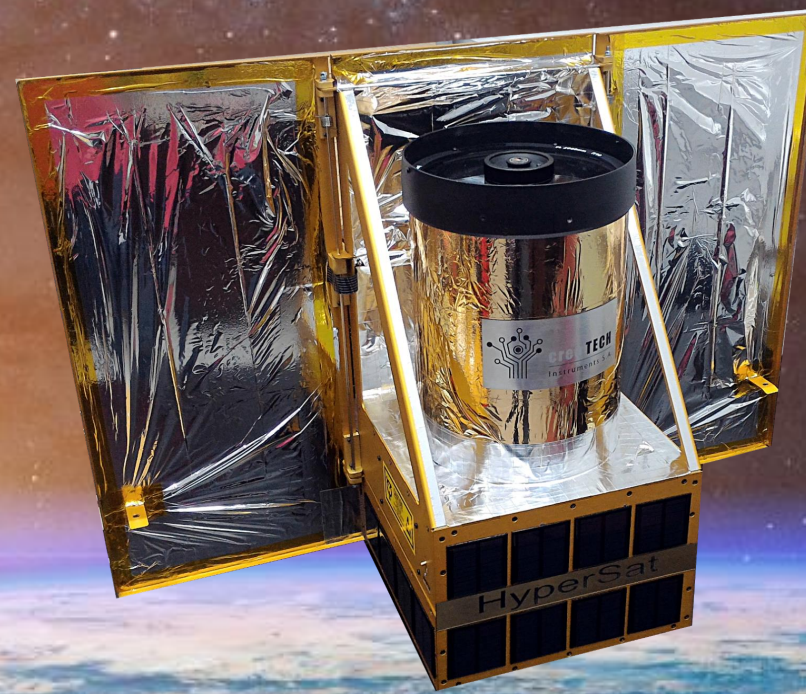
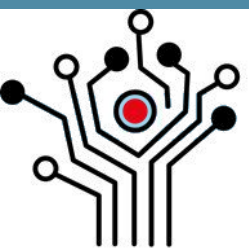




HyperSat – new standard for open hardware/software microsatellite platform phase B1 – first tests of the laboratory models.

Dr Marcin Stolarski - Creotech Instruments S.A.



creo TECH
Instruments S.A.



The National Centre
for Research and Development



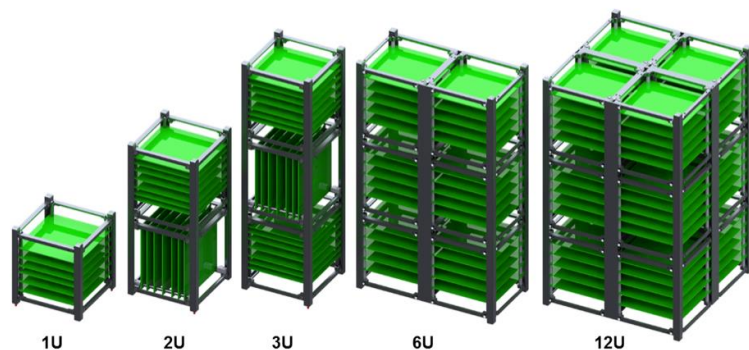
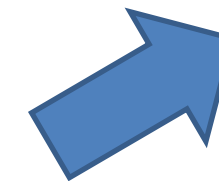
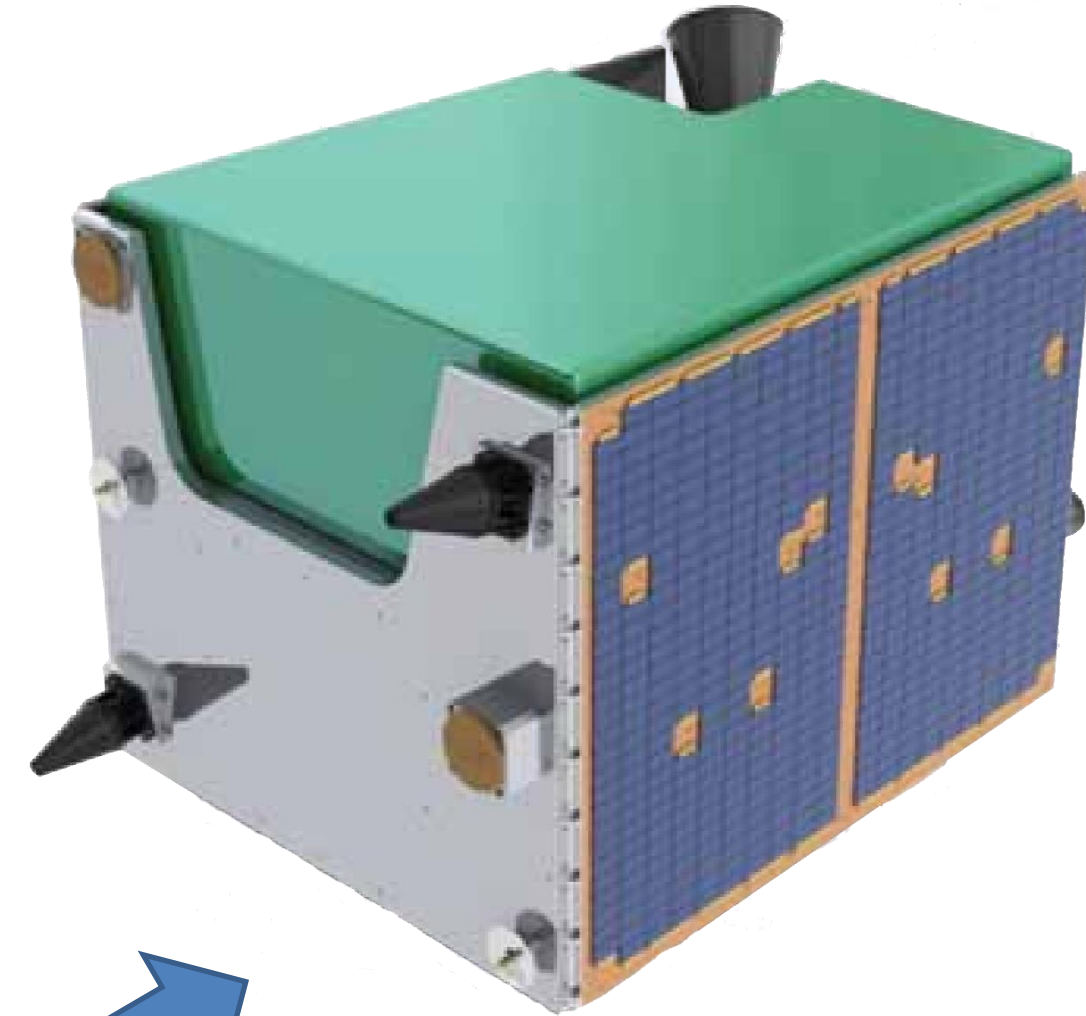
sapienza
SPACE & DEFENCE

HyperSat

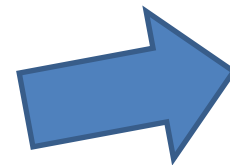
HyperSat – Market position

- **Technical details**

- **Mass:** 10 - 60 kg (payload up to 50 kg)
- **Size:** 350x350x100 - 350x350x600 mm
- **Power:** 50W (3.3V, 12V, 28V)
- **RF link:** 50 Mbps (S-band, X-band)
- **AOCS accuracy:** 1 deg or 10" (with a star tracker)
- **BUS:** HyperSat BUS (SpaceVPX, SpaceWire)
- **Launch readiness:** 6 months
- **License:** Open HW/SW

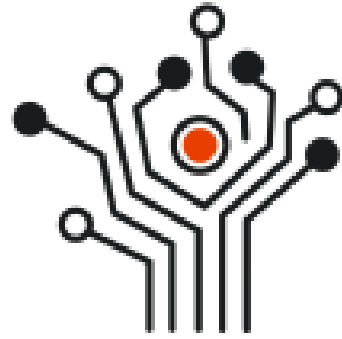


Source: Radius Space
www.radiuspace.com



HyperSat BUS

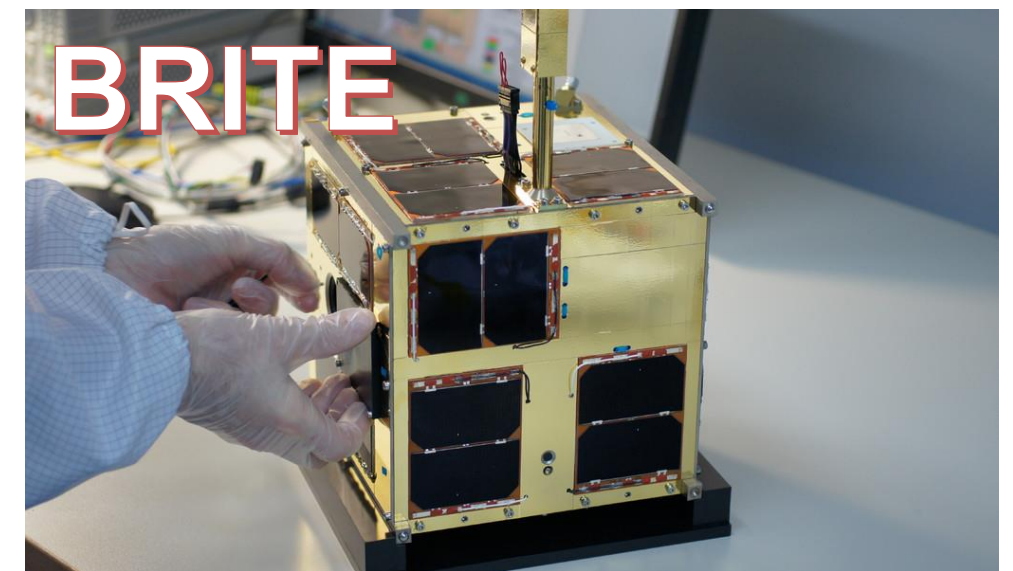
Team



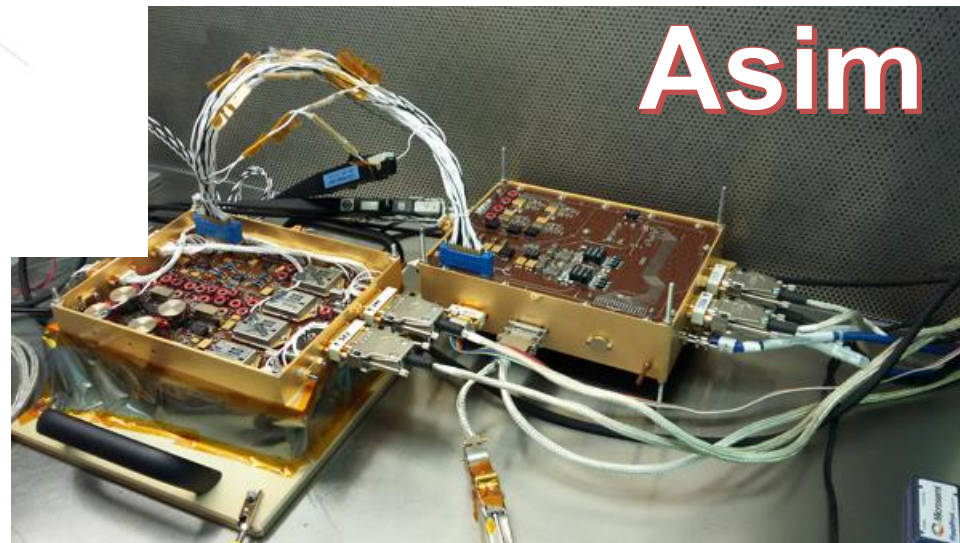
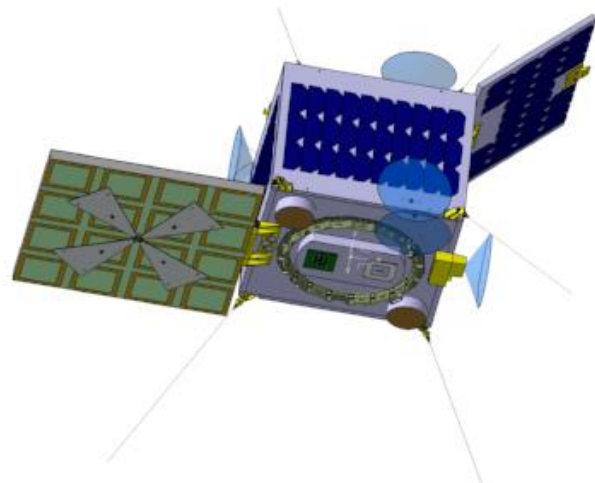
creo TECH
Instruments S.A.



hypersat 



BRITE



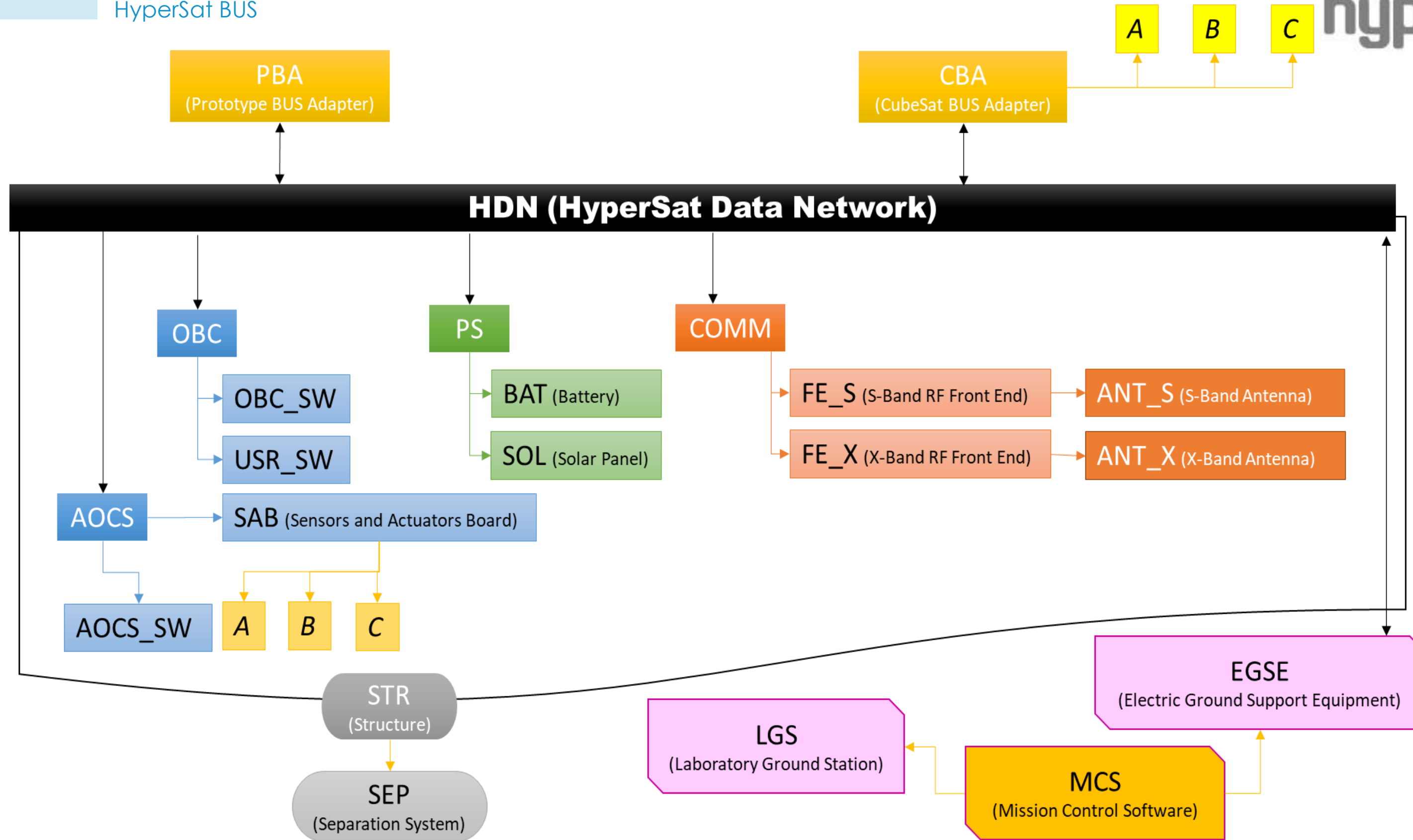
Asim



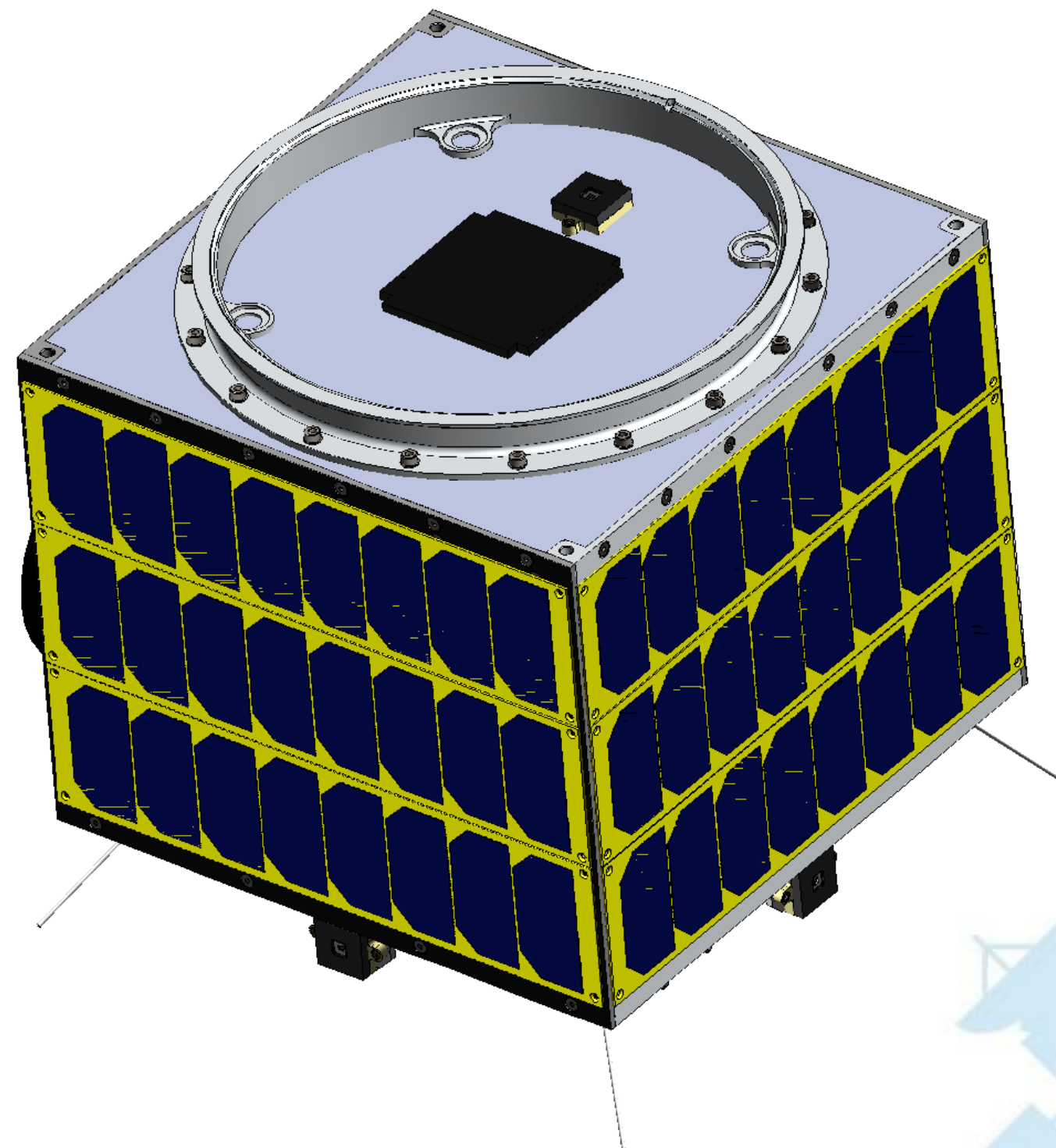
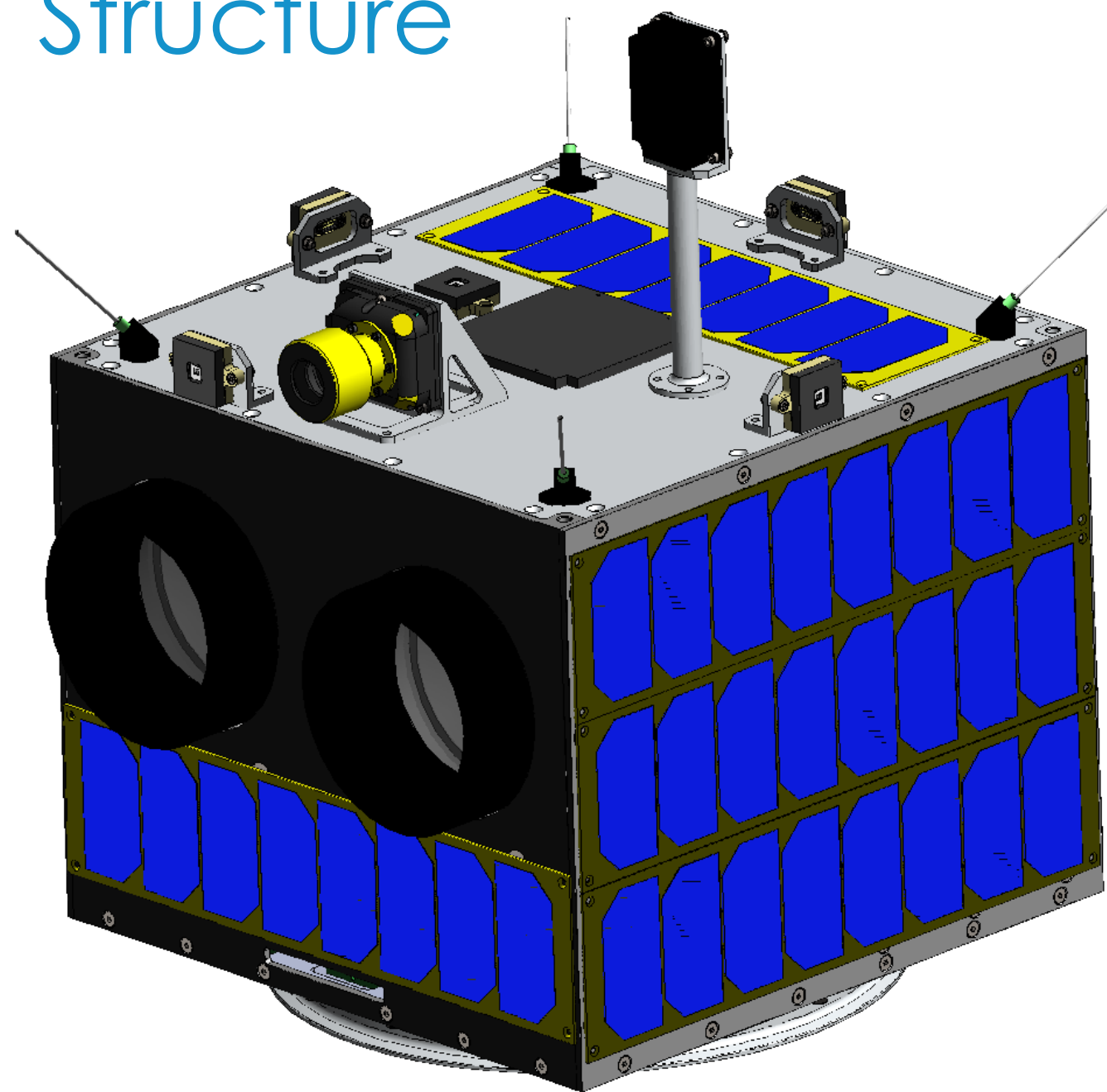
Cassis



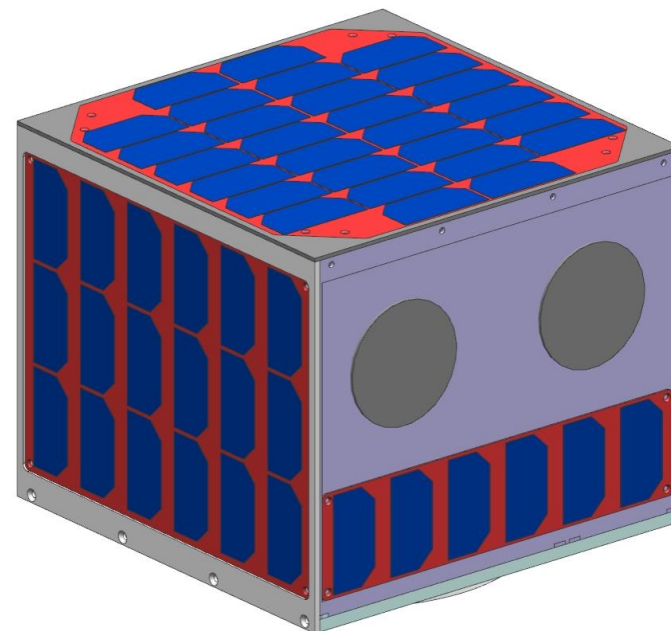
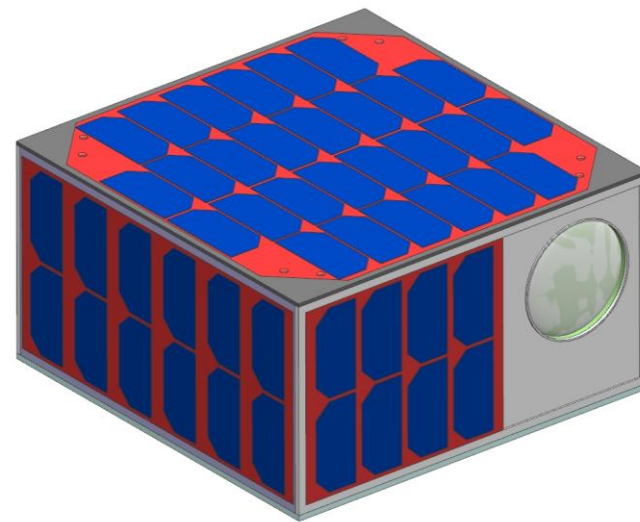
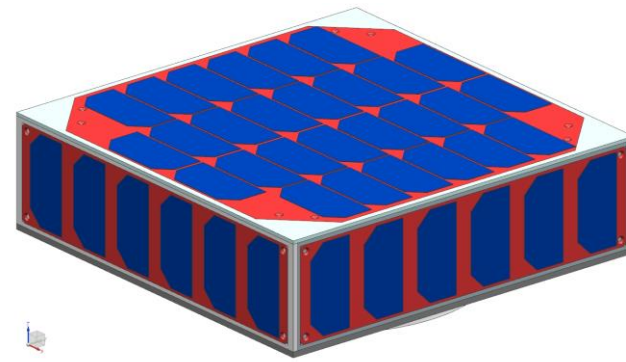
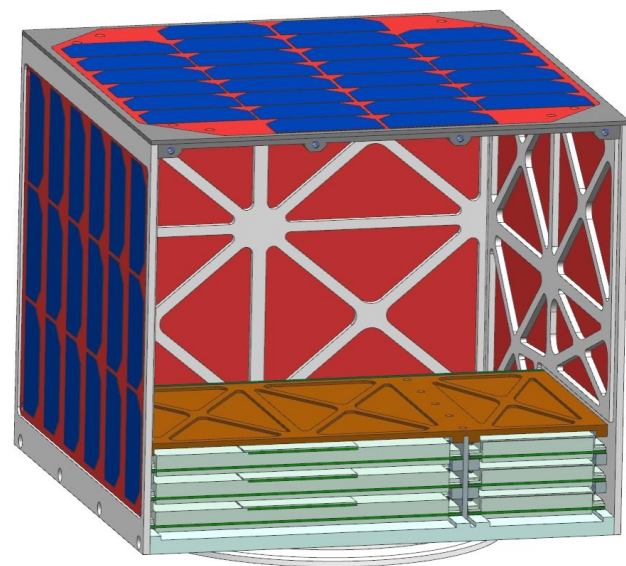
Rosetta



Structure

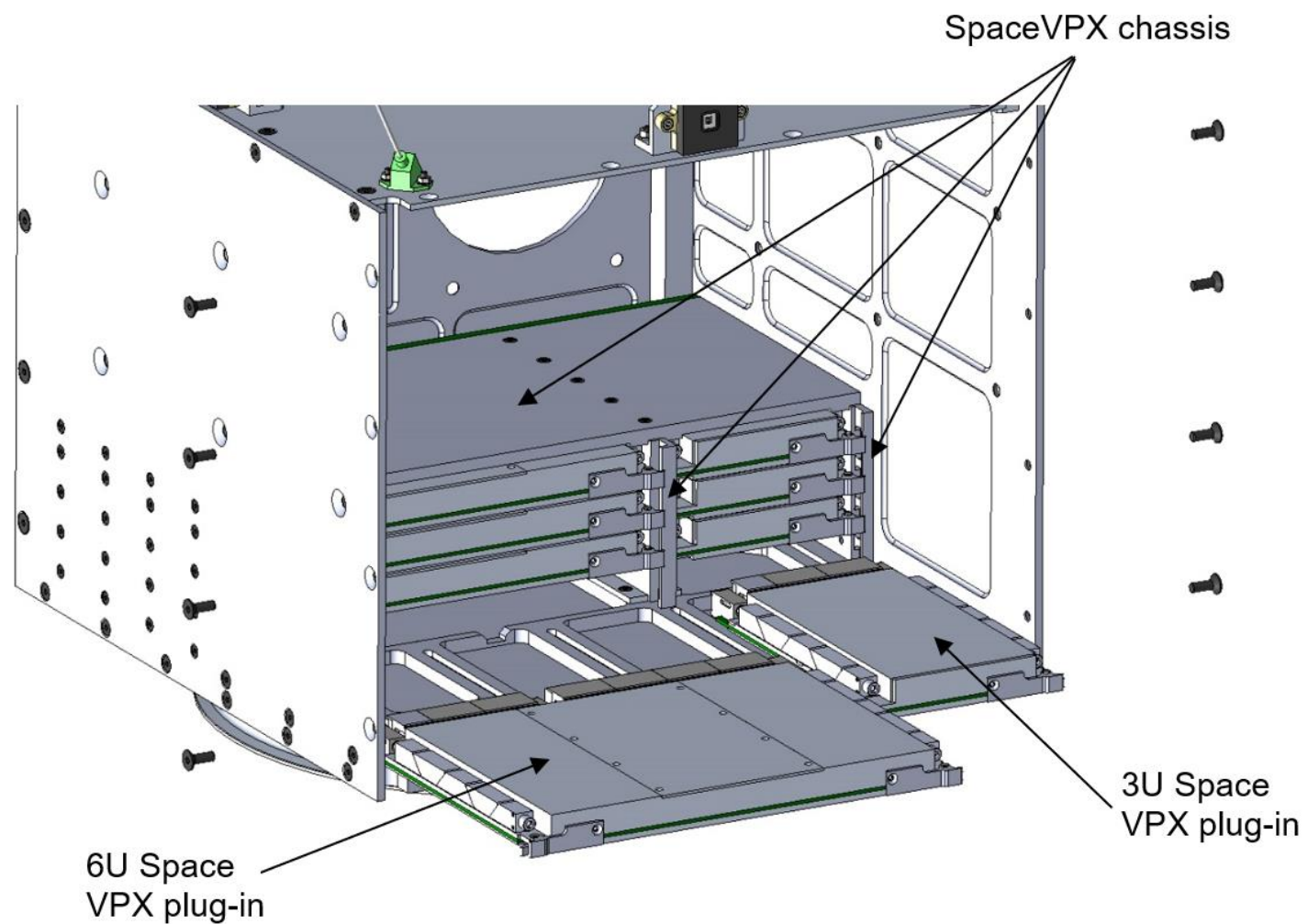


Structure

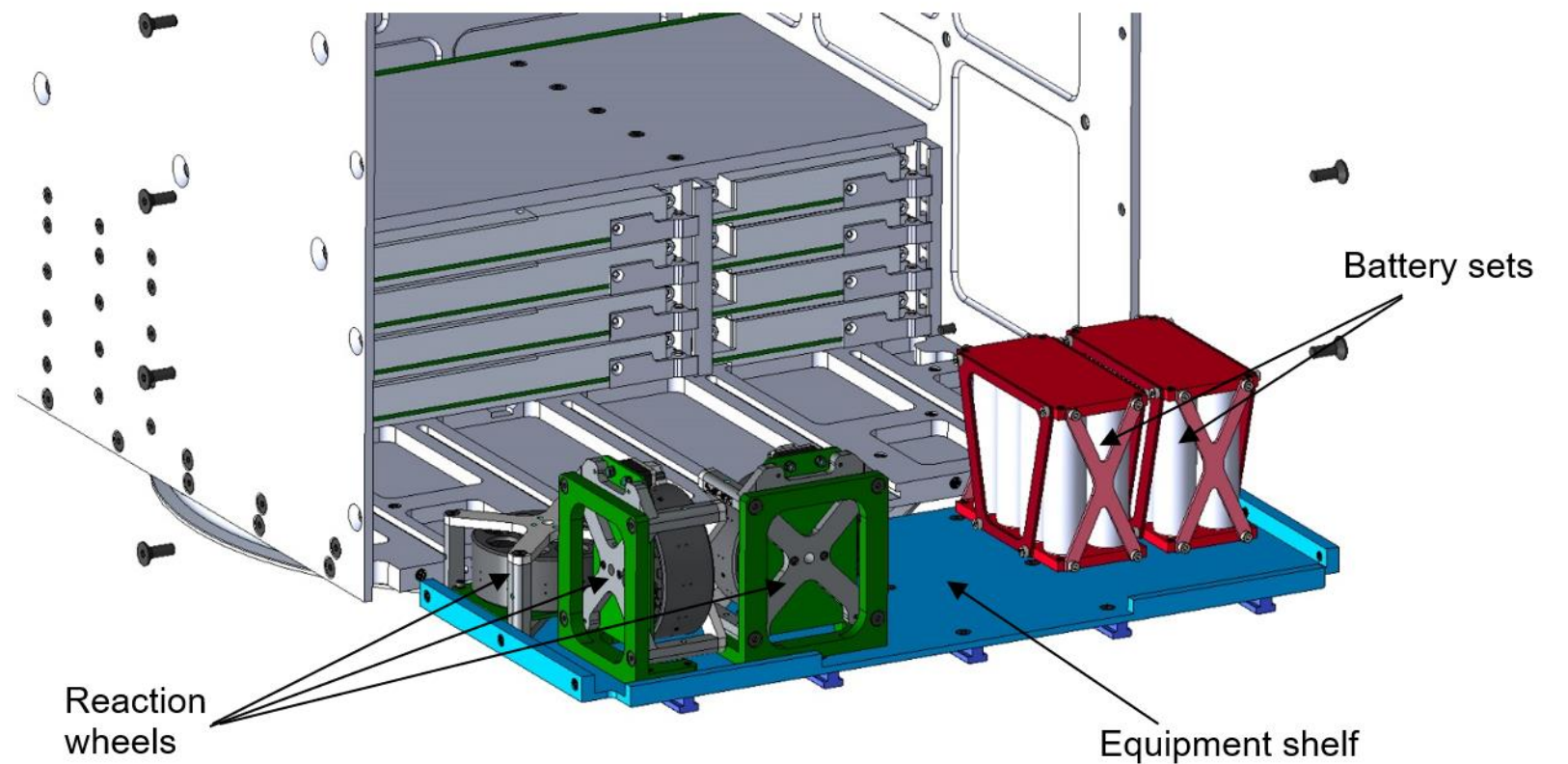


HyperSat modular construction

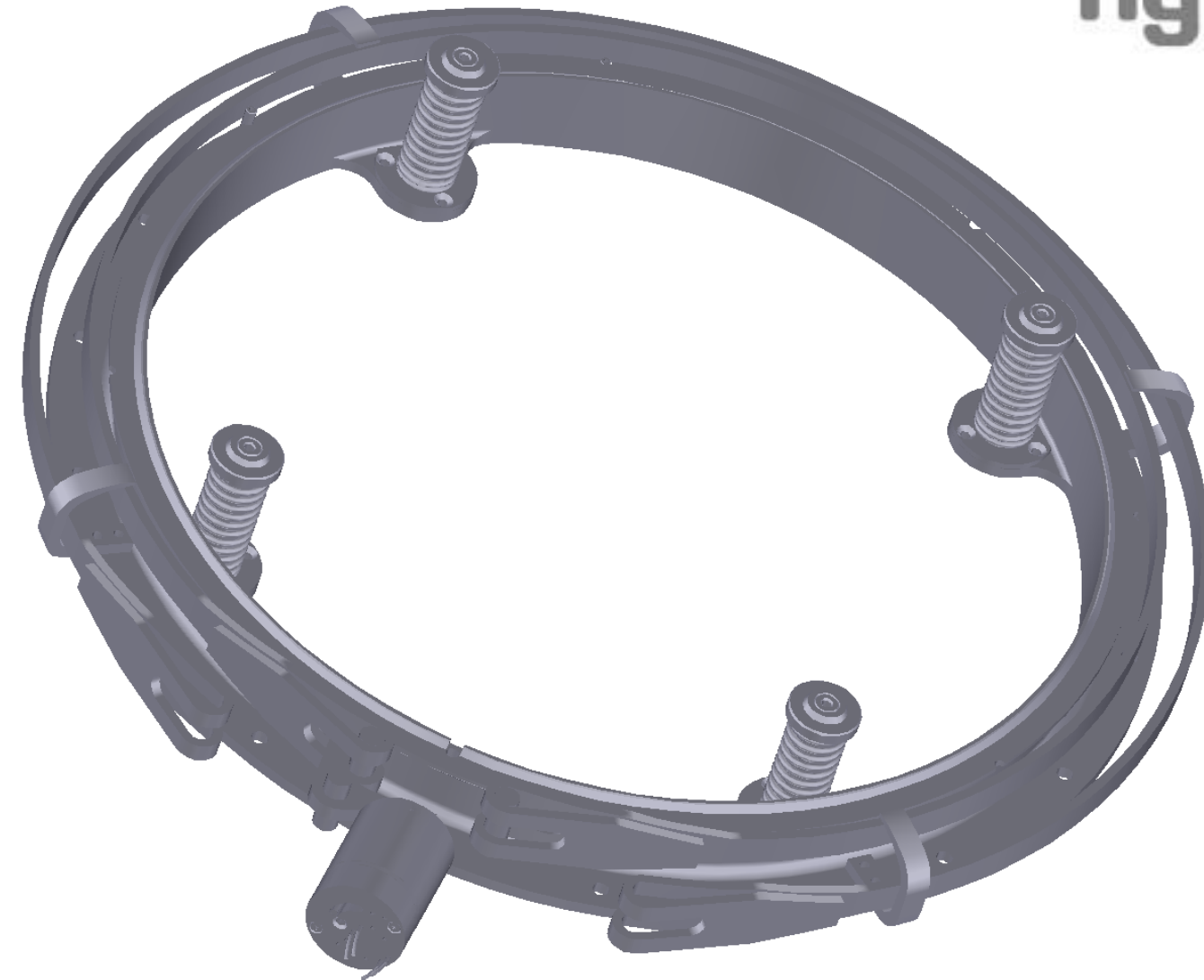
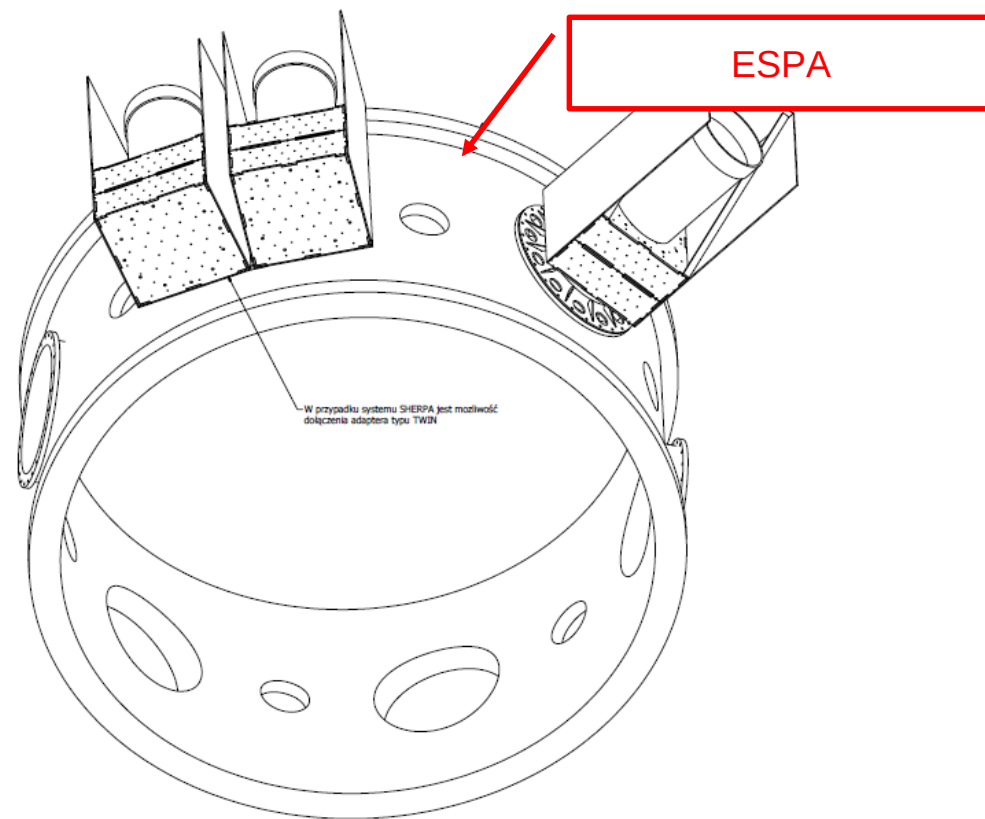
Modular electronics – SpaceVPX



Modular mechanics – removable shelf



Separation system



Considered Marman clamp system

Will most probably develop proprietary clamping system

New satellite market

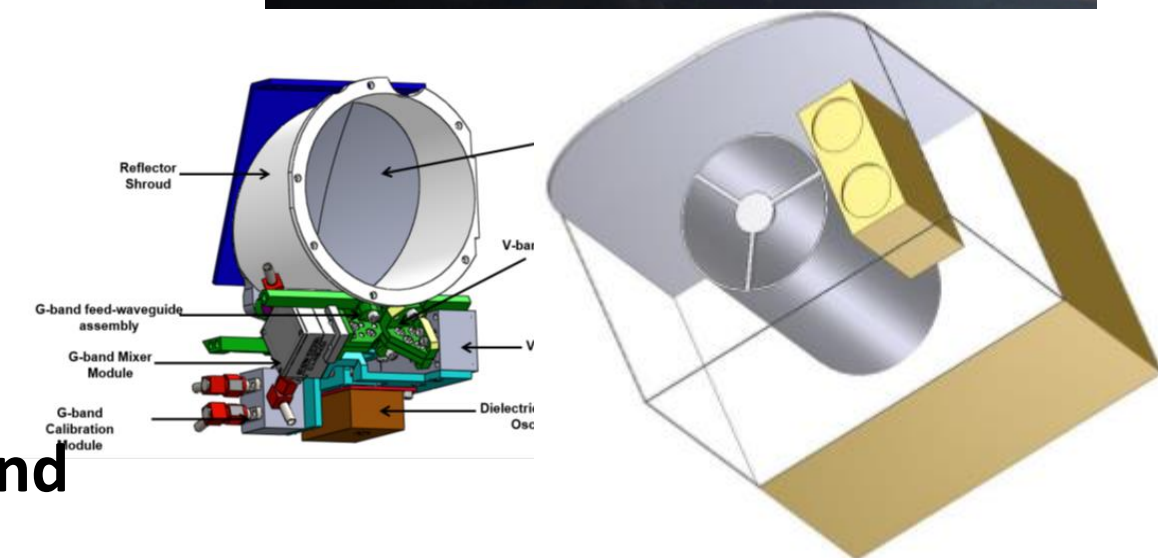
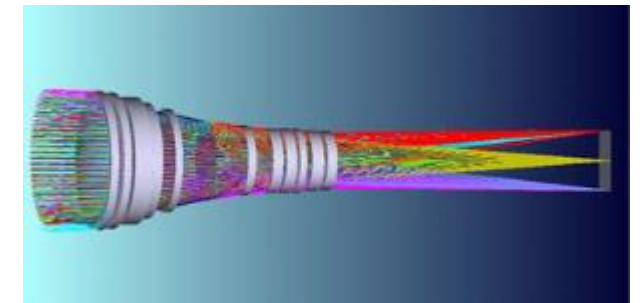
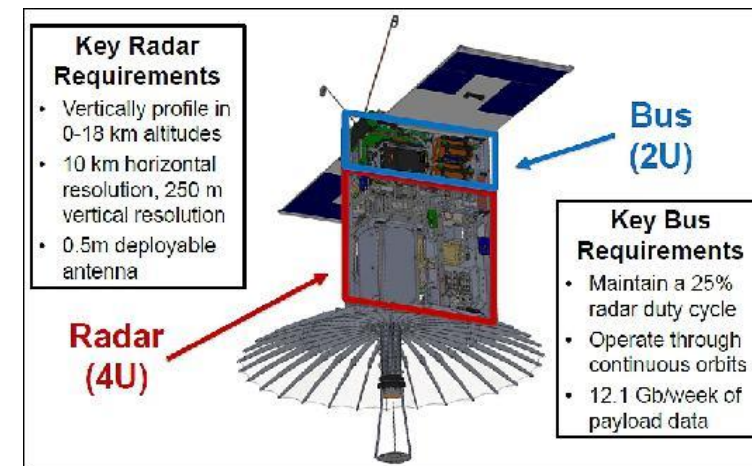
Need for teledetection payloads:

- Visualization (VIS, UV, IR)
- Microwave detection (passive, active)
- Slave to visualization (eg. Active optical aperture)
- Movable (rotation of the instrument w/r to the satellite axis)
- Other (technological experiments)

Rough estimates of useful parameters:

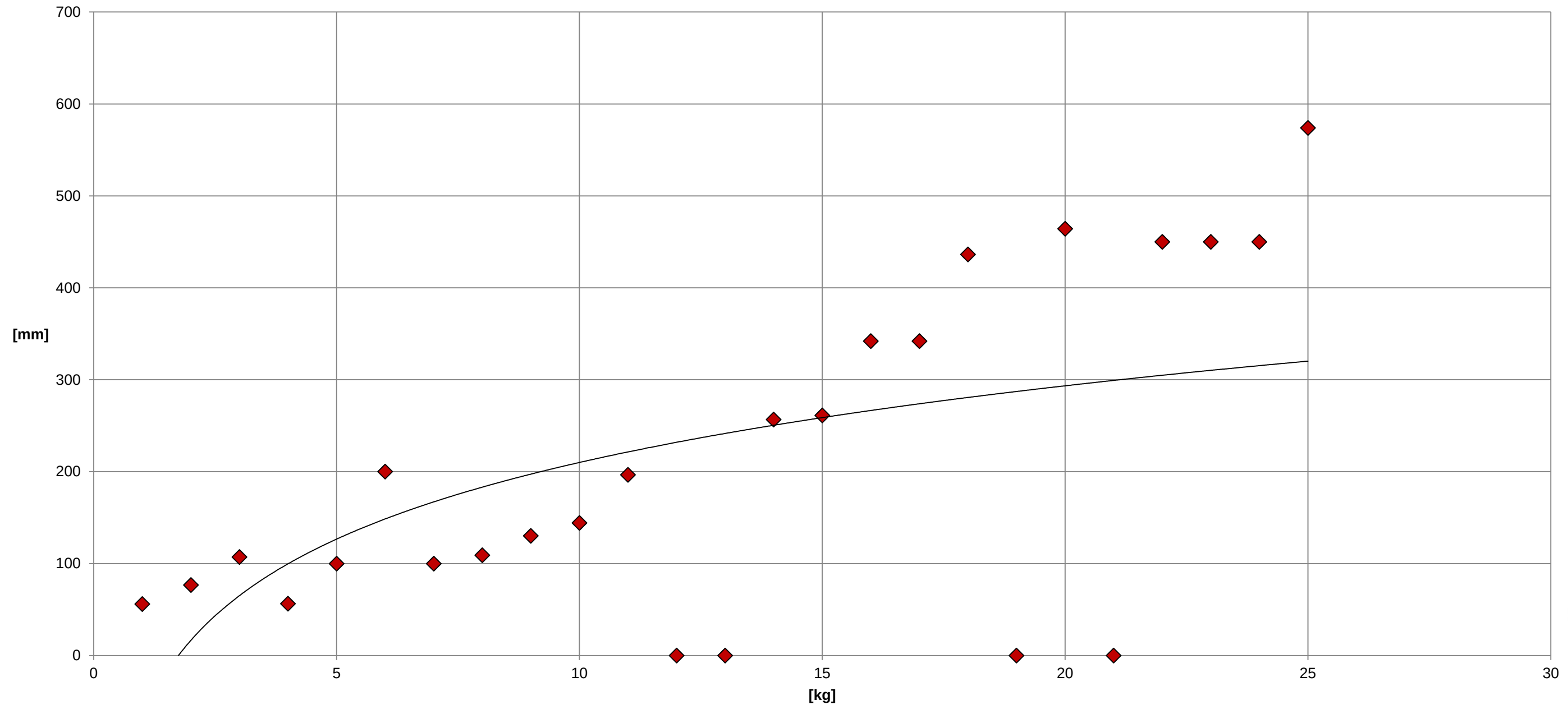
- Instrument mass up to 15kg
- Demand for instrument power (up to 35 W)
- Downlink: from kbits/s to 10Mbit/s

There is a need for a little bigger satellite with little more power and little more RF link throughput



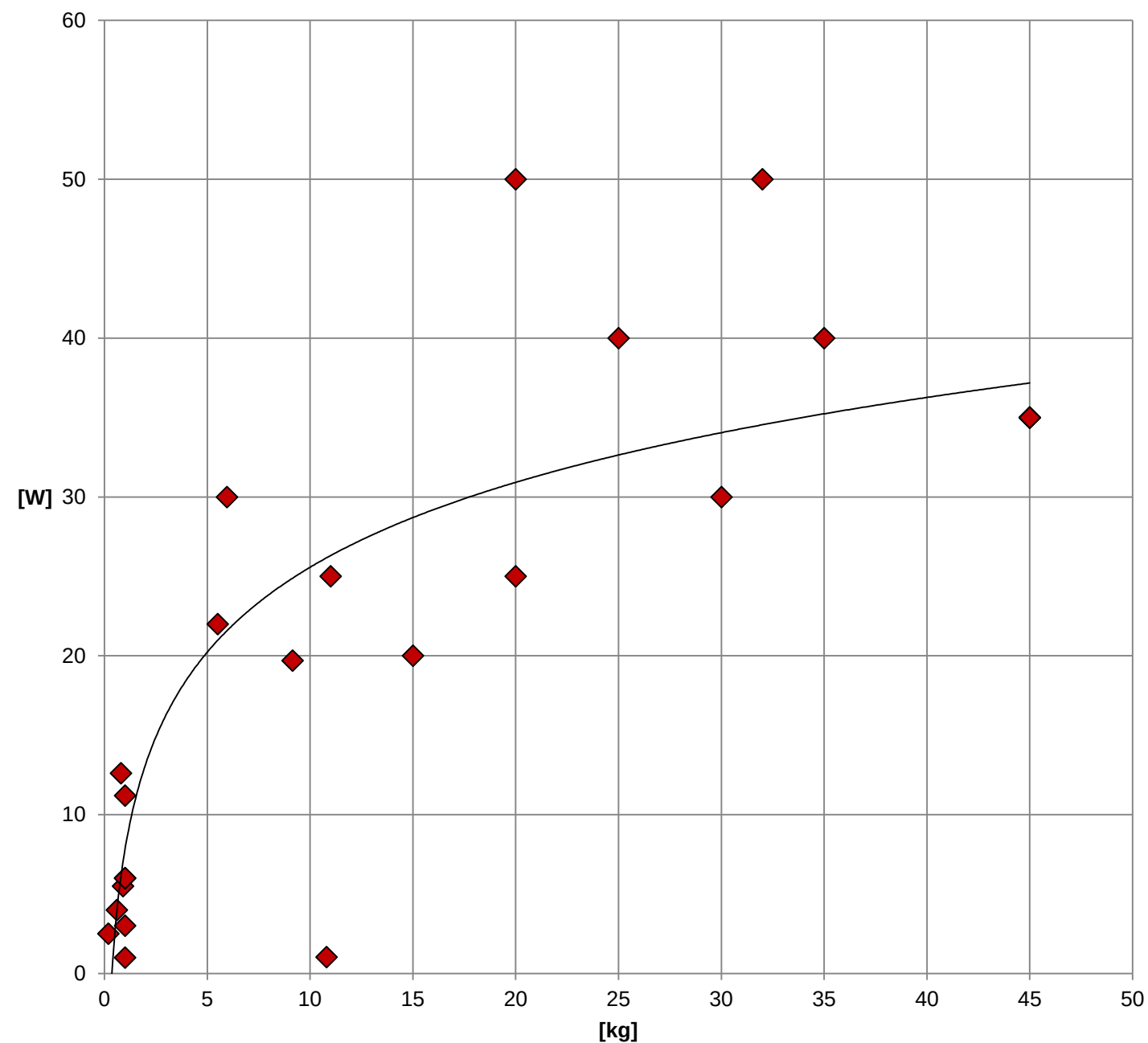
Payload size vs. Volume

Payload size vs. Volume

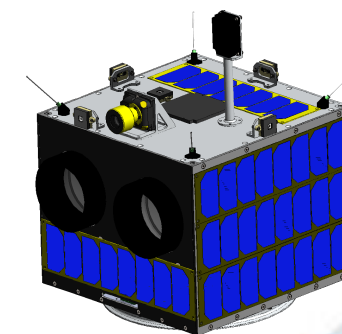
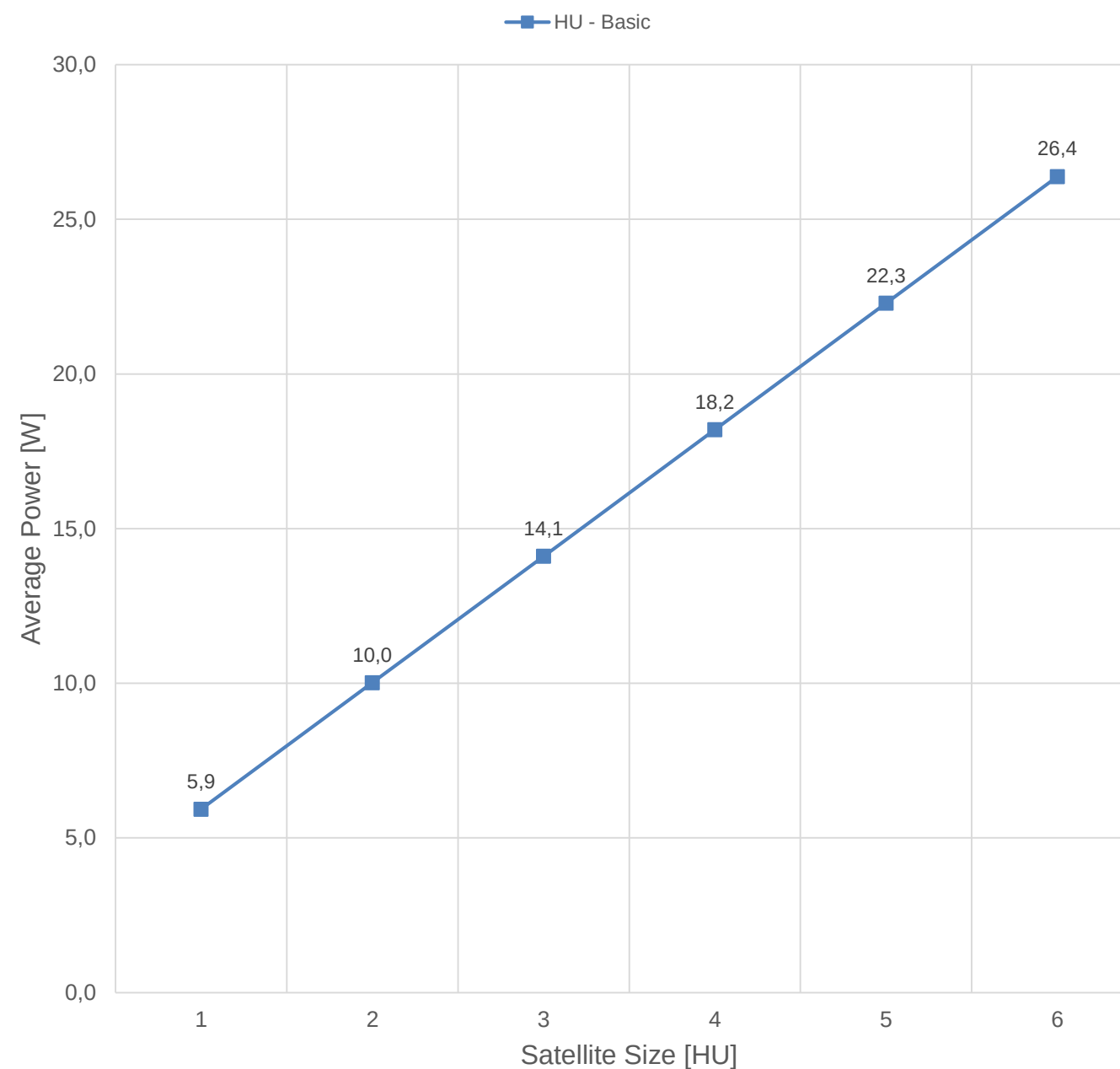


Payload mass vs. Payload power consumption

Payload mass vs. Payload power consumption

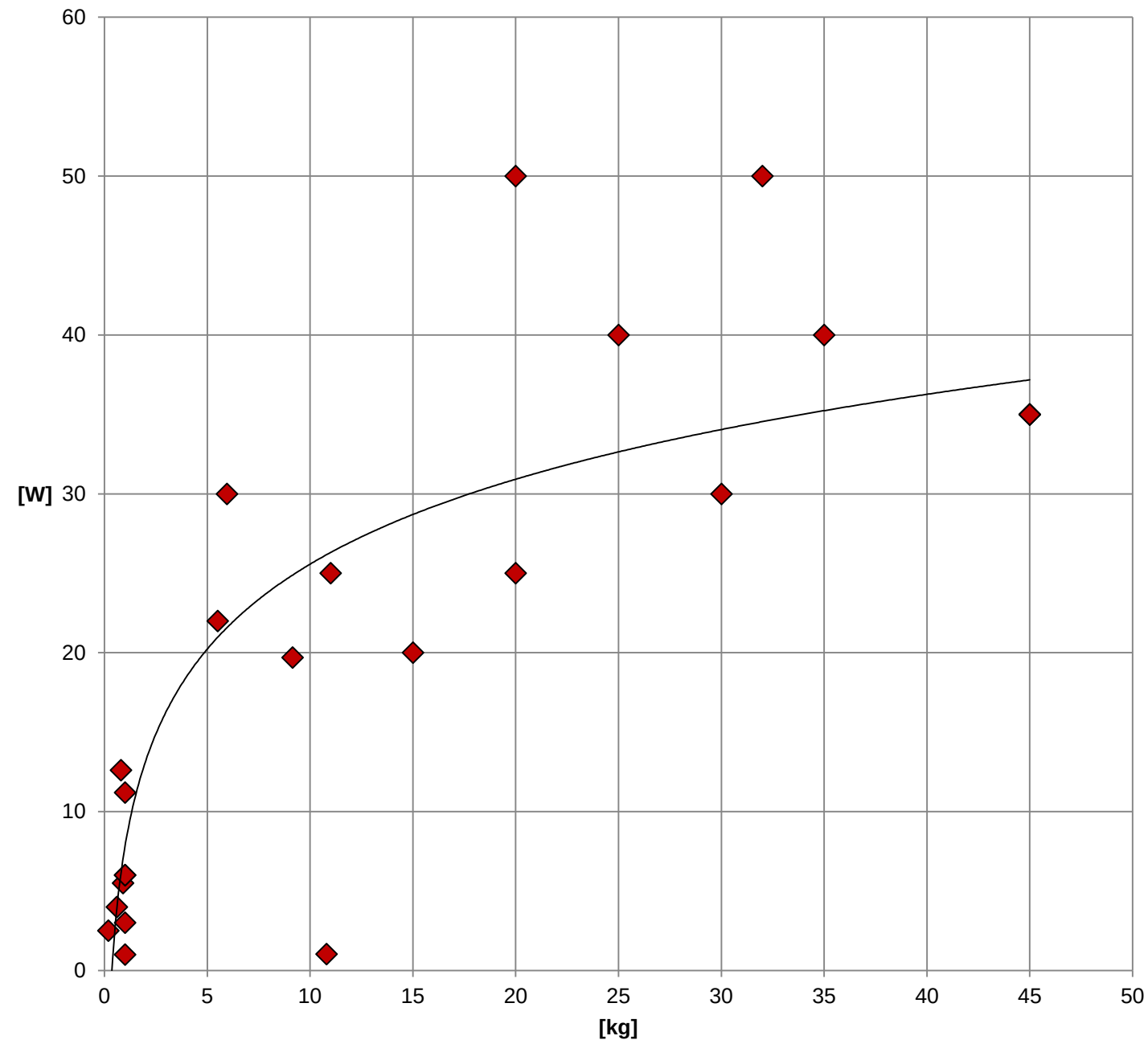


HyperSat Power Harvesting

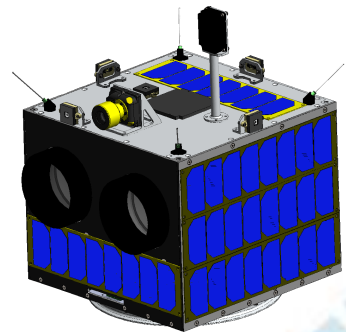
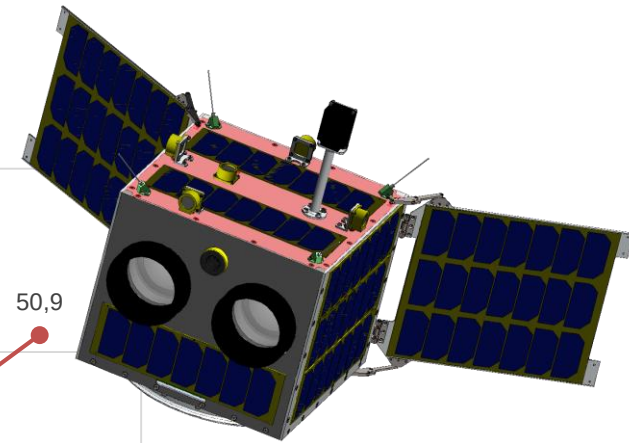
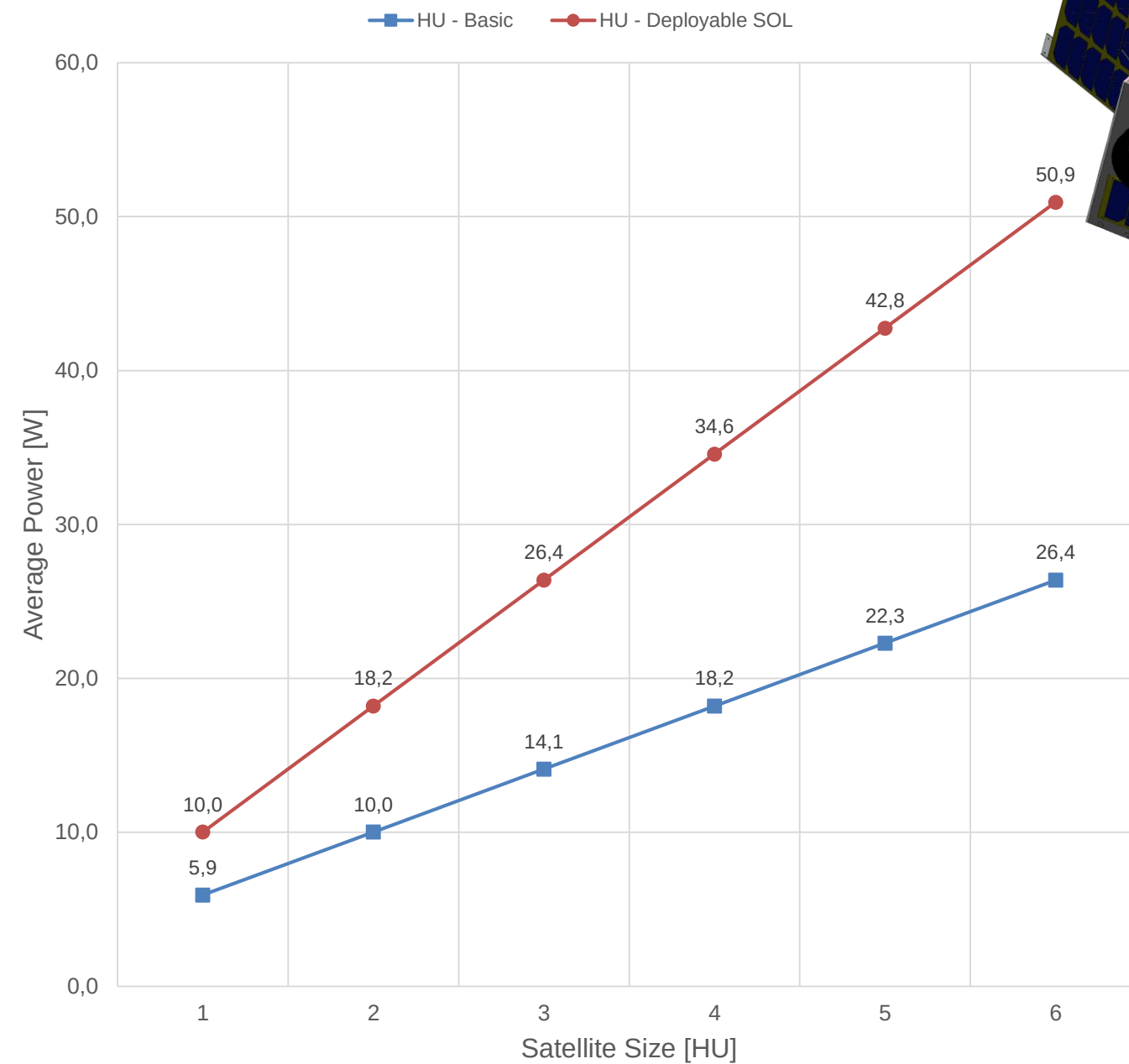


Payload mass vs. Payload power consumption

Payload mass vs. Payload power consumption

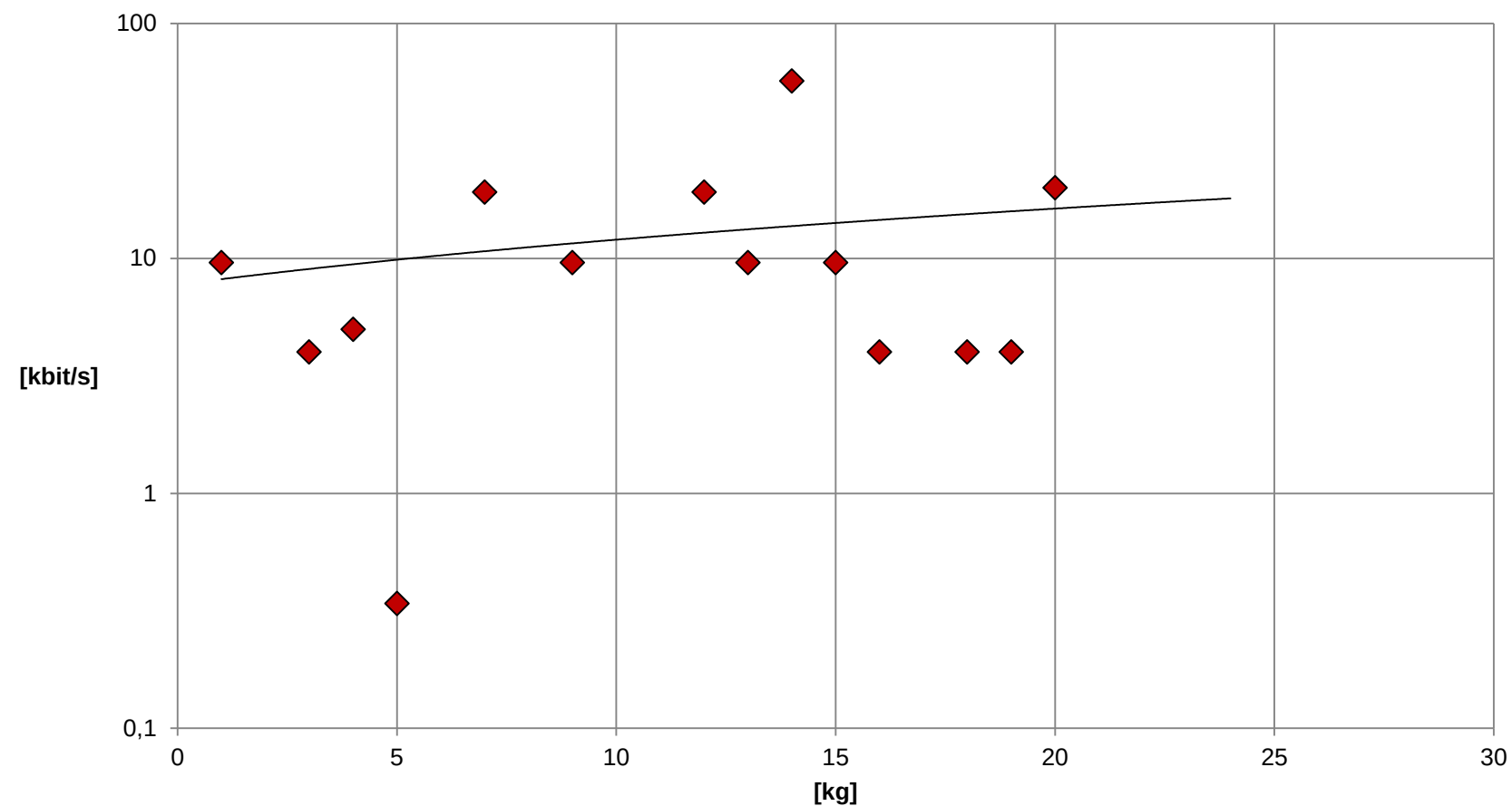


HyperSat Power Harvesting

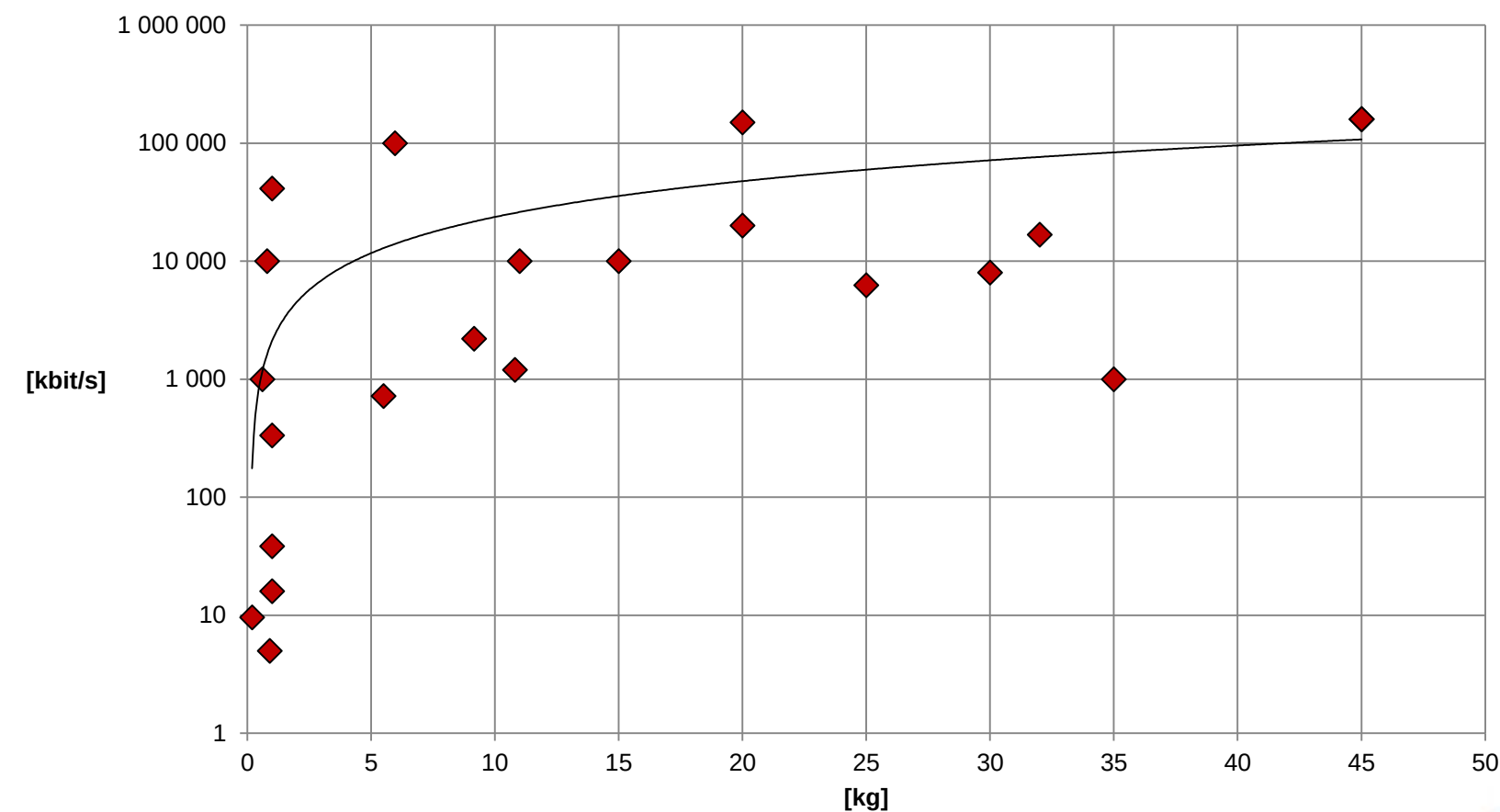


RF Link throughput

Payload mass vs. Uplink throughput



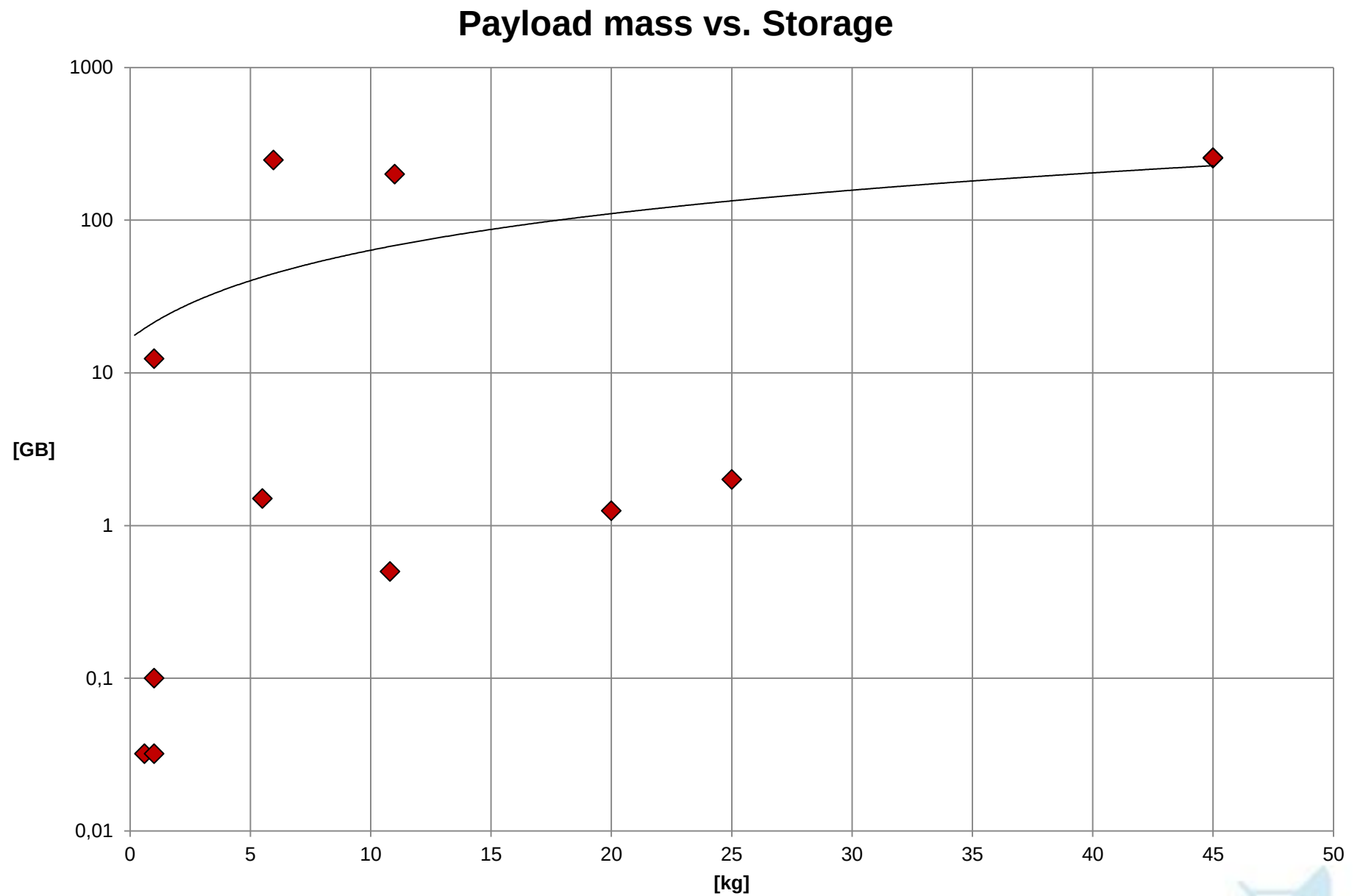
Payload mass vs. Downlink throughput



HyperSat:

- Up Link: 200 kbps
- Down Link: 50 Mbps

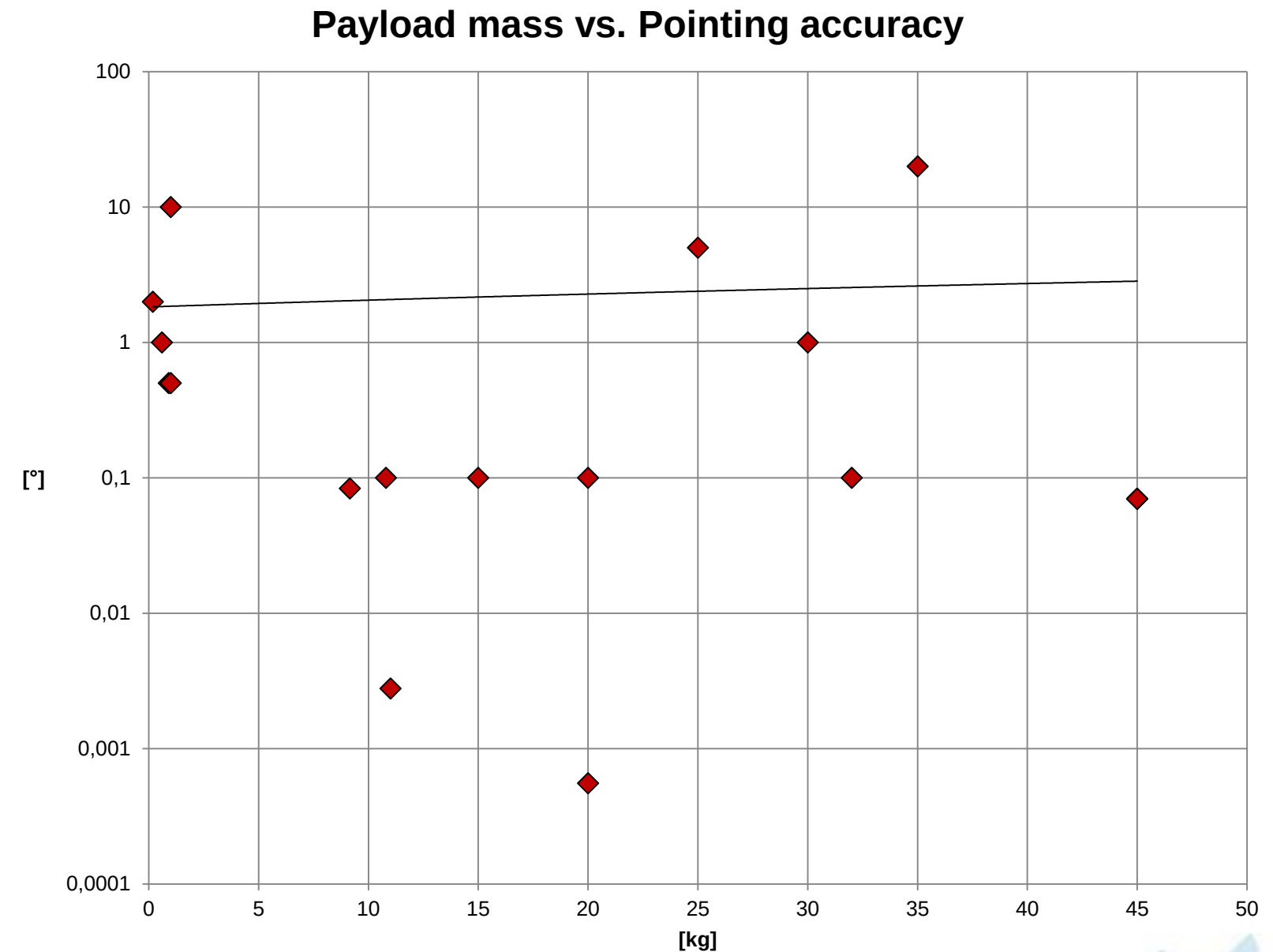
Mass storage



HyperSat:

- Mass storage: 16 GB

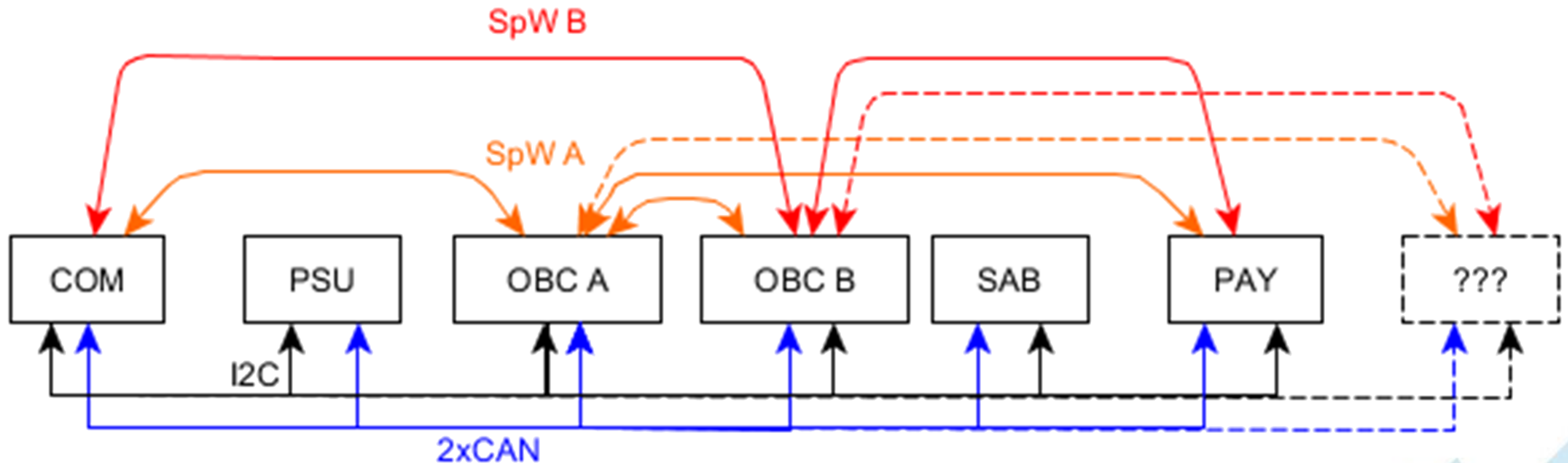
AOCS accuracy



HyperSat:

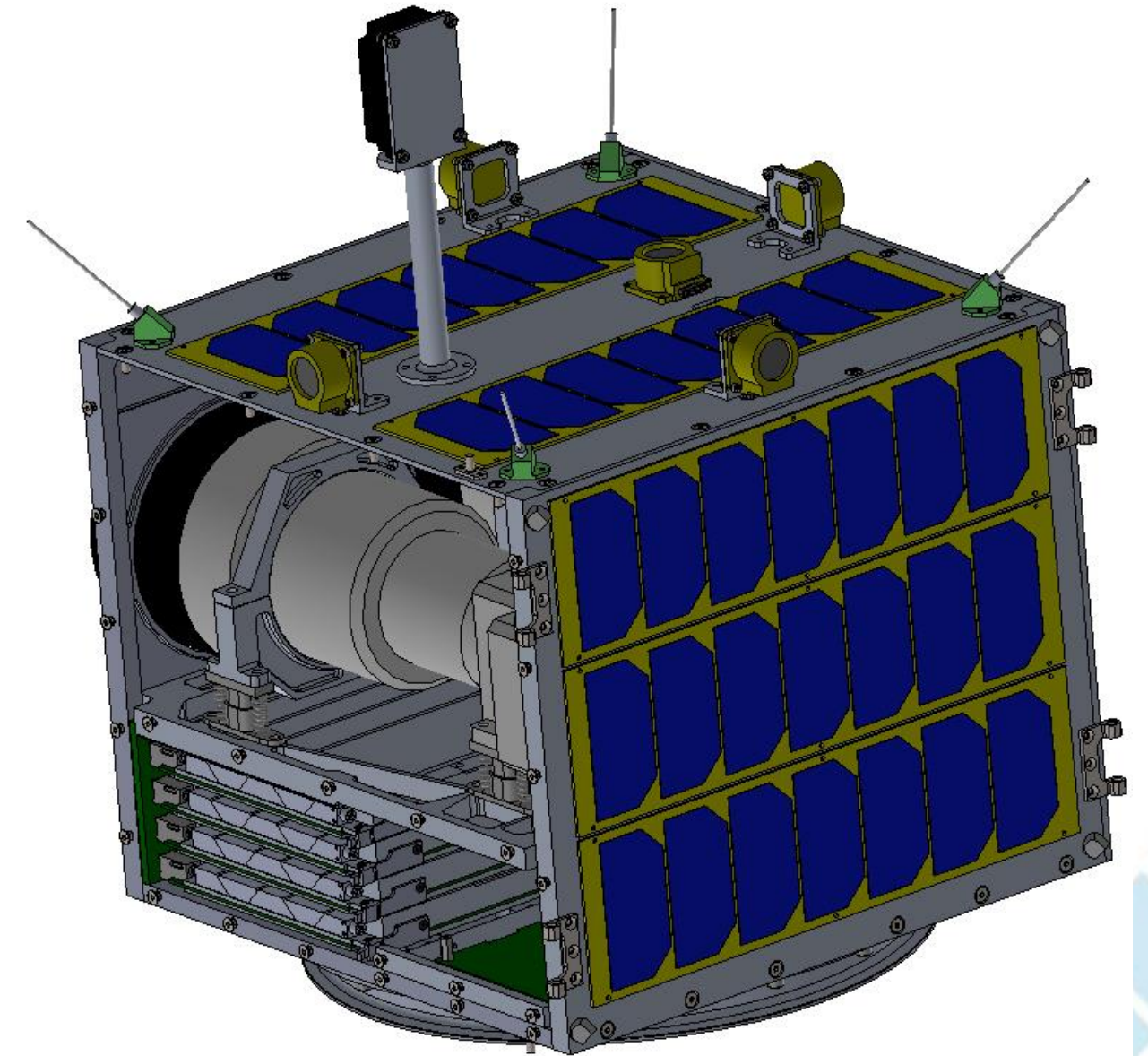
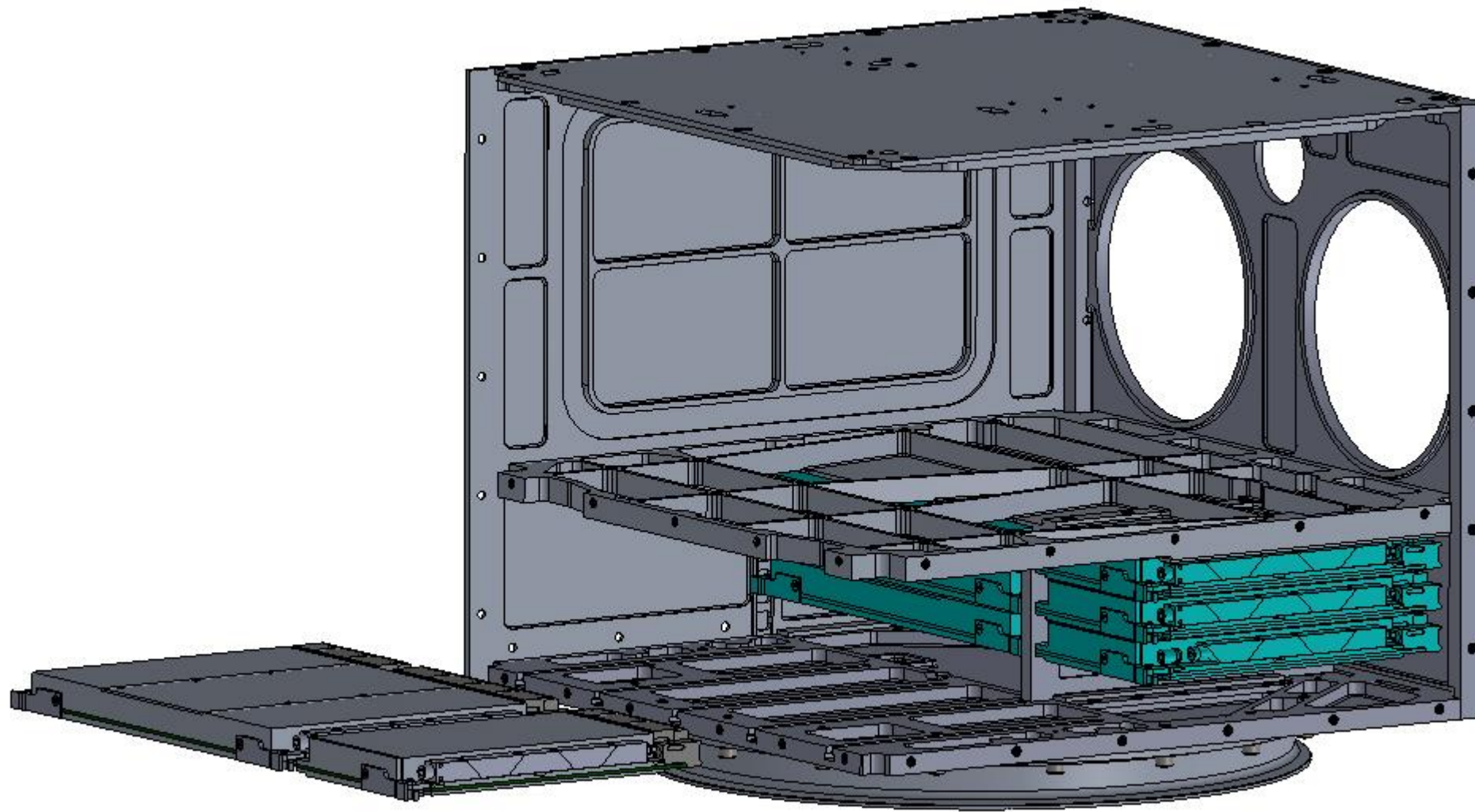
- AOCS pointing accuracy: 30 arc sec ($8.33\text{E-}3$ [°])

HDN – HyperSat Data Network



- Dual, redundant SpaceWire
- I2C
- Optional CAN

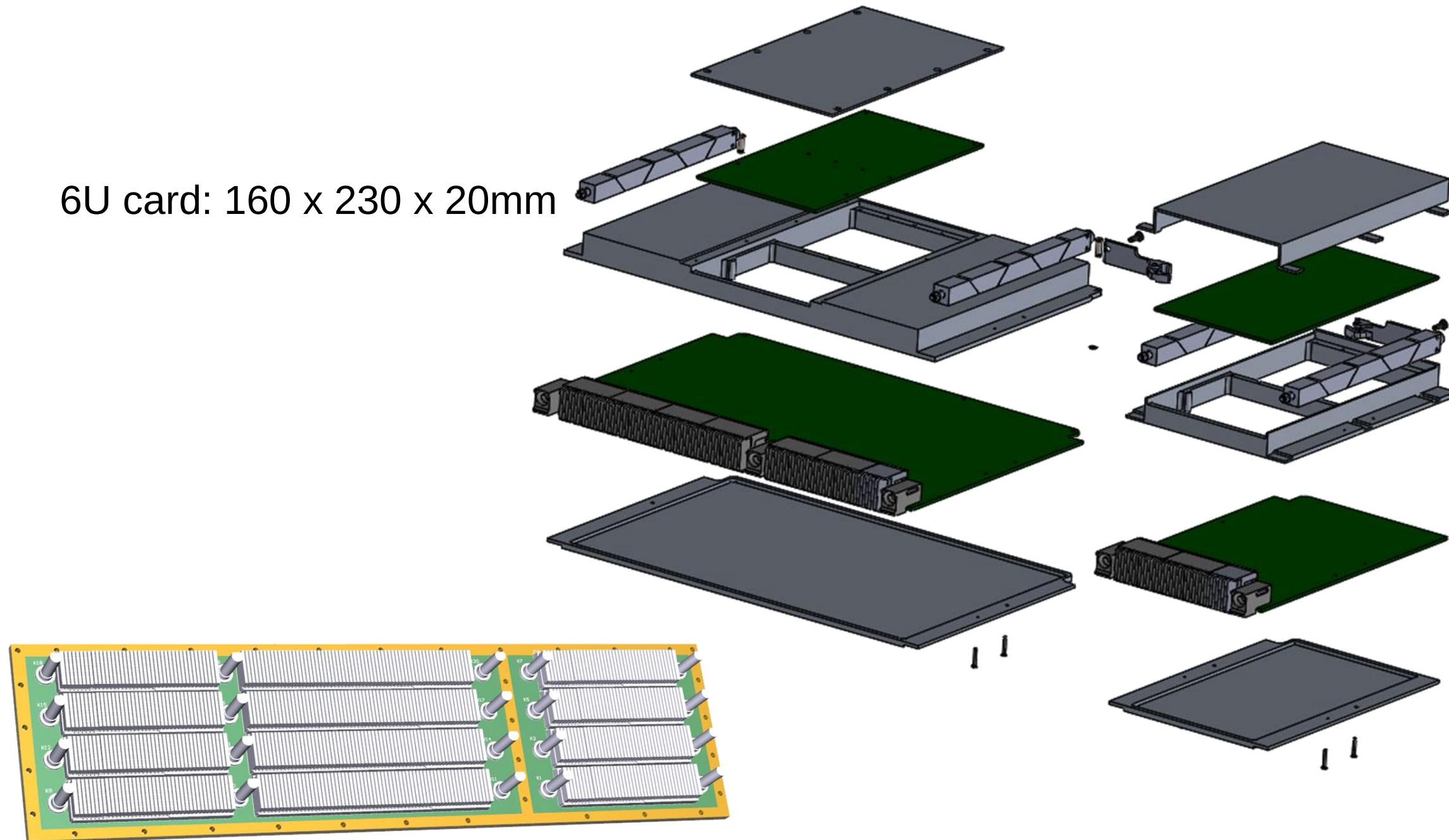
HyperSat Structure



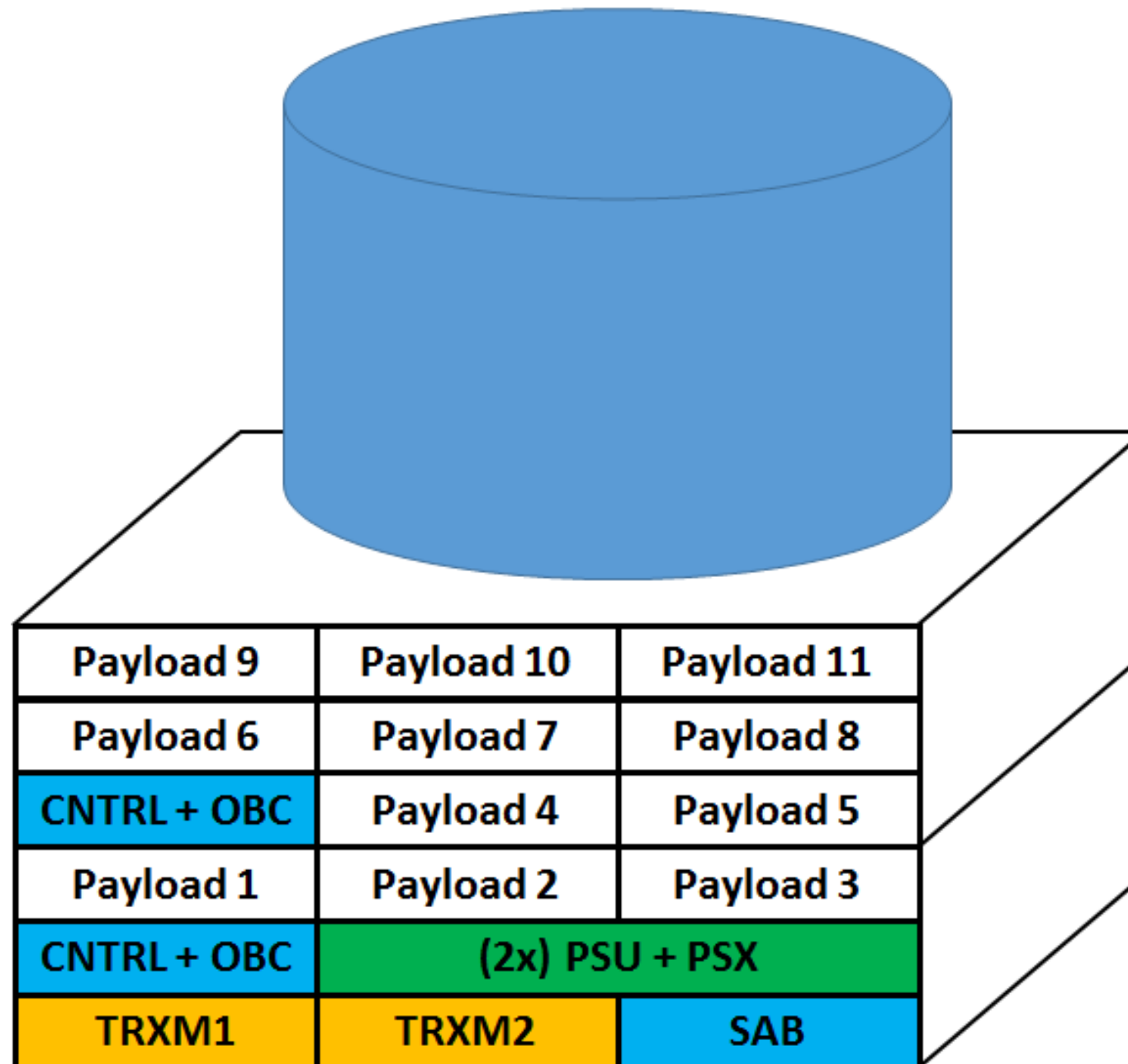
HyperSat design of 3U and 6U VPX modules

6U card: 160 x 230 x 20mm

3U card: 160 x 100 x 20mm



HDN - 4HU (HyperSat Unit)



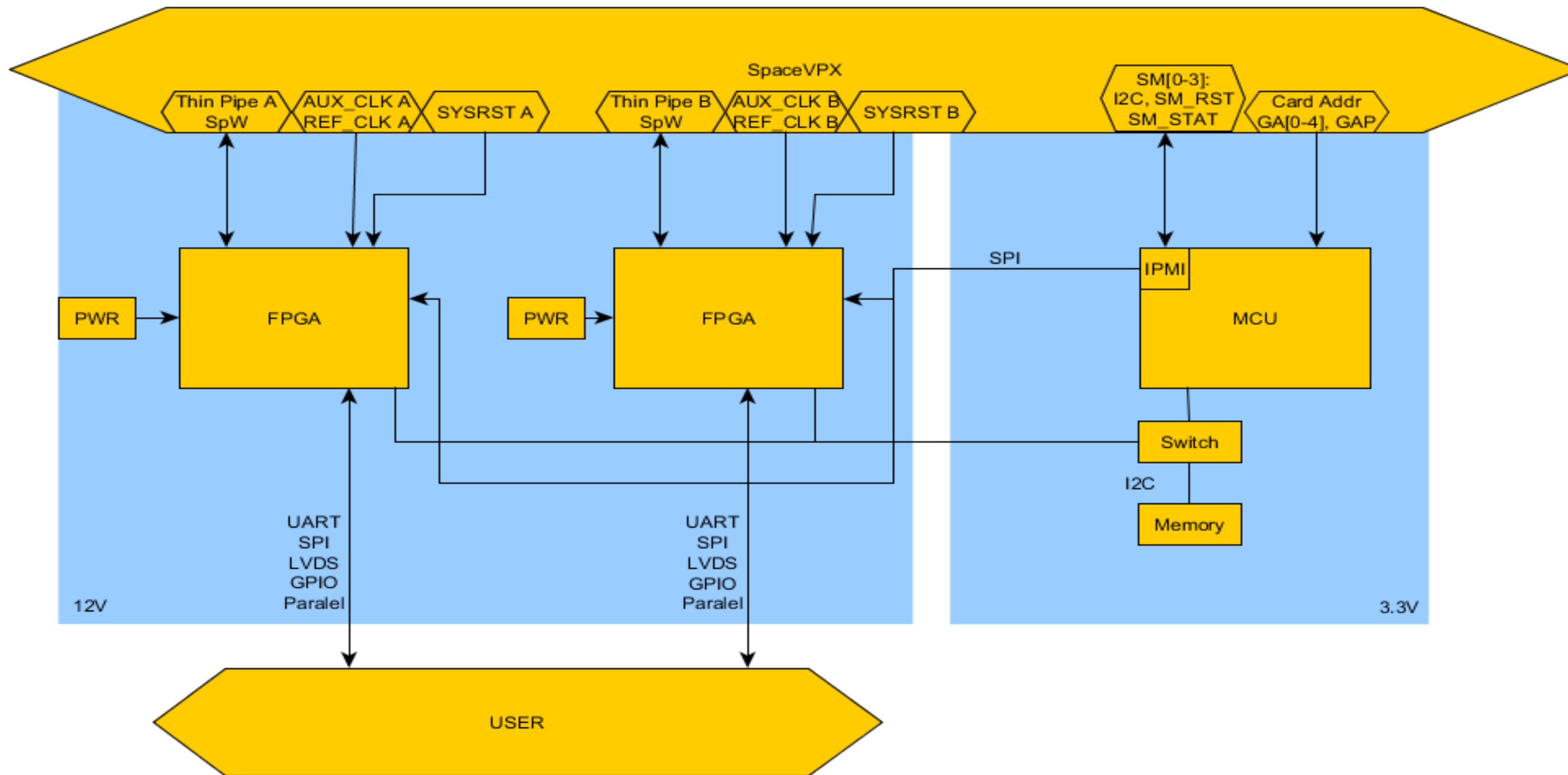
2HU (optics, antenna, etc.)

1HU (electronics)

1HU (electronics)



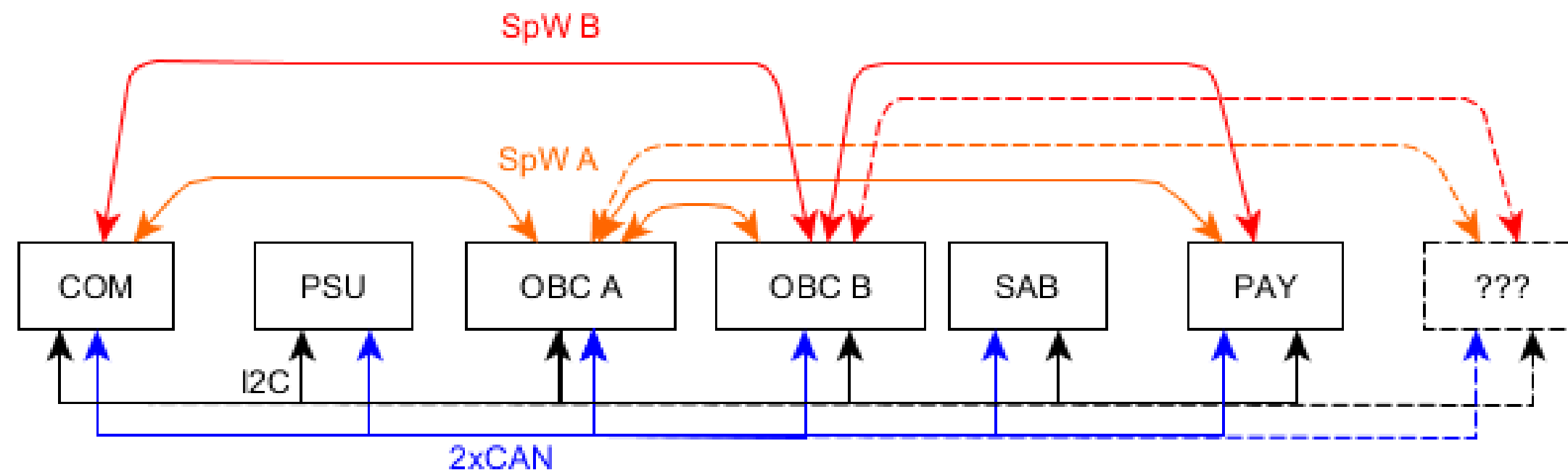
NIC - Network Interface Card adapter



HDN details

	# nodes	Speed [kbit/s]	data per node [kbit/s]	duty cycle	Biasing	Idle power [mW]		Active power [mW]		Total power [mW]	
						typ	max	typ	max	typ	max
CAN (SN65HVD233 + MCP2512)	7	1000	10	0,01	0	254	370	520	635	257	372
CAN (SN65HVD233 + SF2)	7	1000	10	0,01	0	496	797	761	1062	498	799
CAN (SN65HVD233 + w/o controller)	7	1000	10	0,01	0	139	139	404	404	141	141
RS-485 (bus)	7	1000	10	0,01	11	91	140	1925	1925	120	169
RS-485 (star)	12	1000	10	0,01	77	156	240	3300	3300	264	348
SpW (4 nodes, 10Mbit)	4	10000	10	0,001	0	632	891	632	891	632	891
SpW (6 nodes, 10Mbit)	6	10000	10	0,001	0	824	1179	824	1179	824	1179
SpW (6 nodes, 100Mbit)	6	100000	-	1	0	1823	2144	1823	2144	1823	2144

HDN - HyperSat Data Network



Interfaces	Total power [mW]		Total power + efficiency [mW]		Total power + efficiency + margin [mW]	
	typ	max	typ	max	typ	max
CAN + SpW @ 10Mbit (4 nodes)	773	1032	910	1214	1092	1457
CAN + SpW @ 10Mbit (6 nodes)	965	1320	1136	1553	1363	1864
SpW @ 10Mbit (6 nodes)	824	1179	969	1387	1163	1664
SpW @ 100Mbit (6 nodes)	1823	2144	2145	2522	2574	3027

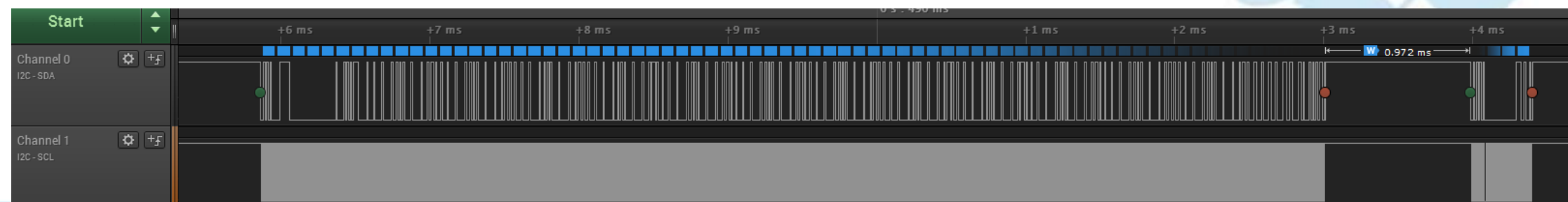
HDN - data rate estimation

Management bus:

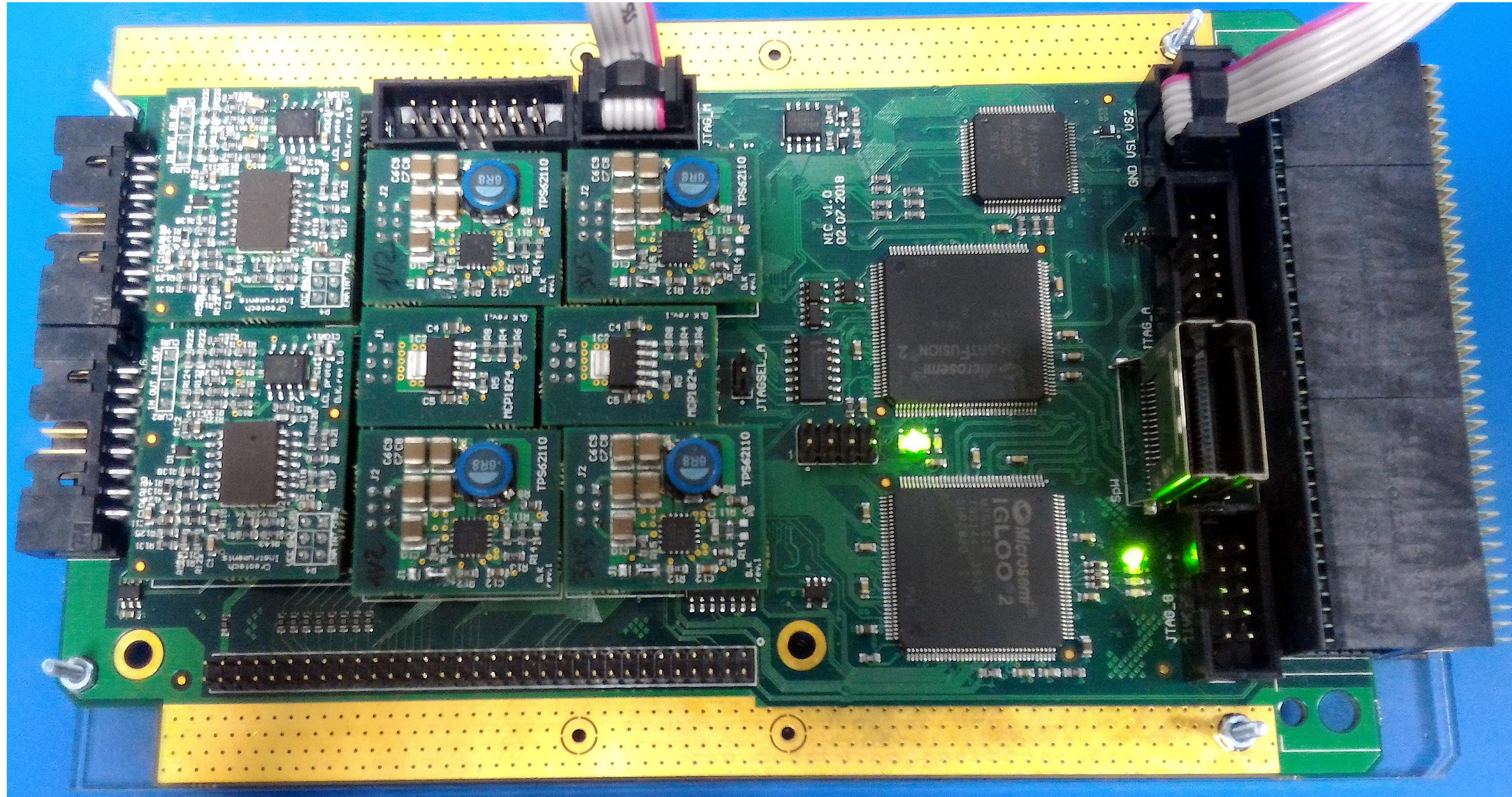
- Maximum data rate (64B/packet): 51.2kbps (6.4kB/s)
- Minimum data rate (1B/packet): 2kbps (250B/s)
- Expected: maximum 5.3-11.8KB/s data flow

Space Wire:

- SpaceWire max data rate - 100Mbps
- Radio max data rate 50Mbps
- Expected: 93.7Mbps

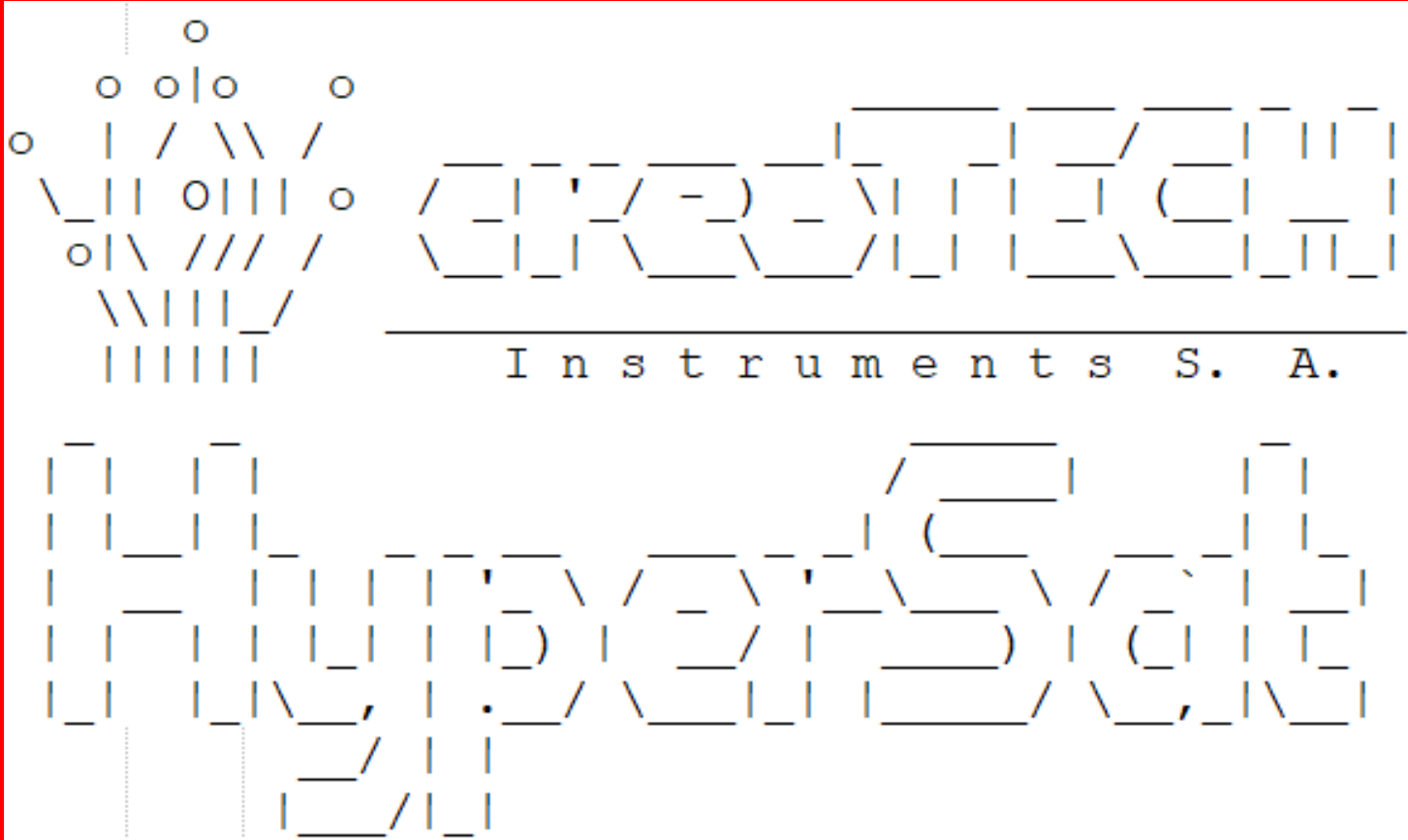
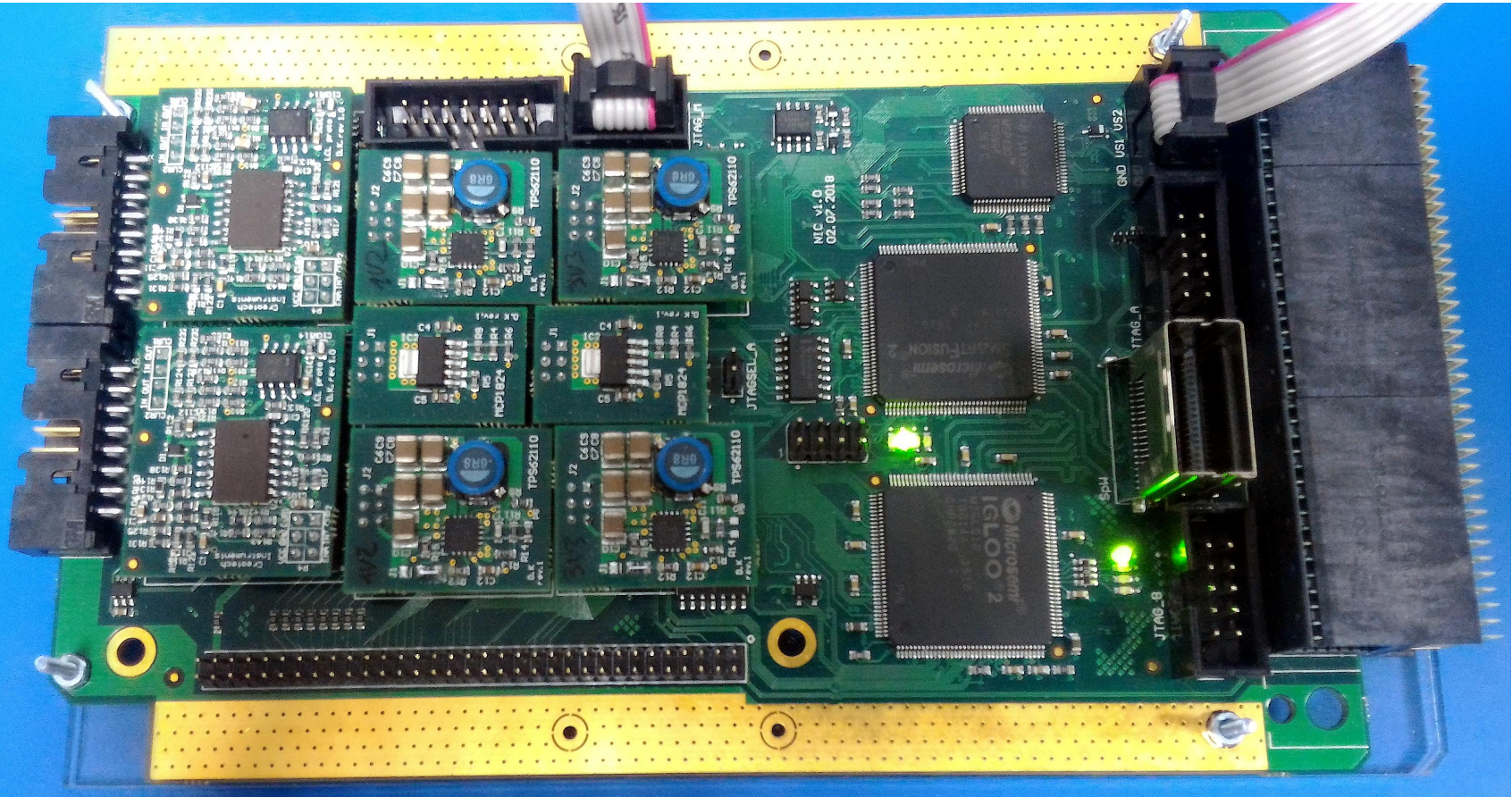


NIC – Laboratory Model 1



NIC – First Run

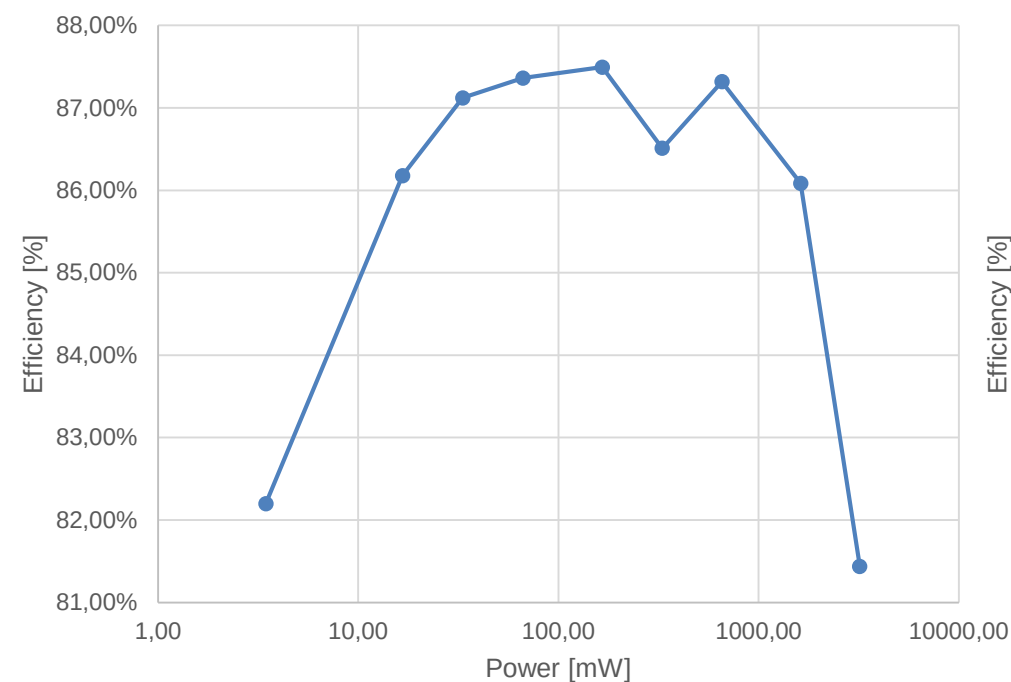
Power = 446 mW



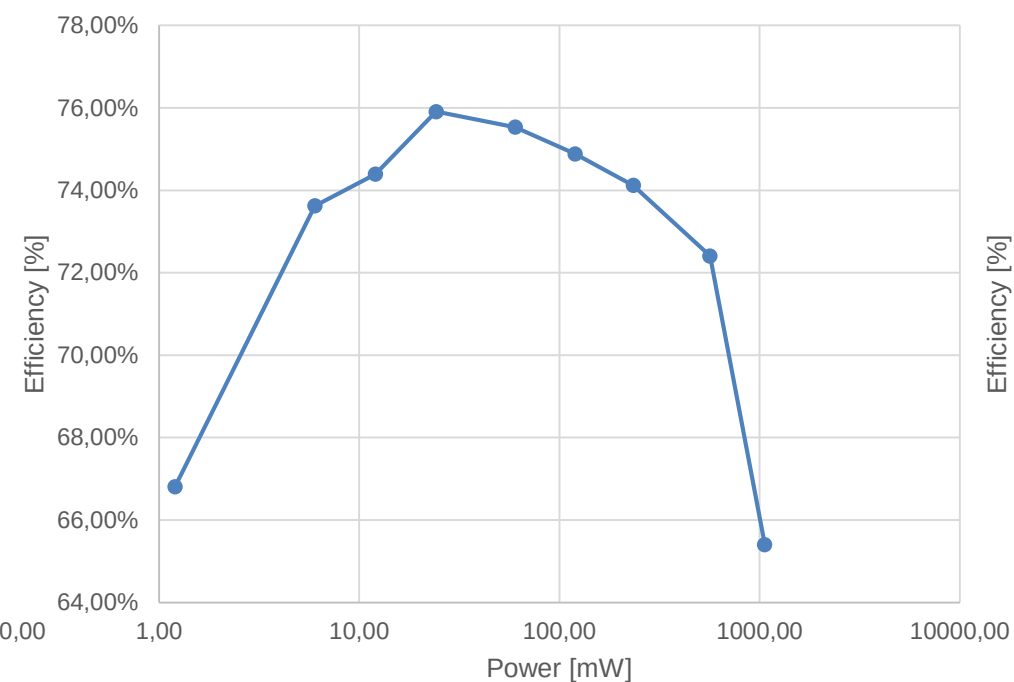
```
+-- GENERAL -----+
3V3_M = 7.9 mA
12V in = 11895 mV
12V A current = 20.7 mA
12V B current = 14.3 mA
+-- A SUPPLY -----+
3V3 = 3305 mV          CUR = 41 mA
2V5 = 2470 mV
1V2 = 1201 mV          CUR = 16 mA
+-- B SUPPLY -----+
3V3 = 3293 mV          CUR = 7 mA
2V5 = 2512 mV
1V2 = 1204 mV          CUR = 3 mA
+-----+
```


DC/DC converters efficiency

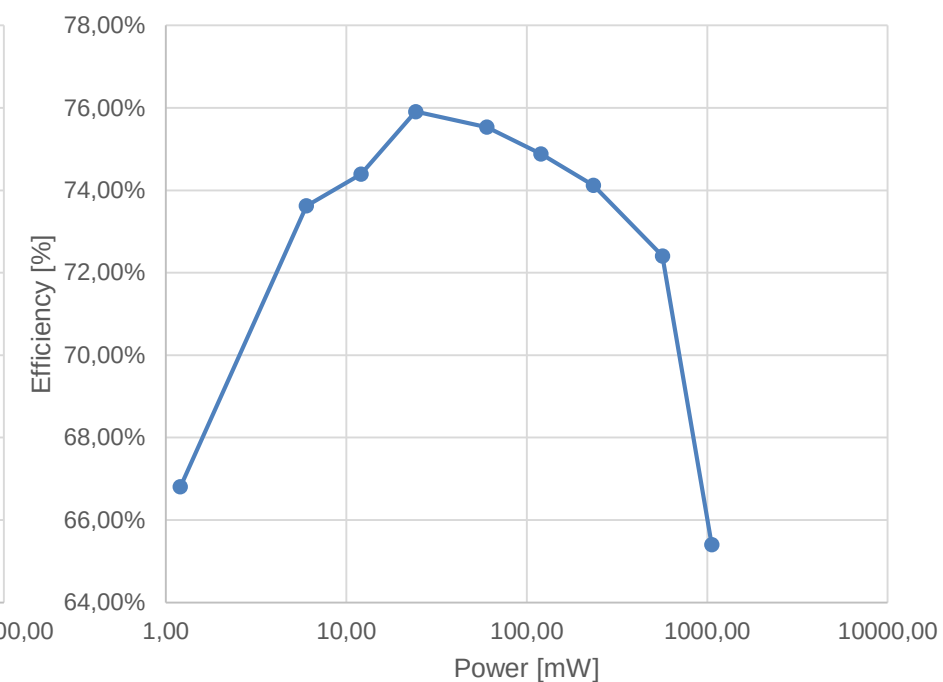
Efficiency TPS62110 3v3



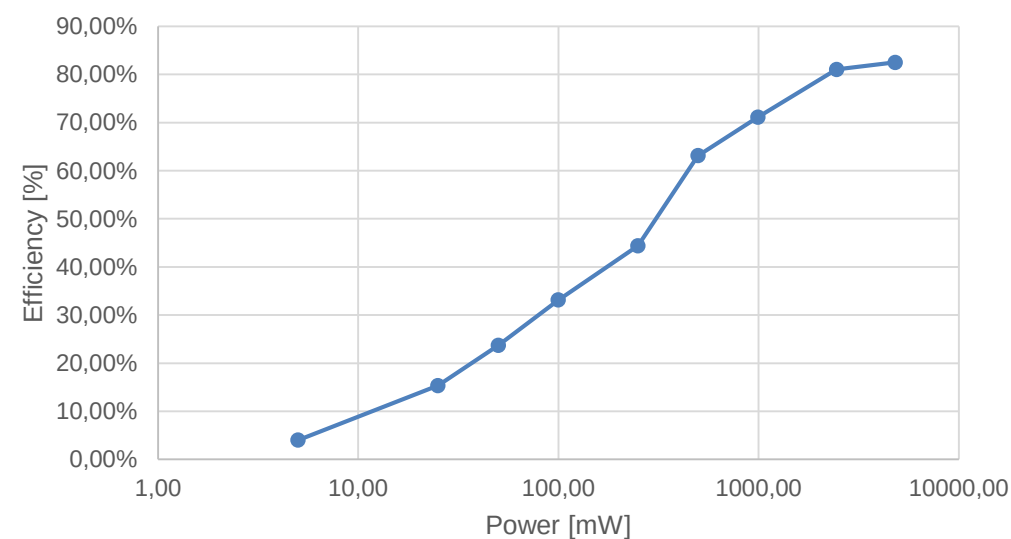
Efficiency TPS62110 1v2 (12v in)



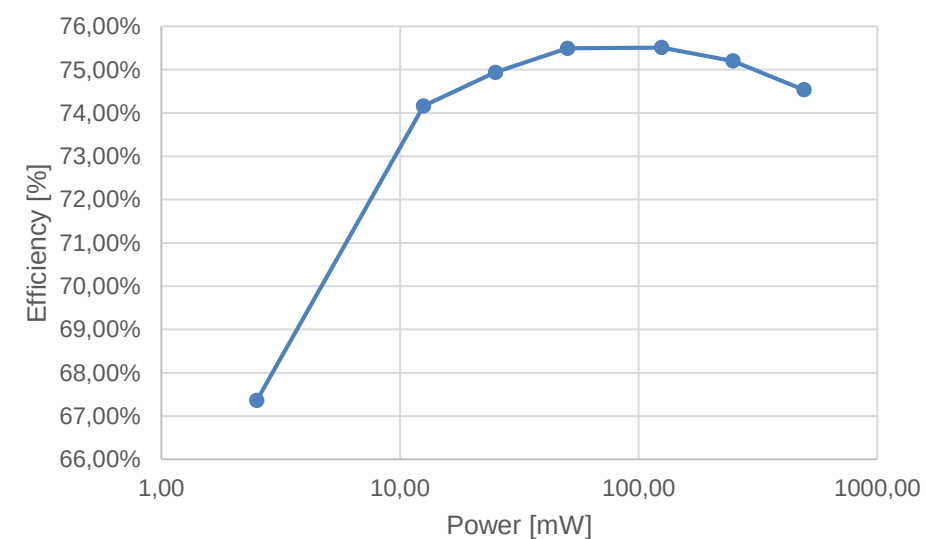
Efficiency TPS62110 1v2 (3v3 in)



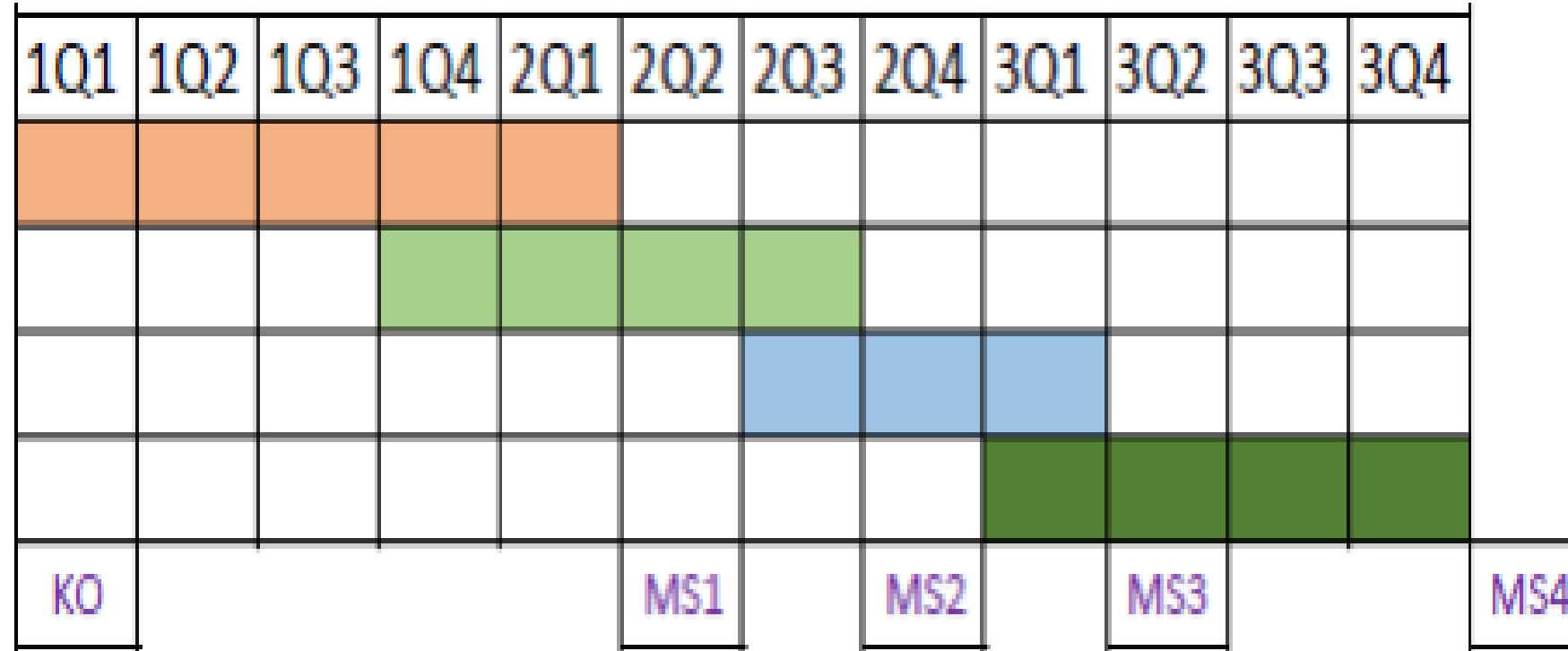
Efficiency TPS5420 5v (32v in)



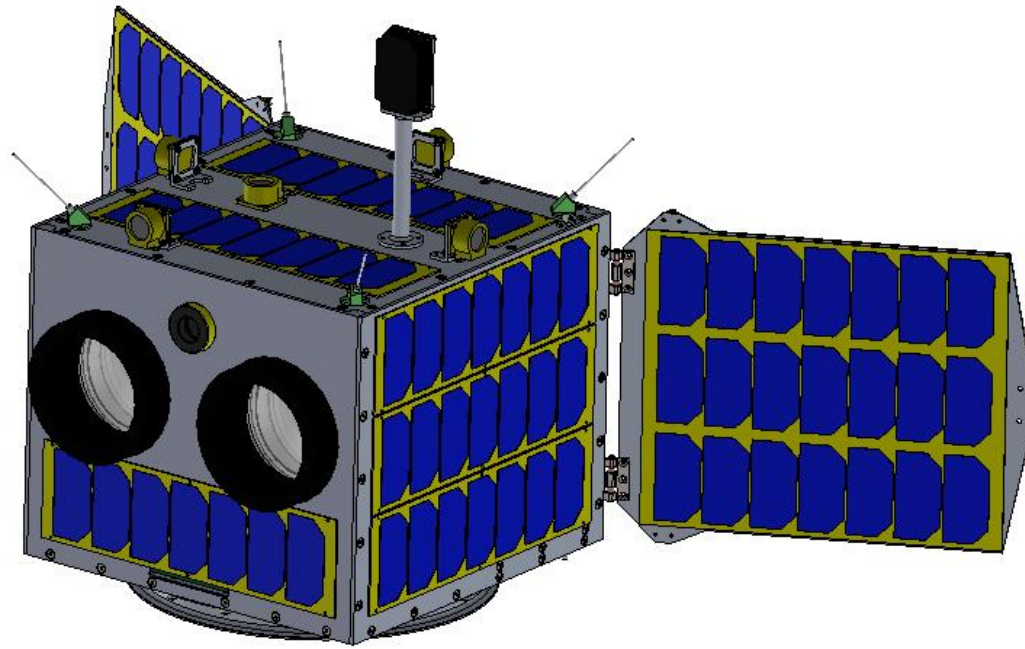
Efficiency MCP1824 2v5 (3v3 in)



TimeLine: 3 years for EM/QM

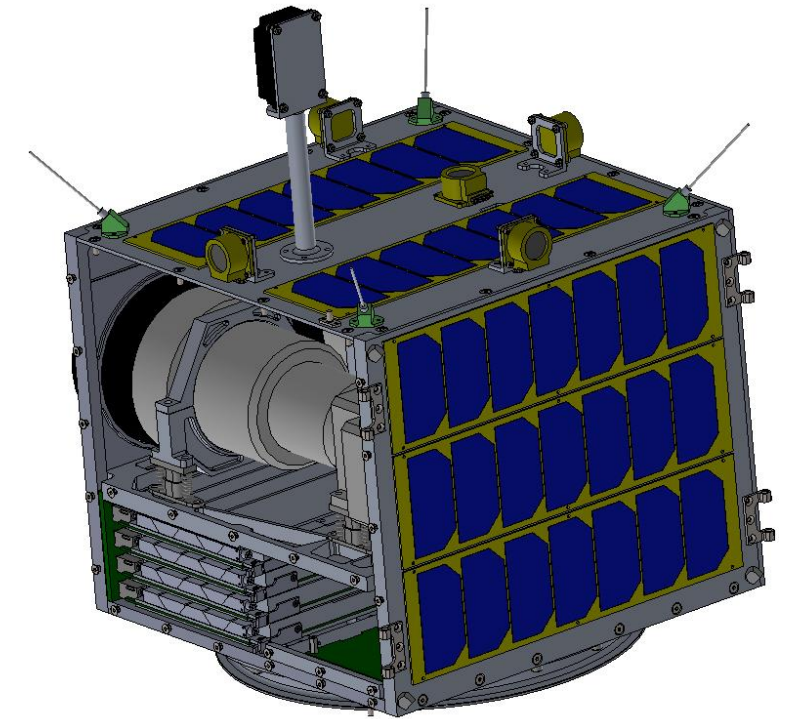


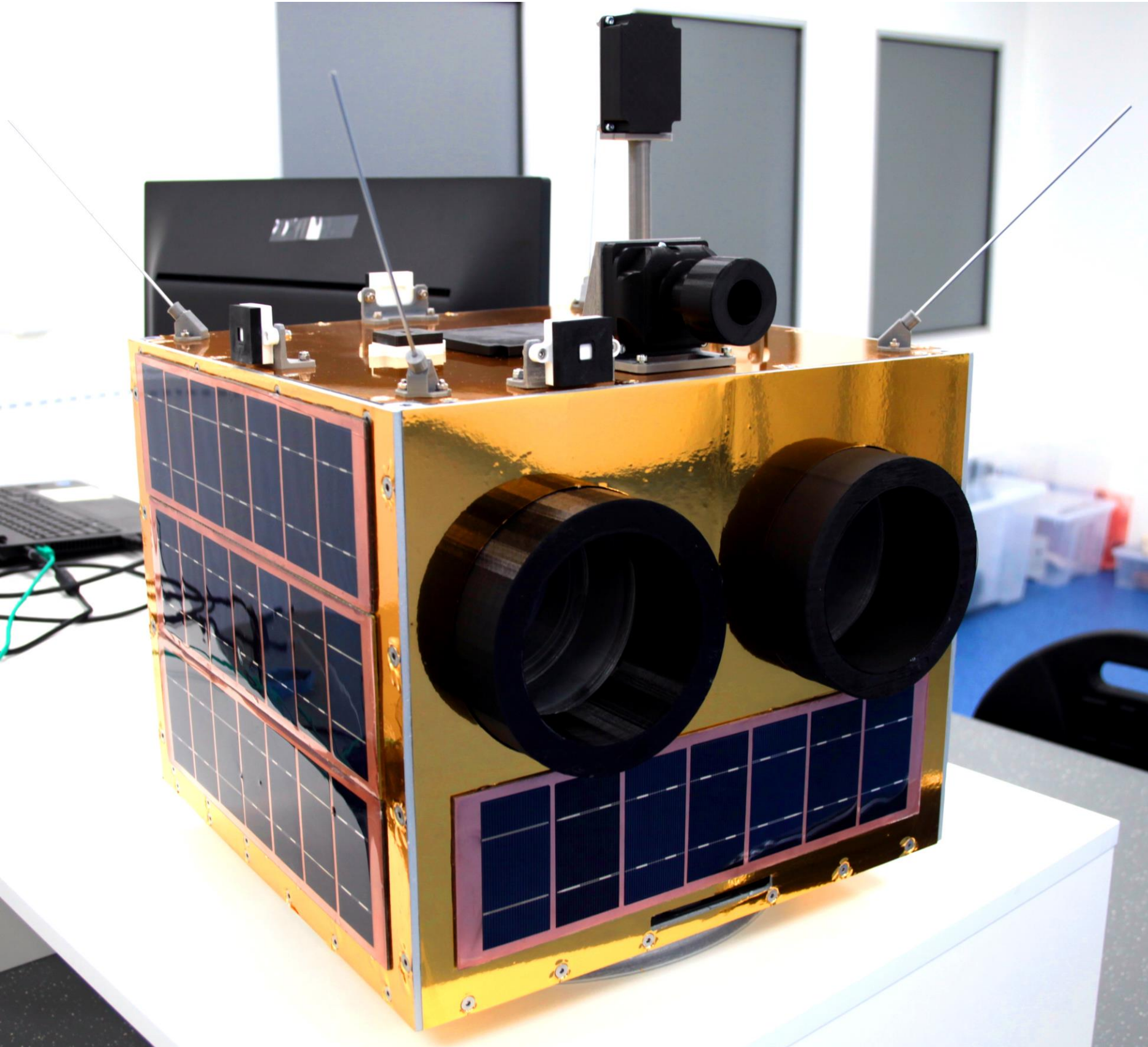
HyperSat Astronomical Multispectral Mission



General instrument parameters:

- Two cameras: UV, VIS
- Mass: 11kg
- Power consumption: 25W
- Storage: 200GB
- Required Energy per day: 250Wh





Summary

- Low cost - uses COTS with space heritage
- Easily reconfigurable, modular
- Configurable in orbit
- Fast turnaround time
- Open license software and hardware
- No ITAR-limited parts
- Space VPX standard to connect





<http://hyper-sat.com>

