Version	Date	Notes
v001	9/19/20	Initial version from Mr. Lucchesi's RPI and Battery spread sheet

Change control

Type	Identifier	Nodes
Processing	Rpi 4B	
Storage	SD card max size (~500GB)	
Camera	RPI HQ camera	
Lens	TBD	either telephoto or wide angle
GPS	TBD	Be careful to pick a GPS that will report altitude to over 30km
IMU	TBD	
Other sensors		
Thermometer	TBD	
LIDAR	TBD	
EM detector	TBD	
IRAS camera	TBD	
Pressure senor	TBD	

Current Hardware

Raspberry Pi	Idle	ab -n100-c10 (un	400% CPU Load (stres	Pwr on 1 64GB USB SSD	OnBrd WiFi on	USB WiFi on
RPi 4B	540 mA (2.7 W)	1010 mA (5.1 W)	1280 mA (6.4 W)			
RPi 3B+	350 mA (1.9 W)	950 mA (5.0 W)	980 mA (5.1 W)		400 mA (2.0 W)	
RPi 3 B	260 mA (1.4 W)	480 mA (2.4 W)	730 mA (3.7 W)		250 mA (1.2 W)	
RPi2 B	220 mA (1.1 W)	450 mA (~2.3 W)	400 mA (~2.1 W)			240 mA (1.2 W)
RPi2B & USB SSD	960 mA (~4.8 W)	1100 mA (~5.5 W)	1250 mA (~6.25 W)	900-1400 mA (~4.5 W)		120 mA (0.7 W)
RPi 0	80 mA (0.4 W)					

Raspberry Pi Pwr (S	Idling (mA)	Loading LXDE (m	Watching 1080p Vide	Shooting 1080p video (mA)
RPi 0	100	140	140	240
RPi 0W	120	160	170	230
RPi A+	100	130	140	230
RPi A	140	190	200	320
RPi B+	200	230	240	330
RPi B	360	400	420	480
RPi 2 B	230	310	290	350
RPi 3 B	230	310	290	350

	mAh	Weight (oz)	Height (in)	Width (in)	Depth (in)		Weight (kg)	height (cm)	Width (cm)	Depth (cm)	vol (cm**3)		mAh/(cm**3)	mAh/Kg
Anker power core 10K	10,000	6.4	3.6	2.3	0.9		0.181	9.1	5.8	2.3	122.116		81.9	55,115.6
Poweradd Slim 2	5,000	4.4	3.9	1.3	1.3		0.125	9.9	3.3	3.3	108.007		46.3	40,084.1
Anker powercore+ mini	3,350	2.8	3.7	0.9	0.9		0.079	9.4	2.3	2.3	49.112		68.2	42,202.8
Patriot Powercell	8,000	7	5.4	2.9	1		0.198	13.7	7.4	2.5	256.621		31.2	40,313.1

Battery Info

https://www.pidramble.com/wiki/benchmarks/power-consumption
> Has a lot of information about current and prior RPi module power consumption

https://raspi.tv/2017/how-much-power-does-pi-zero-w-use
> Has more. information about earlier RPis but unclear whether it corresponds to the same activity as in the above

https://www.maximintegrated.com/en/design/technical-documents/app-notes/1/124.html
> Good information about battery considerations for low power DVcs such as today's electronics
> Batteries are rated optimistically for the lowest discharge rate, i.e.,
>> 1000mAh battery can provide 1mA for 1000 hours.
>> If your device takes more than 1mA then it's discharge is higher than optimal AND it will not last that long
>> Some battery makers provide curves that will show what a battery will last at say 100mA or 300mA discharge rates
> Batteries drop in voltage as they get lower in power. So what's the minimal voltage a battery will supply
>> And what's the minimum voltage required to support your electronics
> Battery nominal voltage may be speced out at 3v but it can range anywhere from 2.8v to 3.9v.
> Battery voltage will vary over different temperature ranges. (What's the avg temp at 100K feet?)

What's a decent proportion of power for RPi vs. External components to RPi
> The 64 GB USB SSD seems to take   68.06%   Of the power but this ranges anywhere from 82% @idle to ? At CPU stress
>> And thats just one device...
> Given this it's going to be important to know how much power each of the sensors will take. Current sensor list
>> 1-4 (multi-spectral) webcams
>> Temperature sensor
>> GPS
>> IMU
>> Radio transciever
>> Storage Micro SD
>> Storage SSD
>> WiFi module
>> Cellular module
>> Wind sensor

https://www.tomsguide.com/best-picks/best-portable-chargers
> Good information on battery packs for cell phones

mission is intended to be 3 to 4 hours

EOSS uses foam enclosure for to keep batteries warm...

Temperature of battery how does battery power change with temperature at 100K ft

balloon launch whats the environment at altitude

condensation problem whith cone shape cut out that ends at the lens of camera...

acrylic walls for the cubesat laser cut, to build together and have corner pieces that it

cut out for the camera lens..

RPI 4B, HQ camera, Power brick, max out SD card
> plan to useo wifi with a directional atennna at ground station
> walls of cubesat will be acrylic, with a cut out for the lens.
> he's got 4mm thick acrylic

Term	Definition	Source
[mAh-milleAmp hour] How many hours does a 3000mah battery last?	The "mAh", meaning milli-amps per hour, gives the energy capacity of the battery. In your case, 3,000 mAh generally means you can expect to get 100 mA for about **30 hours** usage, or 10 mA for **300 hours**, or 1 mA for 3,000 hours.	https://www.quora.com/How-long-does-a-3000mah-phone-battery-last
Glossary Term: **milliamp-hour**	A measure of charge (or current flow over time). One ampere-hour (or amp-hour or Ah) is a current of one ampere flowing for one hour. The amount of charge transferred in that hour is 3,600 coulombs (ampere-seconds). A milliampere-hour (mAh or milliamp-hour) is a thousandth of an amp-hour. An ampere-second (A-s or amp-second) is an amp supplied for one second. A common use of the term is rating energy storage device capacity, especially rechargeable batteries. For example, a 12-volt, 7Ah rechargeable battery used in an alarm system will supply an amp at the rated voltage range for seven hours, 2 amps for 3.5 hours, etc. If my alarm consumes 250mA, this battery would operate the system for 28 hours.	https://www.maximintegrated.com/en/glossary/definitions.mvp/term/milliamp-hour/gpk/596
C-Rates	Charge and discharge rates of a battery are governed by C-rates. The capacity of a battery is commonly rated at 1C, meaning that a fully charged battery rated at 1Ah should provide 1A for one hour. The same battery discharging at 0.5C should provide 500mA for two hours, and at 2C it delivers 2A for 30 minutes. Losses at fast discharges reduce the discharge time and these losses also affect charge times.	https://batteryuniversity.com/learn/article/what_is_the_c_rate

info on temp vs. battery power
https://batteryuniversity.com/learn/article/discharging_at_high_and_low_temperatures

Says thath batteryos lose about 50% of their power at -20C (-4F)

both NiCad and LiOm can discharge at -40C (-40F) but it's anly abou t0.2C