



STEM
LEARNING



Government of South Australia
Department for Education and
Child Development

Phase 0/1 Data Pack

January 2018



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SASSM Key Contacts

Please direct any queries to:

- Sarah Baker - Advanced Technology Project Manager, DECD
 - Email: sarah.baker@sa.gov.au
- Monika Stankiewicz - Marketing and Product Development, Neumann Space
 - Email: momo@neumannspace.com
- For general SA Schools Space Mission updates, please check the Moodle website <http://dlb.sa.edu.au/ctmoodle/course/view.php?id=133>

Stage 2 Feedback

Stage 2 Feedback has been released directly to individual schools, please email Sarah or Monika directly with any specific queries or general queries may be discussed at the Technical and School/Industry/Tertiary Partnership meetings during Terms 1, 2 & 3, 2018.

2018 Deliverables Overview

Term 1:

- 'Proof of concept' Model completed
- Phase 0/1 Presentation and Checklist completed

Term 2:

- 'Engineering' Model completed
- Phase 2 Presentation and Checklist completed

Term 3:

- 'Flight' Model completed
- Phase 3 Presentation and Checklist completed

Term 4:

- Final presentations/Portfolio updates
- Expert Panel selection of final experiments
- Handover of final experiments to Neumann Space

2018 Schedule overview

Terms 1-3

- Week 0: Feedback and information about 2018 timeline released
- Week 1: Updated data pack, Phase 0/1 Portfolio template, Phase 0/1 Checklist released
- Week 2: Technical meeting to provide opportunity for Data pack clarification
- Week 5: Progress meeting for Schools/Industry/Tertiary Institution partnerships to check in on project issues and provide opportunities for project specific questions to be answered
- Week 10: Completed Phase 0/1 Portfolios and checklists to be sent to Sarah Baker

Term 4:

- Final Presentations and Portfolio updates
- Selection of final experiments and handover

Term 1 – ‘Proof of concept’ model

The proof of concept model shall be part of the final Phase 0/1 submission for the project. This model shall be expected to demonstrate the basic functionality of the sub-payload as outlined in the final design proposal.

It is important to note that this submission does not have to be constructed with space rated materials or components. The proof of concept model shall:

- Provide a functional prototype of the project apparatus able to demonstrate the intended functionality defined in the final design proposal.
- Provide a segment of code capable of operating the apparatus through a basic IO pin interface representing the SASSM sub payload computer. In particular showing the remote operation of any actuators/effectors and the acquisition of data from any sensors used within the apparatus (data processing or storage is not required for this demonstration).
- Demonstrate the operation of the model showing interaction between the prototype apparatus and the computer code.

The documentation required at this stage would be;

- The complete Phase 0/1 Portfolio
- The completed Phase 0/1 Checklist

This model may be constructed of any materials and components, the purpose of this step is demonstrating operation of the apparatus interacting with software to produce an intended result.

Term 1 – Key Dates

All Stage 2 Feedback emailed to schools	By Wed, 24 Jan, 2018
Release of Week 0, Term 1 materials: <ul style="list-style-type: none"> • SASSM schedule and deliverables • List of approved materials/components in alignment with Airbus and ISS safety protocols • Phase 0/1 checklist • General Guidelines (Do's and don'ts) 	By Thursday 25 Jan, 2018
Technical meeting held to discuss Week 0, Term 1 materials Release of further materials including: <ul style="list-style-type: none"> • SASSM ICD • Interface Board/data computer 	T1: Wk2 at EDC*, 3-6pm Thursday 8 Feb, 2018
Progress meeting with Schools/DECD/Partnerships/Neumann Space meeting will be held	T1: Wk5 at EDC*, 3-6 pm Tues 27 Feb, 2018
Phase 0/1 documents (template to be supplied) collected by Sarah Baker	T1: Wk10 By Fri 06 April, 2018
Release of Term 1 feedback, Term 2 updated documents and Phase 2 checklist	T1 Break, By Wed 25 Apr, 2018

* EDC - Education Development Centre, 4 Milner Street, Hindmarsh, SA, 5007

Term 1 – Phase 0/1 Portfolio

The final design proposal submission for individual school projects would represent the preliminary design planning phase* inherent to most engineering projects.

- The final design proposal submission documentation shall;
 - Provide a Word, Pdf or powerpoint presentation outlining the following:
 - Describe what the designed experiment will do at a system and subsystem level, using figures, drawings and block diagrams.
 - Demonstrate basic design for integrating the project apparatus with the provided inputs for the SASSM sub payload computer (pin usage, programming language, need for external power)
 - Provide a list of sensors and actuators that would be used within the payload and their number
 - The payload end to end mission scenario, from the start of the mission, to when it ends by burning up in the earth's atmosphere (disposal).
 - The design of any safety-critical subsystems (eg. Pressurised containers, batteries) as well as their flight operations.
 - Hazards and how they shall be mitigated or controlled.
- Provide a labelled drawing (sketch, 3D model or otherwise) of the overall form of the payload apparatus including all electronics, sensors and structures that would make up the design. Basic dimensions would be required.
- In addition to this, providing a list of potential questions teams may have in advance of the SASSM Partnership meeting scheduled in Term 1: Week 5 would allow Neumann Space time to research solutions and provide answers to commons or specific questions teams may have.

**Note: At this stage it is not a requirement for teams to submit designs using specific or space rated materials. If a team has done further research into potential space rated materials they are welcome to include this information in their design.*

Phase 0/1 Checklist

This checklist (which should be completed in parallel with the Phase 0/1 Portfolio template) is to double check that all relevant information has been included in the documentation that needs to be submitted at the end of Term 1. It shall also help alert Neumann Space to any parts of the sub-payloads that may be safety critical or hazardous.

Term 2 – ‘Engineering’ Model

The ‘Engineering’ model would be the final Phase 2 submission for the project. This model would build upon the functionality demonstrated in the ‘Proof of Concept’ model while demonstrating the form of the final flight model as outlined in the final design proposal.

This model **does not have to be constructed with space rated materials**, however it is recommended at this stage to be considering using components of similar size, shape and material properties to those you would use in the flight model. Examples include, using aluminium stock in place of space rated aluminium or using a regular model of an IC or Microcontroller in place of its space rated version.

- The Engineering model shall:
 - Provide a functional apparatus conforming to required size and volume constraints while being constructed from analogous materials to those intended to be used within the flight model.
 - Provide functional project code capable of demonstrating operation of the apparatus, any required processing of data and storage of data in the intended format for the flight model.
 - Demonstrate the operation of the model showing full interaction between the apparatus and the computer code.
- The documentation required at this stage would be;
 - The completed Phase 2 Portfolio (preferably in the same format as Phase 0/1)
 - The completed Phase 2 Checklist

At this stage teams would have commenced selecting and sourcing of space rated materials to construct the Phase 3.

Planning for testing with industry partners ahead of construction of the flight model is advised.

Term 2 – Key Dates

Release of Term 1 feedback, Term 2 updated documents and Phase 2 checklist	T1 Break, By Wed 25 Apr, 2018
Technical meeting held to discuss Term 1 feedback and released materials	T2: Wk2 at EDC*, 3-6pm Wed 9 May, 2018
Progress meeting with Schools/DECD/Partnerships/Neumann Space meeting held	T2: Wk5 at EDC*, 3-6pm Wed 30 May, 2018
Phase 2 document (template to be supplied) will be collected by Sarah Baker	T2: Wk10, By Wed 04 July, 2018
Release of Term 2 feedback, Term 3 updated documents and Phase 3 checklist	T2 Break, by Wed 18 July, 2018

* EDC - Education Development Centre, 4 Milner Street, Hindmarsh, SA, 5007

Term 2 – Phase 2 Portfolio and Checklist

The Phase 2 Portfolio template and checklist will be released in the second week of the Term 1 break before the start of Term 2, 2018. Feedback for the Phase 0/1 Portfolio will also be given.

Term 3 – ‘Flight’ Model

The ‘Flight’ model would be the final Phase 3 submission for the project. This model would be the fully functioning model, constructed out of space rated materials.

- The flight model shall:
 - Conform to the final specifications
 - Survive testing, and have evidence of the results
 - Provide functional project code capable of demonstrating operation of the apparatus, any required processing of data and storage of data in the intended format for the final version.
 - Demonstrate the operation, showing interaction between the apparatus and the computer code.
- The documentation required at this stage would be:
 - The completed Phase 3 Portfolio
 - The completed Phase 3 Checklist

Term 3 – Key Dates

Release of Term 2 feedback, Term 3 updated documents and Phase 3 checklist	T2 Break, by Wed 18 July, 2018
Technical meeting held to discuss Term 2 feedback and released materials	T3: Wk2 at EDC*, 3-6 pm Thurs 02 Aug, 2018
Progress meeting with Schools/DECD/Partnerships/Neumann Space meeting held	T3: Wk5 at EDC*, 3-6 pm Wed 22 Aug, 2018
Phase 3 document (template to be supplied) will be collected by Sarah Baker	T3: Wk10, By Wed 26 Sep, 2018
Release of Term 3 feedback and any final material	T3 Break, By Mon 08 Oct, 2018

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Term 3 – Phase 3 Portfolio and Checklist

The Phase 3 Portfolio template and checklist will be released in the second week of the Term 2 break before the start of Term 3, 2018. Feedback for the Phase 2 Portfolio will also be given.

Term 4 and onwards – Key Dates

Release of Term 3 feedback and any final material	T3 Break, By Mon 08 Oct, 2018
Preparation of final 5 minute Presentation/Portfolio and test results.	T4: Wk1-Wk2 Mon 15 Oct to Wed 24 Oct, 2018
Submission of final 5 minute presentation, portfolio and test results.	T4: Wk2, By COB Thursday 25 Oct, 2018
All 5 minute presentations and portfolios uploaded onto SASSM Moodle for online judging	T4: Wk2 Fri 26 Oct All Portfolios/ Presentations uploaded onto Moodle for Online Judging
The Expert Panel judging for the three final experiments will be based on online judging and a formal meeting in Adelaide looking at: <ul style="list-style-type: none"> • A five-minute presentation (filmed/recorded – format open) • A portfolio consisting of Background, Experimental outline, Partnership collaboration, Curriculum alignment, Phase 0/1, 2, 3 documents and a Conclusion. 	T4: Wk3 (Date TBA) Expert Panel meeting for final experiment selection and announcement of finalists
Final 3 school payloads handed over for integration	T4: Wk5, By COB Fri 9 Nov, 2018
Launch	October, 2019
Data from the experiments on Bartolomeo will be released to the Final Experimental schools first in 2019/2020 and then openly after a month	2019/2020

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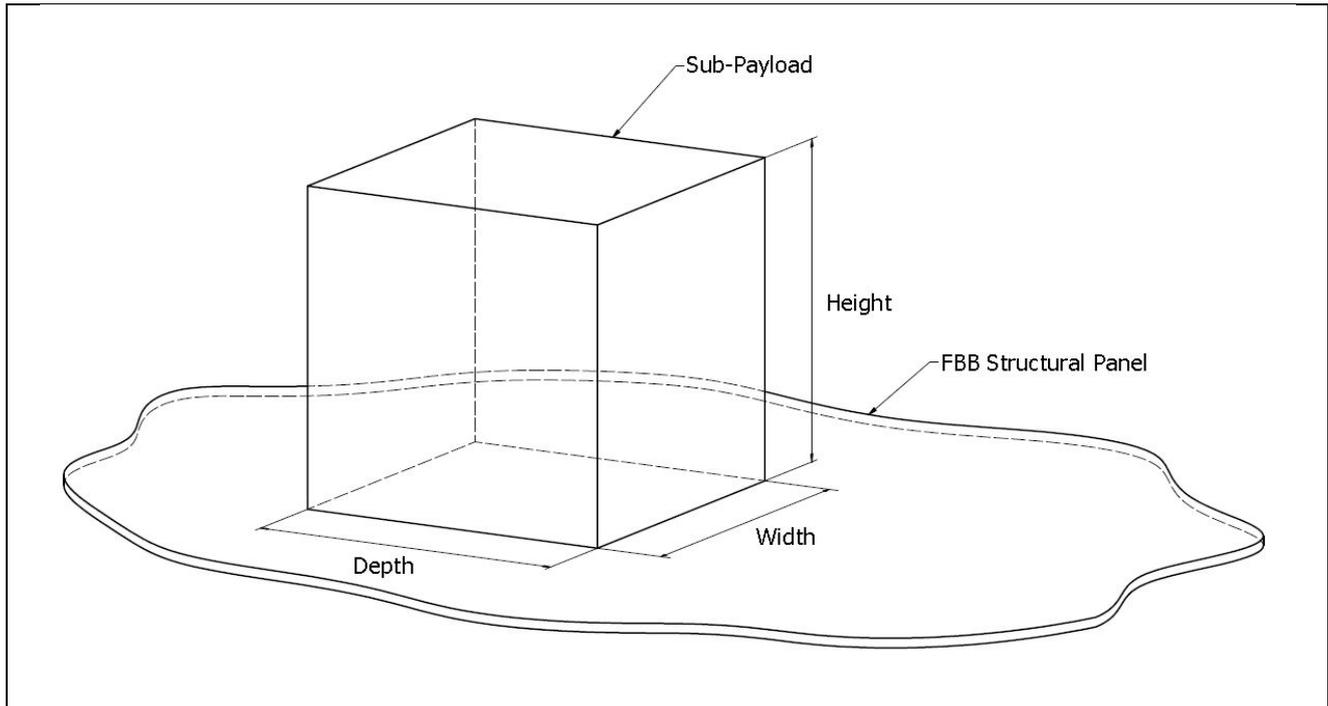
General Do's

- When designing the payload, note that you can (but do not have to) use the following items:
 - Permanent magnets
 - LED's
 - Sealed containers
- Design the payload, so that it:
 - Does not require students to wear protective equipment when handling it, after it has finished being built
 - Can't be broken with rouge software commands (e.g. Wrong command sent, mistakes made in commands)
 - Uses as few moving parts as possible
 - Doesn't try to launch anything off the ISS
 - Can survive without power for up to 6 hours
 - Won't set itself or other payloads on fire

General Don'ts

- DO NOT design the payload with the following sorts of parts/systems:
 - Pressure systems
 - Pyrotechnic devices
 - Components that generate ionizing radiation
 - Lasers
 - Electrolytic capacitors
 - Solid rocket motors
 - Fluid propulsion systems
 - Batteries
 - Parts, materials or items that have an expiry date (within 1 year of the mission timeline)
- DO NOT design the payload so that an astronaut has to look after it or that it requires maintenance during orbit operations.

Mechanical Interface Overview

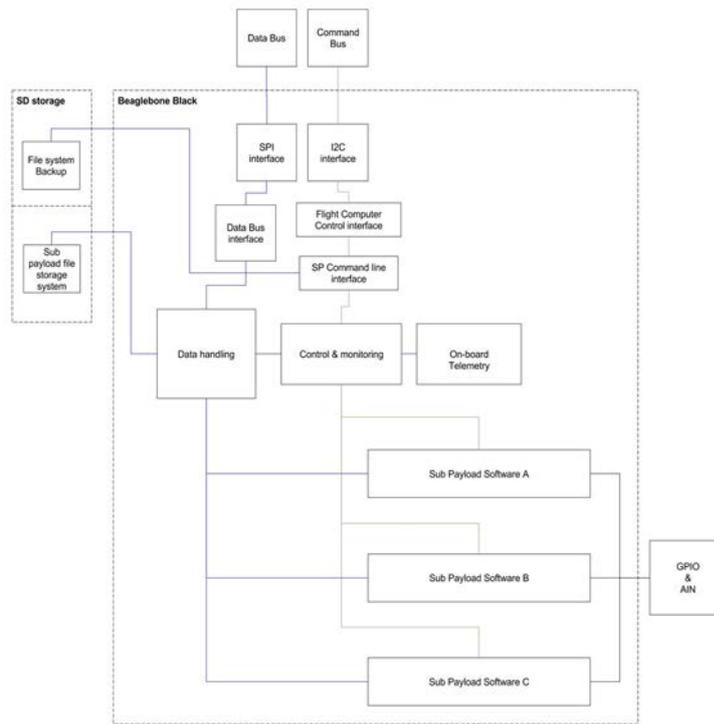


- The FAST Bartolomeo Box (FBB) structural panel has a regular pattern of interfacing bolts to connect to the sub-payload
 - To interface with the FBB, the sub-payload must have fit the specified footprint sizes
 - Footprint area is Width by Depth (see diagram)
 - Footprint sizes based on standard CubeSat dimensions
 - Sub-payload width and depth sizes can be:
 - 10 cm, 20 cm, 30 cm
 - There is no limit on the sub-payload's height, provided that the maximum volume of sub-payload is 1 litre
 - This volume would be determined by the furthest point the sub-payload projects from the FBB Structural Panel
 - Maximum volume provided by the SASSM experimental constraints
-
- Example sub-payload sizes include:
 1. Footprint: 10 cm by 10 cm, Height: 10 cm
 2. Footprint: 30 cm by 10 cm, Height: 3 cm
 3. Footprint: 20 cm by 20 cm, Height: 2.5 cm

Software/Electrical Interface Overview

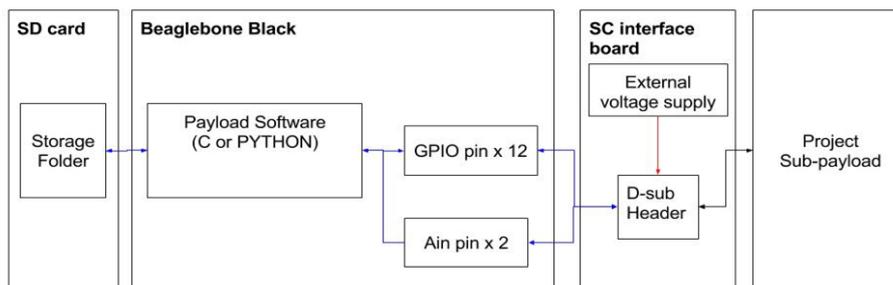
SASSM sub-payload computer shall be based upon a Beaglebone Black with kubOS as the operating system, Neumann Space being responsible for the development and delivery of the final flight unit. All peripherals and software required for the operation of the FAST platform shall be provided by Neumann Space, with the exception of those outlined in the project requirements for schools.

The software for the final three projects shall run on this unit, responding to external input from the control and monitoring software and saving experimental data to the external storage of the computer.



The control software for each project shall be written in either the C or PYTHON programming languages exclusively, development of this may be performed using a Beaglebone Black interfacing through the standard board I/O. Individual projects shall be allocated 12 GPIO pins, 2 Analogue inputs and an external voltage supply, these shall be made accessible through a computer interface board with a dedicated D-sub connector per project supplied by Neumann Space.

Projects are free to define the use of these pins as required. Cabling and connectors between the D-sub interface and the project sub-payload apparatus shall be included in the design requirements for each project. Specifics for hardware interfaces, software and data system requirements shall be addressed at a later date.



Skill Development

As it is recommended to code in C or Python, some professional development may be needed by SASSM students and teachers.

- Free online courses for Python include
 - <https://www.learnpython.org/>
 - <https://www.python.org/about/gettingstarted/>
- Coding in C
 - Introduction to C at <https://www.youtube.com/watch?v=rk2fK2IiiQ>
 - C fundamentals for Absolute beginners https://mva.microsoft.com/en-us/training-courses/c-fundamentals-for-absolute-beginners-16169?!=Lvld4EQIC_2706218949
- A more structured programming course can be found through GROK learning (Please note the SASSM project through DECD (talk to Sarah Baker) will fund up to 20 students per SASSM shortlisted school)
 - <https://groklearning.com/courses/>

If you find a course on coding or any other technique needed to build your project that you think is worth sharing, please let Sarah know at sarah.baker@sa.gov.au

Also, if you find a great course but it has some costs, similar to the GROK learning, please also discuss with Sarah as there is professional learning money available for SASSM shortlisted schools.

Resources

Although this is a Cubesat site, it has some great resources and documentation for building space rated projects at <http://www.cubesat.org/resources/>

More resources will be added as we find them.