Systems Engineering Structure 3](#_Toc311464258)

[3.4 Path to Launch 5](#_Toc311464259)

[4 Action points 8](#_Toc311464260)

[4.1 Summary 8](#_Toc311464261)

[4.2 Time Criticality 8](#_Toc311464262)

[4.3 Timeline for Critical Action Points 9](#_Toc311464263)

# Warrawal Consortium Meeting

The following is a summary of points discussed during the consortium meeting on Friday, December 9th, 2011 on project management for the BLUEsat project and the path to balloon launch. In particular, points were raised regarding possible launch dates, the environmental specifications for a balloon launch, the systems engineering approach needed to be taken by BLUEsat and a timeline until launch in 2013.

## Launch Dates

Three possible dates were put forward for launch of BLUEsat on a stratospheric balloon by UNSW@ADFA. They are

1. A March 2013 launch where BLUEsat would piggyback on an as yet defined NASA payload
2. An April 2013 launch where BLUEsat would launch independently
3. An October 2013 launch where BLUEsat would launch independently.

The March 2013 launch has the advantage of a small to nil launch cost, as we would be piggybacking on a much larger and much more significant payload. Permission will only be given by NASA if our satellite operates independently from and is electromagnetically compatible with the NASA payload.

**AP1 (Action point 1) –** Generate a full specifications suite including

1. Mechanical interface specification
2. Thermal reaction and generation data
3. Field of view requirements for BLUEsat communication
4. Electromagnetic compatibility (EMC) specifications. i.e. the nature of BLUEsat’s RF transmissions.
5. Electrostatic Discharge specifications.

Of the above, it becomes obvious that BLUEsat’s RF transmissions will be the most significant factor in determining if BLUEsat is an allowable piggyback payload for the NASA payload. Specifications pertaining to RF transmission are already available and should be provided to UNSW@ADFA as soon as possible.

**AP2–** Provide fully detailed specifications to A/Prof Ravi Sood on

* Antennae Design and expected transmission power
* Expected bandwidth and frequency of transmission
* Full specifications of BLUEsat’s on-board radios.

The April and October launches are dates determined by a desire to maximise flight time. These launches are more flexible in terms of restrictions on the satellite, but detailed specifications on the mission of the satellite and how we wish to be launched need to be provided.

**AP3 –**Provide satellite mission specification to all consortium parties ASAP

It should be noted that all discussions assume a March or April 2013 launch. The October 2013 date is to be used as a last resort measure in case of unforeseeable scheduling issues.

## Balloon Launch Environmental Specifications

The exact environmental conditions that the Satellite will be subject to during launch and flight will vary depending on ‘user’ specified flight options. These are

* Launch Time (and therefore the flight’s desired day/night cycle)
* Method and angle of payload suspension (Mechanical interface specification)
* Altitude

Once these have been specified, the following is able to be determined

* Ascent air-pressure profile
* Ascent and flight temperature profile
* Changing azimuth angle of the sun’s rays at they hit the BLUEsat solar array
* Flight Duration

**AP4 –** Discuss which set of flight options would be best for BLUEsat and deliver to ADFA to obtain full environmental specification.

## Systems Engineering Structure

Michel Perdu from Thales Alenia Space presented a Product Tree approach to Systems Engineering for the satellite. In such a system the functions of the satellite are broken down into deliverable boxes. At the lowest level, there are component descriptions; at higher levels system functional descriptions and at the highest level, the mission statement of BLUEsat itself. Figure 3.1 illustrates an example of such a tree.

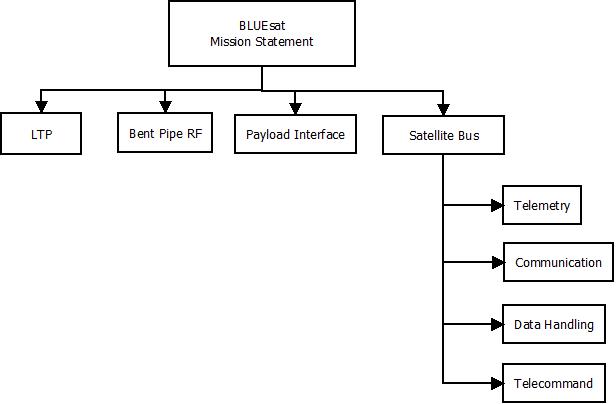


Figure . - Example Product Tree

Each item or box in the product tree must have

* Design File
  + Drawings
  + Analysis of system
* Production File
  + Manufacturing File
    - Drawings
    - Process descriptions
  + Procurement Documentation
    - Bill of Materials and Suppliers
    - Statement of work (for third party fabrication)
      * Quantity
      * Standards of testing
    - Terms and conditions of procurement
* Assembly, Integration and Testing (AIT) file.
  + AIT Procedures
  + Specification of Electrical Ground Support Equipment (EGSE)[[1]](#footnote-1)
  + Specification of Mechanical Ground Support Equipment (MGSE)[[2]](#footnote-2)

It should be noted that this level of detail was quoted as being an “Industry” standard. The general consensus at the consortium was that being a student body, BLUEsat could afford to generalise many of the above documents. For example, we could produce a design file for an entire system, rather than producing design files for each sub-box which makes up the system. The design file itself also would not necessarily need to be as detailed as it initially seems. Our approach to generating this level of engineering needs to be specified

**AP5 –** Discuss and establish the structure of the product tree, as well as BLUEsat’s approach to generating the documentation necessary for the product tree.

The establishment of the main dot-points in the above structure will generate “work points” for the team to fulfil. These work points will make up the Work Breakdown Schedule (WBS) and therefore the project management plan until launch. In particular, a progress appraisal is required from the project in order to evaluate the body of work needed to be completed from January 2012 onwards.

**AP6 –** Identify what criteria in the product tree have already been fulfilled and generate current progress appraisal and list of work points that need to be fulfilled.

## Path to Launch

Preliminary project planning was carried out backwards, setting March/April 2013 as the launch date. During this session, 4 main stages were identified. Within each stage, tasks were identified briefly with the agreement that BLUEsat will carry them out with some degree of freedom.

The following breakdown will be used as a guide in conjunction with the product tree in order to undertake final project planning with an aim to produce a final and detailed plan by January 2012.

Note that within each stage, some components can be carried out in parallel given the manpower.

### Stage 1 – Design – 7 months (January 2012 – August 2012)

In this stage BLUEsat is to finalise all design and documentation. The project is also required to conduct thermal, structural and functional simulations and analyses across the satellite and produce documentation on these analyses. The intention is that by June 2012, there will be enough documentation to conduct a Critical Design Review (CDR)

* ***Functional Design and Documentation*** – Complete and document design for the Satellite bus and payloads
  + Create all documentation for the product tree (noted above).
  + Prepare a justification file that checks budgets across systems in the satellite for
    - Power Dissipation
    - Telemetry and Telecommand
    - Reliability (single point failure, worst case scenario analysis)
    - Data flow
    - Thermal heat generation
* ***Modelling and simulation -*** Generate and document specifications and accurate data on the following:
  + Static and Dynamic Thermal Modelling
    - Generate accurate thermal analysis for the satellite as it travels to and stays in the Stratosphere during launch and flight, respectively
    - Determine the severity of the effects of temperature differences caused by a relatively static satellite (e.g. shear stress on glues due to thermal expansion)
    - Model how heat will be generated, received and dissipated by the satellite during flight
  + Power Consumption and Generation simulation
    - Simulate and generate data on how the angle of sunlight on the solar panels will affect the battery charge regulators and the power being fed to the satellite
    - Simulate and generate data on the switching of devices on and off. Specifically, data needs to be generated on the load on the power supply and the nature of current flow into different subsystems as they are activated and begin drawing power
  + Structural modelling
    - Perform a structural analysis and generate data on the ability for the satellite to survive
      * Vibrational Stresses
      * Shock Stresses (as the satellite falls to earth)
  + Test procedures, expected results and documentation for all of the above in order to prepare for qualification testing

**AP7 –** Find and identify what methods can be feasibly used by the BLUEsat project for the above modelling and analysis, and to what depth we can carry these analyses out in the allotted time.

* ***Critical Design Review (June 2012)*** – Present all designs, documentations and analyses to UNSW, UNSW@ADFA, Optus and Thales to perform a design review on the satellite.
* ***Packaging and Preparation*** – prepare user manuals for each subsystem of the satellite, ready for production and assembly.

### Stage 2 - Production – 3 months (August 2012 – October 2012)

In this stage, planning for the assembly and manufacture of the satellite will be carried out. Assembly is to be carried out in sub-units as defined by the product tree and all related AIT documentation. Production should occur in an organised and timely manner. 3 months was allocated as a deliberately generous time to allow for unforeseeable issues.

* ***Production and Assembly***
* ***Test Readiness Review (TRR)* –** Present completed preliminary product to all Consortium members for review and to evaluate final testing readiness.

### Stage 3 – Assembly Integration and Testing – 12 weeks (November 2012 – February 2013)

This testing will need to occur in order and to a strict schedule, as at this point there is only one model satellite available.

1. ***Initial Functional Test – less than 1 week*** (i.e. bus communications, telemetry and telecommand)
2. ***Thermal Cycling – 1 week -*** +600C to -400C with +/-5 degree margins; perform Functional tests throughout testing
3. ***Thermal Vacuum Testing* – *6 weeks*** - Simulate launch and flight mission. We will need to specify:
   1. Pressure and Temperature cycles during launch and flight
   2. How the satellite will function during said cycles
   3. Tests that will be periodically carried out to ensure proper operation of the satellite.
4. ***Mechanical Testing – 1 week***
   1. Vibrational testing
   2. End of flight, single axis 10g quasi-static shock
   3. Collision shock (when the satellite hits the ground)
5. ***Electromagnetic Compatibility (EMC) and Electro-static Discharge (ESD) testing – 1 Week***
   1. Measure RF Field and magnetic moment during satellite operation
   2. Simulate RF frequencies and magnetic field from Launcher
   3. ESD should be cured by design.
6. ***Final Functional Testing (FFT)*** **– 1 week -** Perform final check of all functions on the satellite

### Stage 4 – Delivery – 2 to 3 weeks (February 2013)

At this stage we are to ensure that we have a satellite ready for launch on the balloon and deliver it to the launch site.

* ***Health Check*** – see if the satellite is ready for the balloon
* ***Delivery and Transport to Launch Site***.

The above outline will be used to generate the final Work Breakdown Schedule and Project plan for BLUEsat.

**AP8 –** Generate project plan and WBS.

# Action points

The following details action points that the seniors within the BLUEsat project will have to enact over the next few months.

## Summary

A summary of the action points given in this document are given below

**AP1 –** Generate a full specifications suite including

1. Mechanical interface specification
2. Thermal reaction and generation data
3. Field of view requirements for BLUEsat communication
4. Electromagnetic compatibility (EMC) specifications. i.e. the nature of BLUEsat’s RF transmissions.
5. Electrostatic Discharge specifications.

**AP2–** Provide fully detailed specifications to A/Prof Ravi Sood on

* Antennae Design and expected transmission power
* Expected bandwidth and frequency of transmission
* Full specifications of BLUEsat’s on-board radios.

**AP3 –**Provide satellite mission specification to all consortium parties ASAP

**AP4 –** Discuss which set of flight options would be best for BLUEsat and deliver to ADFA to obtain full environmental specification.

**AP5 –** Discuss and establish the structure of the product tree, as well as BLUEsat’s approach to generating the documentation necessary for the product tree.

**AP6 –** Identify what criteria in the product tree have already been fulfilled and generate current progress appraisal and list of work points that need to be fulfilled.

**AP7 –** Find and identify what methods can be feasibly used by the BLUEsat project for the above modelling and analysis, and to what depth we can carry these analyses out in the allotted time.

**AP8 –** Generate project plan and WBS.

## Time Criticality

AP1, AP4, and AP7 are all non-time critical and would need to be completed by the design stage (end of Stage 2, August 2012) at the very most.

In particular AP2, AP3, AP5, AP6 and AP8 are all points specified by the consortium as actions needed to be fulfilled by the BLUEsat project by the end of January 2012.

## Timeline for Critical Action Points

The proposed timeline for the critical action points are as follows

**December 17th, 2011:**

* **AP2** – Provide Ravi Sood with RF specification for BLUEsat
* **AP3 –** Deliver final mission specification to all consortium members

**December 23rd, 2011**

* **AP5 –** Complete product tree and identify work points that will need to be fulfilled

**January 9th, 2012[[3]](#footnote-3)**

* **AP6 –** Deliver project progress appraisal and generate list of work points that need to be addressed.

**January 31st, 2012**

* **AP8 –** Deliver Work Breakdown schedule and project plan.

1. EGSE refers to the spectrum of test and soldering equipment to the Groundstation System Itself. [↑](#footnote-ref-1)
2. MGSE in our case is rather simple. It means method of storage and transport. That is, component storage boxes, board storage bags etc. [↑](#footnote-ref-2)
3. This is the final date that Thien Nguyen will be able to work on the project full time. It is ideal that most of the ground work be completed by this time. [↑](#footnote-ref-3)