HASP Integration Plan

Payload Title: ARIES GPS Payload

Payload Class: (Small)   Large   (circle one)

Payload ID: 8

Institution: Inter American University of Puerto Rico Bayamon Campus

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I. Mechanical Specifications:

A. Measured weight of the payload (not including payload plate)

In order to know the ARIES GPS payload weight some steps were done. First we weighted all the electronic components (board and devices) that will be part of the ARIES GPS payload. Then doing the design of ARIES GPS payload in Solid Work software we estimated the payload structure weight, which we confirm with the construction of the prototype structure. The material selected for the Solid Work simulation was Aluminum 6061T6 and PVC ¼. Table 1 show the result for the measured and estimated weight.

Table 1: Weight for the ARIES GPS payload components

ITEM	WEIGHT
MBS-GPS-OEMV -1DF PC/104	89g
Flight Computer	113.53g
Temperature Sensors DS18B20-TO-92	1g
Payload Structure	555.85g
Mounting Plate **(estimated)**	329.15g
Antenna Bracket	224.41g
Antenna	100g
RF splitter+ board	333g
CASES GPS	453.6g
Power Board	239g
External Temperature Sensor	2g
Cables & Connectors (**estimated**)	50g

Total Weight (**without payload plate**)	**2161.39g**
Total Weight (**with payload plate**)	**2490.54g**
Weight Limit	**3kg**
Weight Margin	**16.982%**

B. Provide a mechanical drawing detailing the major components of your payload and specifically how your payload is attached to the payload mounting plate.

Several Solid Work designs were developed to addressing this point. **Figure 1** show the ARIES GPS payload major components and **Figure 2 and 3** show how the payload will be attached to the mounting plate. In addition the **Figure 4 and 5** illustrates the ARIES GPS payload design and dimensions.

Dual frequency GPS antenna

Dual frequency GPS power Splitter

Novatel Dual Frequency GPS receiver MBS-GPS-OEMV -1DF PC/104

Flight Computer

Power Board

CASES RF front end Board

CASES acquisition board
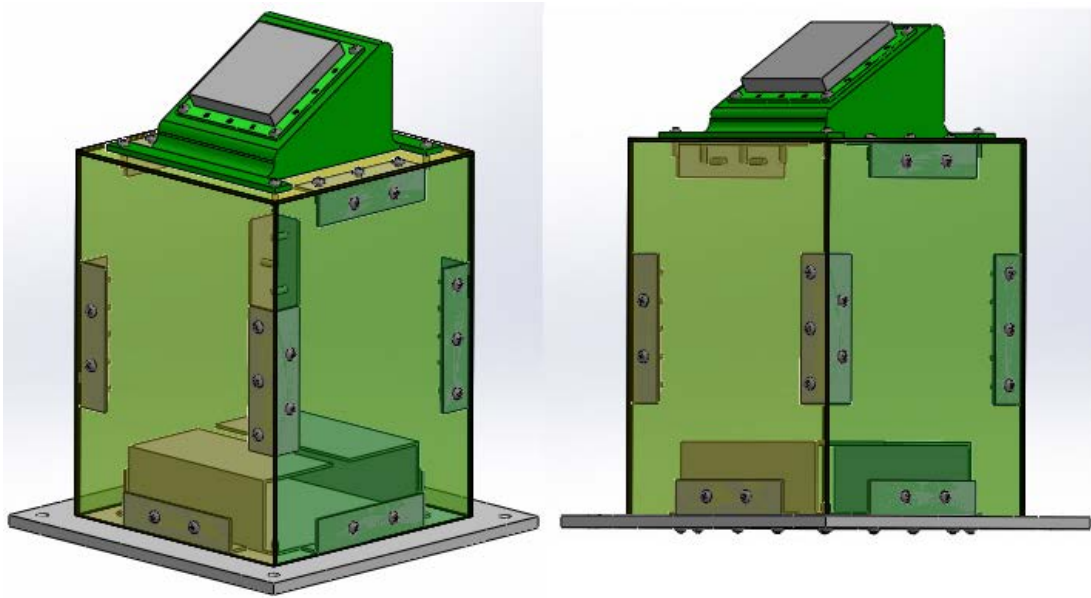
CASES Computer
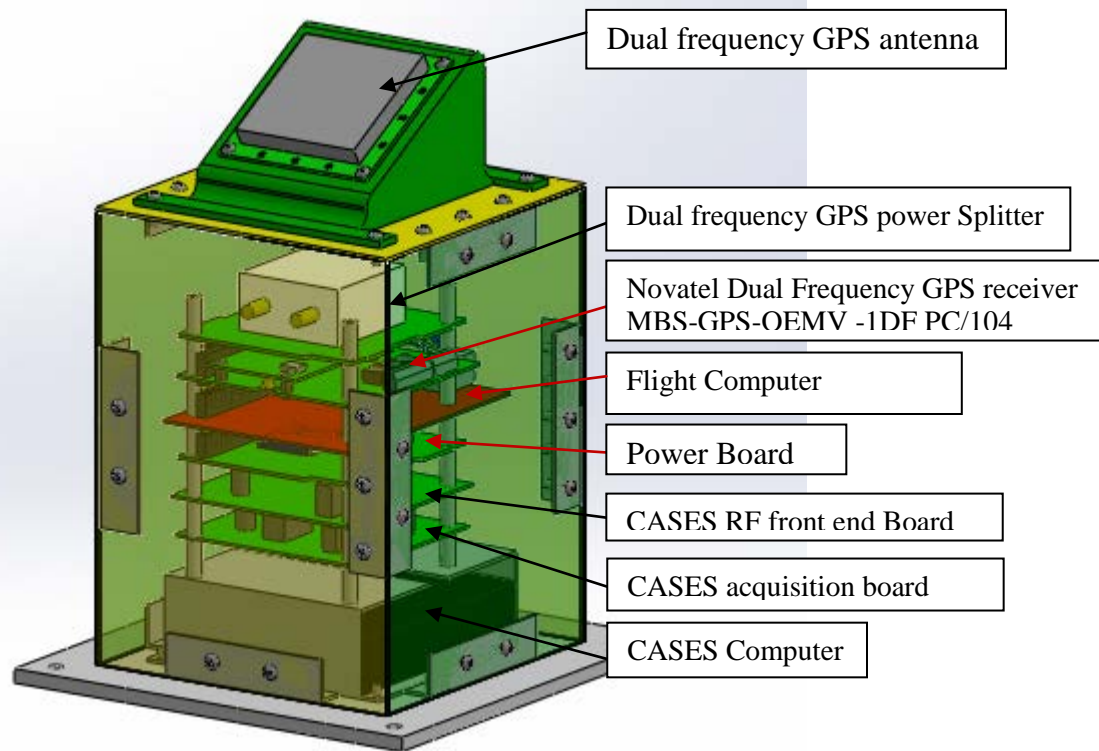
Figure 1: ARIES GPS payload major components
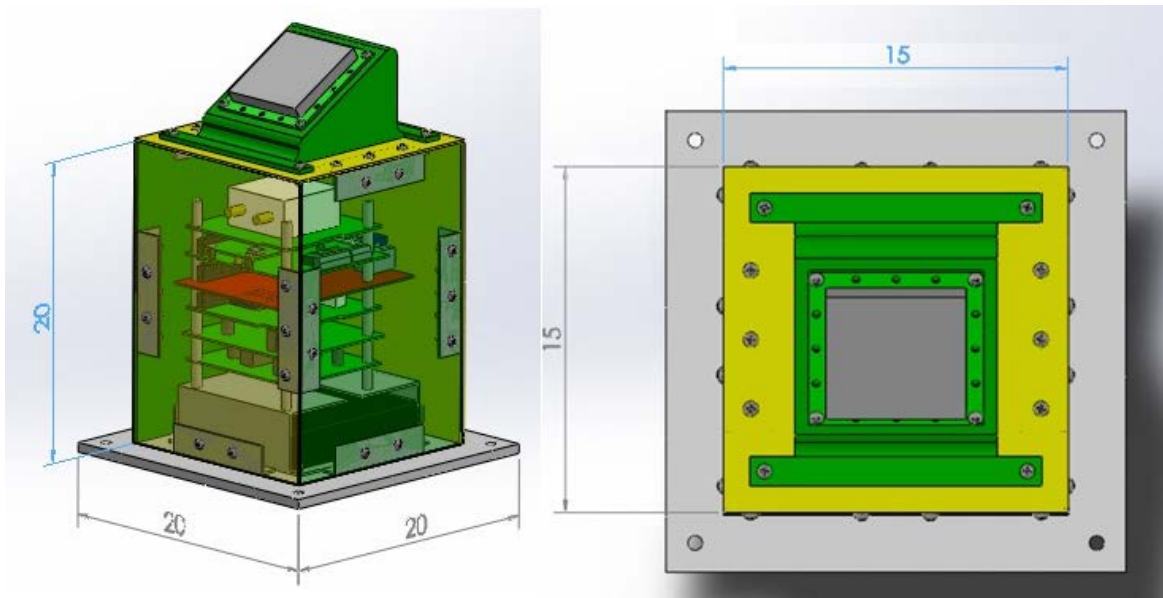
Figure 2 & 3: How the payload will be attached to the mounting plate

Figure 4 & 5: ARIES GPS payload design and dimensions.

C. Hazard Information :

The GPS payload will not fly any material that will be hazardous to the HASP balloon.

D. Other relevant mechanical information

N/A

II. Power Specifications:

A. Measured current draw at 30 VDC

In order to identify the total current consumption for the ARIES GPS payload at 30 VDC some test were realized on the payload. The result of this test is shown below in Table 2.

Table 2 – Current draw of the components on the ARIES GPS payload.

ITEM	Voltage (V)	Current (mA)	Watts (mW)
MBS-GPS-OEMV -1DF PC/104PC	5	320	1600
Flight Computer	5	200	1500
Temperature Sensors DS18B20-TO-92	5	1.5	15
Antenna	5	50	250
CASES GPS Computer board	12	500	6000
CASES GPS acquisition board	5	200	1000
ASTRA GPS RF front end board	5	300	1500
Razor IMU	3.3	6.86	22.64
External Temperature Sensor	5	2	10
Total Power Consumption	**30**	**396.6**	**11898**
Power Limit	**30**	**500**	**15000**
Power Margin	**30**	**103.4**	**20.68%**

B. If HASP is providing power to your payload, provide a power system wiring diagram starting from pins on the student payload interface plate EDAC 516 connector through your power conversion to the voltages required by your subsystems.
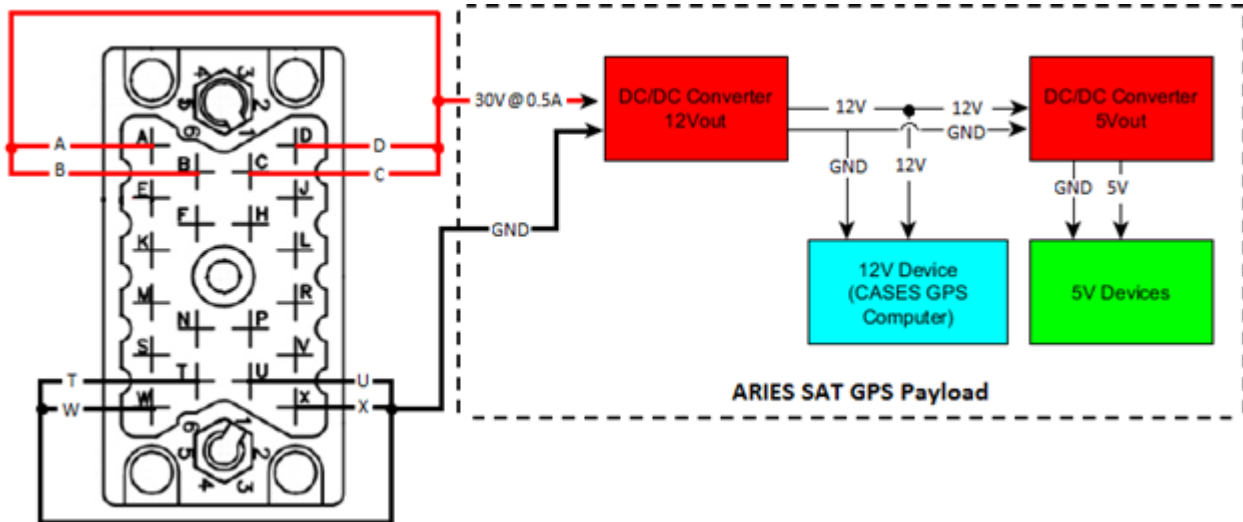

Figure 6 – Wiring Diagram

This payload will employ power from the HASP platform. A source of 30V at 0.5A will be supplied by the HASP platform to the payload through the EDAC 516 connector. Wires A, B, C and D are connected together to obtain a positive 30V at 0.5A from the platform. Wires T, W, U and X are connected together for ground. The LM2576 DC/DC converter will step down the 30V from HASP to 12V, supplying power to the 12V devices (blue blocks on **Figure 6**). Another LM2576 DC/DC converter will step down the 12V to 5V and supply voltage to all the 5V devices (green blocks on **Figure 6**).

C. Other relevant power information

The Razor IMU will be powered from the digital pins of the Flight Computer, which are able to output 3.3 VDC.

III. Downlink Telemetry Specifications:

A. Serial data downlink format: Stream   Packetized   (circle one)

B. Approximate serial downlink rate (in bits per second)

The approximate serial downlink rate will be 63*8 = 504 bits each 8 seconds, which is equivalent to 63 bits per second.

C. Specify your serial data record including record length and information contained in each record byte.

The ARIES-GPS team will send scheduled health and status packages through the downlink at regular intervals. These packets are used for monitoring the payload performance, at almost real time. The amount of data generate by our experiment is extensive and we are unable of downloading all the data recompiled. However some packages will be downloaded as a Housekeeping data. The almost real time analysis of the data will provide the experiment of a method for knowing the experiment health. Each packet, stored and down linked will be time-stamped. In addition these packets will follow a custom made format developed by our team members, and will be composed of the bytes show in **Table 3**:

Table 3: Packets bytes format

BYTE	NAME OF BYTE
0	Start of header ('#'-ASCII character)
1-4	UTC year
5	Comma separator
6	UTC month (0-12)
7	Comma separator
8	UTC day (0-31)
9	Comma separator
10	UTC hour (0-23)
11	Comma separator
12	UTC minute (0-59)
13	Comma separator
14-17	UTC millisecond (0-60999)
18	Comma separator
19-22	GPS pseudorangeL1
23	Comma separator
24-27	GPS pseudorangeL2
28	Comma separator
29-32	GPS carrier_phaseL1
33	Comma separator

34-37	GPS carrier_phaseL2
38	Comma separator
39-42	GPS Latitude
43	Comma separator
44-47	GPS Longitude
48	Comma separator
49-52	GPS Height
53	Comma separator
54-57	SBC temperature
58	Comma separator
59-60	Packet number(0-65536)
61	Comma separator
62-63	16 bits CRC

D. Number of analog channels being used:

Not analog port will be used by ARIES Sat GPS payload.

E. If analog channels are being used, what are they being used for?

N/A

F. Number of discrete lines being used:

None.

G. If discrete lines are being used what are they being used for?

N/A

H. Are there any on-board transmitters? If so, list the frequencies being used and the transmitted power.

No, the GPS payload will not have an on boar transmitter.

I. Other relevant downlink telemetry information.

None

IV. Uplink Commanding Specifications:

    A. Command uplink capability required: (Yes) No   (circle one)

    B. If so, will commands be uplinked in regular intervals: Yes (No)   (circle one)

    C. How many commands do you expect to uplink during the flight (can be an absolute number or a rate, i.e. *n commands per hour*)

We expect to uplink a few times (around 12 uplinks) through the flight, no more than 4 commands in one hour. The amount of commands uploaded will depend on the experiment health checked with the downlinked data.

    D. Provide a table of all of the commands that you will be up-linking to your payload

    1. Start Mission Command:

Command Name:	ON
Hex Command Byte:	4F
Critical?	Yes
Payload Response Message:	"Command Received: ON"

Brief Description:

The command should be sent immediately after the payload is in secure flight. At power up the payload will initialize all the drivers and prepare the system for mission's objectives. The command will enable the modules related to the payload mission requirements.

    2. **Reboot Command:**

Command Name:	RBT
Hex Command Byte:	42
Critical?	Yes
Payload Response Message:	"Command Received: RBT"

Brief Description:

The Reboot command will reset the payload flight computer operation if something goes wrong. This command will be executed upon command received action or upon problematic performance in software.

3. **IMU OFF Command:**

Command Name:	ION
Hex Command Byte:	49
Critical?	No
Payload Response Message:	"Command Received: ION"

Brief Description:

The command will turn on only the IMU, if required in some point of the experiment.

4. **IMU OFF Command:**

Command Name:	IOFF
Hex Command Byte:	50
Description:	Turns off the IMU.
Critical?	No
Payload Response Message:	"Command Received: IOFF"

5. **NULL Command:**

Command Name:	NULL
Hex Command Byte:	00
Description:	Terminates listening mode
Critical?	No
Payload Response Message:	"Unrecognized or NULL command"

Example of Command Transmission String

As part of the uplink command format below is an example on how the commands will be formatted for future uploading .This is an example of the Start Mission TON command string in hexadecimal format:

"0102804F030D0A"

Byte	Hex Value	Description
1	01	Start of Heading (SOH)
2	02	Start of Text (STX)
3	80	Payload ID + Checksum

4	4F	Hex Command Byte
5	03	End of Text (ETX)
6	0D	Carriage Return (CR)
7	0A	Line Feed (LF)

E. Are there any on-board receivers? If so, list the frequencies being used.

The ARIES GPS payload will have two on-board GPS receiver, which we listed below:

1) Novatel OEMV-1DF GPS receiver, working at the L1 (1575.42 Mhz) and L2 (1227.60 Mhz) GPS frequencies.

2) ASTRA CASES GPS receiver, working at the L1 (1575.42 Mhz) and L2 (1227.60 Mhz) GPS frequencies.

F. Other relevant uplink commanding information.

None

V. Integration and Logistics

A. Date and Time of your arrival for integration:

ARIES GPS payload team will arrive on July 29, 2012 to Palestine, TX. The time of arrival will be dependent on the flight schedule.

B. Approximate amount of time required for integration:

The approximate amount of time required for the integration of the ARIES GPS payload is no more than three hours.

C. Name of the integration team leader:

Damian Miralles

D. Email address of the integration team leader:

dmiralles2009@gmail.com

E. List **ALL** integration participants (first and last names) who will be present for integration with their email addresses:

Damian Miralles: dmiralles2009@gmail.com

Jean Ojeda: jojeda6340@gmail.com

F. Define a successful integration of your payload:

To get a successful integration the ARIES Sat GPS payload has to meet all HASP requirements. Its total current draw at 30V has to be less than 500 mA and its weight less than 3kg. In addition the payload has to be able of send data to the HASP platform to a data rate of 1200 bps or lower. Moreover the ARIES GPS payload need to be capable of receive

uplink command from the HASP platform. In addition the payload dimension has to be equal or smaller to 15x15x30 (cm). Finally the thermal range has to be between -80C to 40C, and the ambient pressure up to 10 mbar.

G. List all expected integration steps:

The expected integration steps for the ARIES GPS payload are as follow:
1. Weight the payload to prove that it is within the HASP parameter.
2. Provide to the HASP personnel a detailed drawing with the payload description.
3. Ensure that the payload is properly attached to the platform and is correctly insulated
4. Turn on the payload to prove that it power consumption doesn't exceed the HASP requirement.
5. Give to the HASP personnel a detailed wiring diagram.
6. Perform the thermal and vacuum test to demonstrate that payload is able to work appropriate on the HASP environment.
7. Send some downlink packages to evidence that payload data rate is within the HASP requirement and to confirm a successful communication between the ARIES GPS payload and the HASP platform.
8. Provide a list of the Up-link command for the payload to the HASP personnel.
9. Review that not frequency interference between the GPS receiver on the payload and the HASP platform.
10. Offer a list with the payload team members and their contact information to the HASP personnel.
11. Present the mission plan to the HASP personnel.

H. List all checks that will determine a successful integration:

Table 4: The checks that will determine a successful integration for the ARIES GPS payload

Integration Step	Requirement	Expected	Checks
Weight the Payload	3kg or less	2.5 Kg	
Payload Drawing	Mechanical drawing detailing the major components and how your payload is attached to the payload mounting plate.	A detailed Solid Work diagram addressing those points will be submitted.	
Measure the current consumption at 30V	500 mA	400 mA	
Wiring Diagram	Power system wiring diagram starting from pins on the student payload interface plate EDAC 516 connector through your power conversion	A complete power wiring diagram, developed in Eagle will be submitted.	

Thermal and Vacuum Test	Thermal Range -80C to 40C and ambient pressure up to 10 mbar.	Several tests will be performed to the payload at the Inter American University vacuum chamber to ensure it appropriate operation under these conditions.	
Down Link	1200 bps	The flight computer baud rate will be setup to send serial data to 1200 bps.	
Team Members information	A list of all payload team members including contact information	A document providing the team information will be submitted for the team during the integration process.	
Mission Plant	A mission plant has to be developed.	A document specifying the mission plant will be developed for the team and summated for the corresponding deadline.	

I. List any additional LSU personnel support needed for a successful integration other than directly related to the HASP integration (i.e. lifting, moving equipment, hotel information/arrangements, any special delivery needs…):

None

J. List any LSU supplied equipment that may be needed for a successful integration:

Power supply of 30VDC @ 1A.