

DESIGN OF PAYLOAD AND SATELLITE FOR LOW EARTH ORBIT MEGA-CONSTELLATIONS

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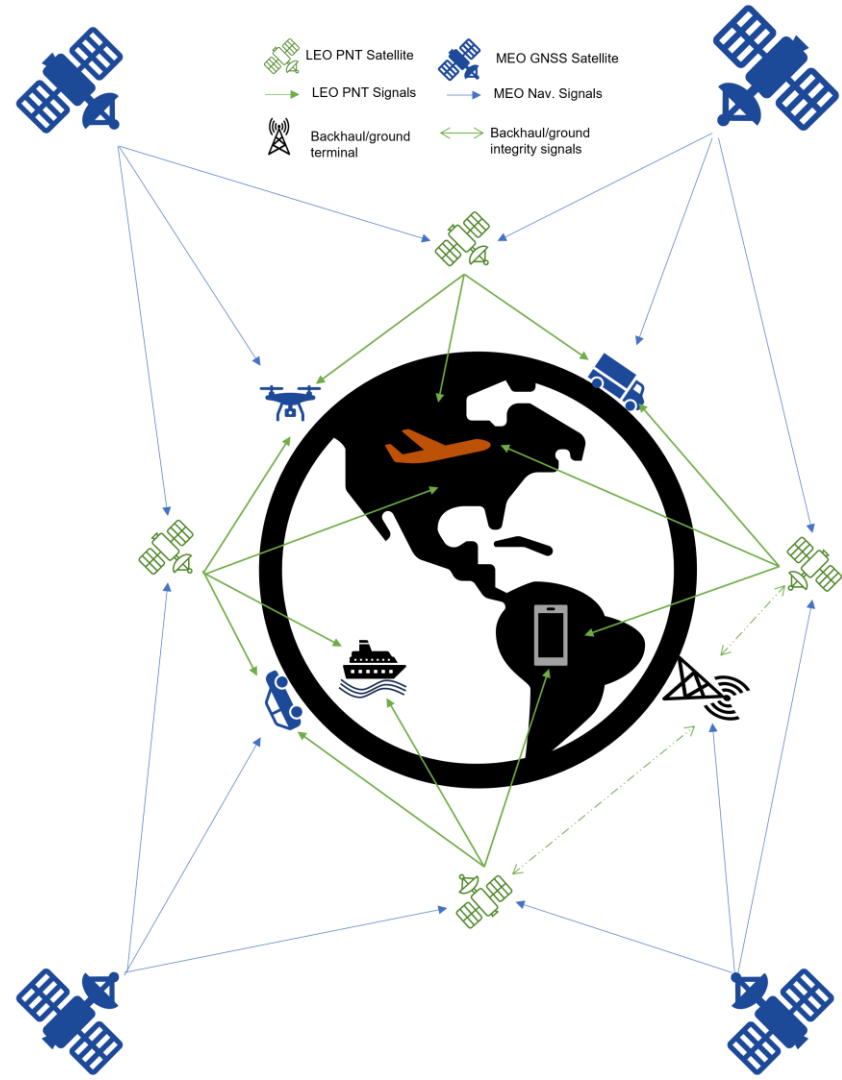
Motivation (Mission concept)

LEO PNT Constellation

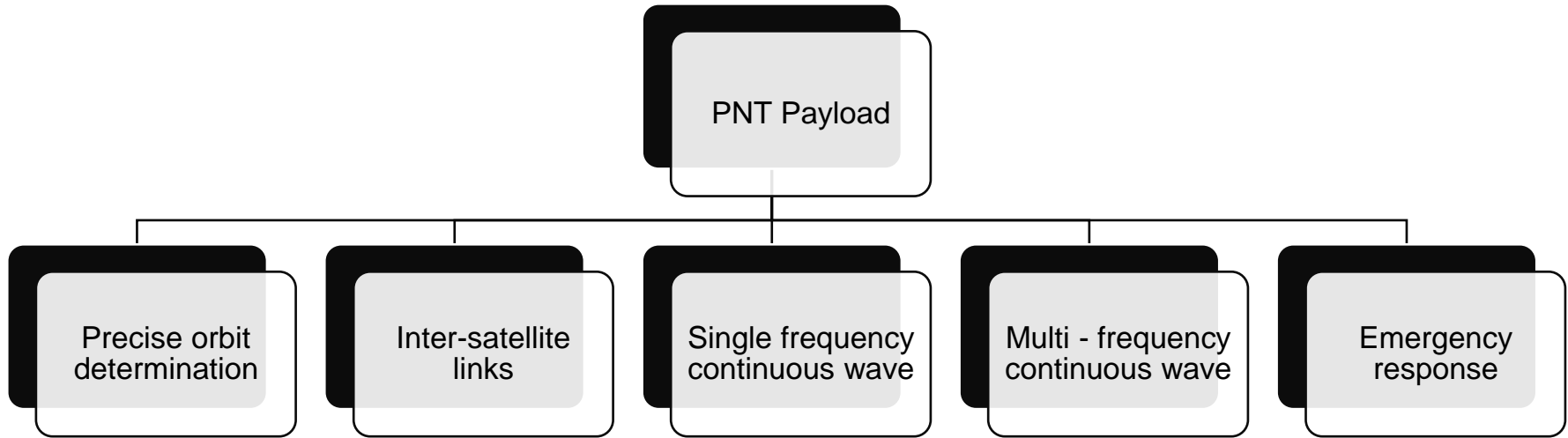
Novel PNT payload

- Multi-frequency navigation services
- Intersatellite links

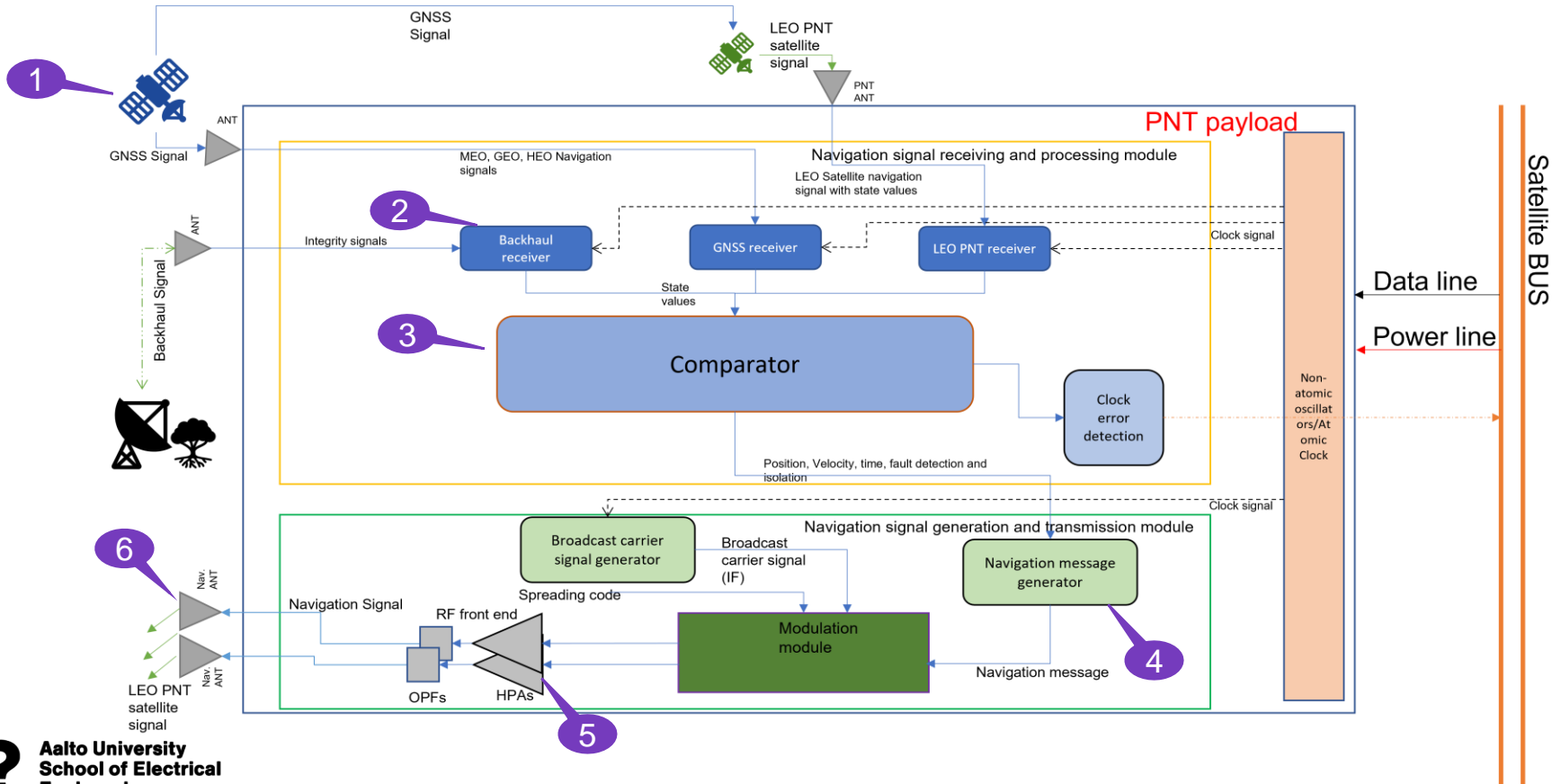
LEO PNT Satellite



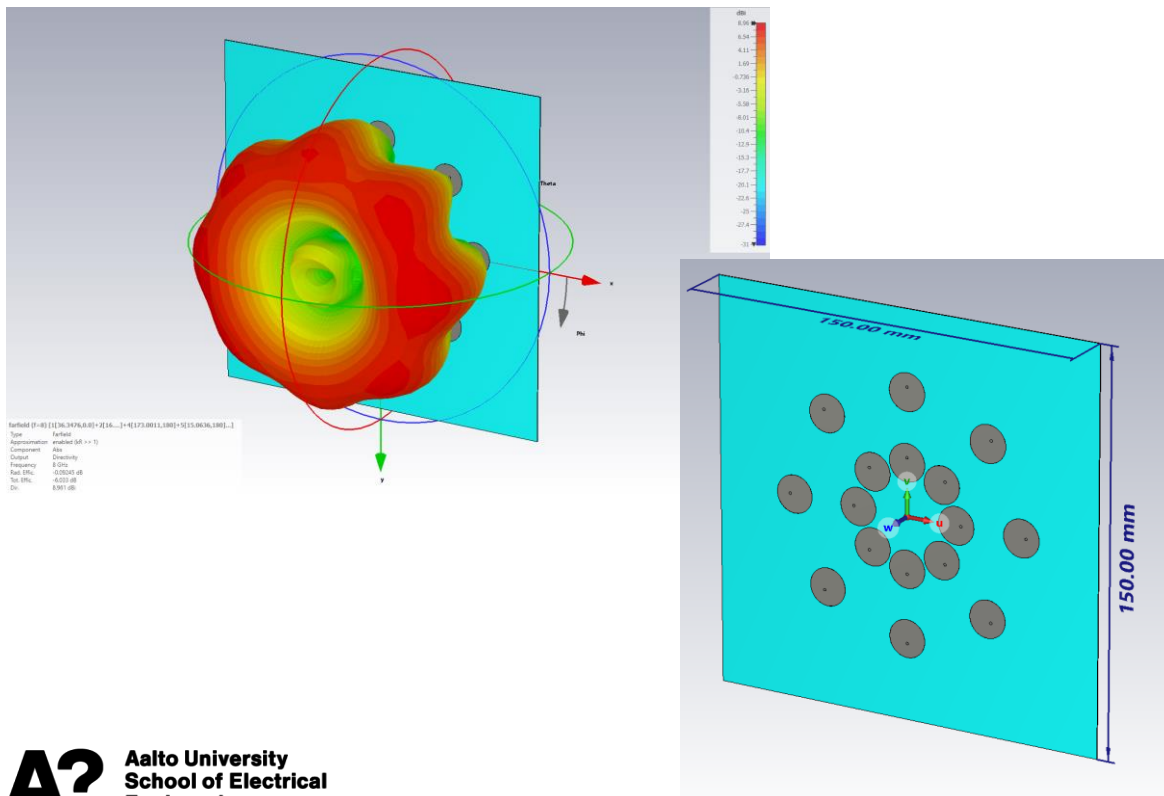
Payload functions



PNT Payload

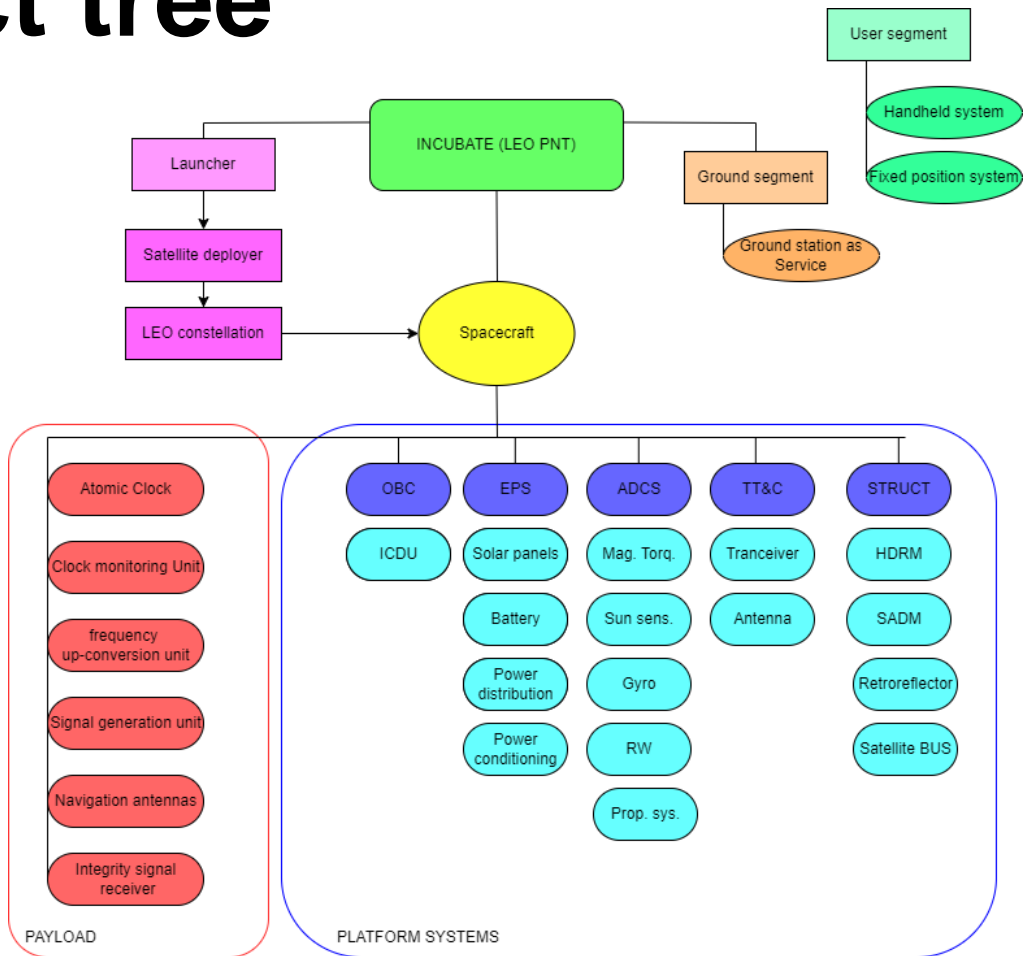


Navigation antenna



Characteristics	Value
Frequency	L, S and X band
Beamwidth	> 120 deg.
Gain	4, 7 and 13 dBi
Radiation pattern	Isoflux
Polarization	Circular
Dimension	150 x 150 x 3 mm

Product tree



Component selection



System	Selection	Activity	Quantity	Size (mm)
GNSS receiver and antenna	<u>OEM719</u>	Receive GNSS signals	2	46x71x11
Backhaul receiver and antenna	<u>TOTEM SDR</u>	Receive backhaul signals at UHF	2	
Navigation antennas	In house designed	Transmission	4	200x200x7
Inter satellite transceiver	<u>Nano-link</u>	Transmission and reception	2	95x91x10
Battery	<u>Ibeos-B28-825</u>	Power storage	1	95x89x98
EPS	<u>Ibeos</u>	Power regulation	1	96x90x14
Communication system	<u>TOTEM SDR</u>	SDR based Communication system	1	89.3x93x3
ADCS	<u>Reaction wheels</u>	3 axis Attitude control	1	96x96x57
Propulsion	<u>B1 thruster</u>	Orbit maneuvers	1	94x68x47
Data handling	<u>Nano mind A3200</u>	On board computer	1	65x40x7

Mass budget

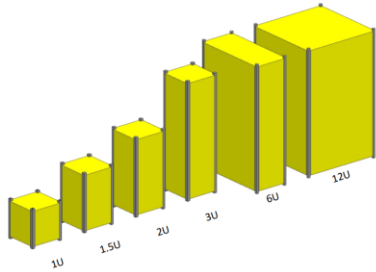


Figure 2: The Current CubeSat Family (1U – 12U)

Table 1: CubeSat Mass Specifications

U Configuration	Mass [kg]
1U	2.00
1.5U	3.00
2U	4.00
3U	6.00
6U	12.00
12U	24.00

<https://www.cubesat.org/cubesatinfo>

System	Mass (g)	Quantity	Overall mass (g)
GNSS receiver	31	2	62
GNSS antenna	12	4	48
Backhaul receiver	125	2	250
Backhaul antenna	30	4	120
LEO PNT payload	31	2	62
LEO PNT antenna	150	3	450
Intersatellite transceiver	170	2	340
ISL antenna	60	6	360
Electrical power system	6000	1	6000
ADCS	1150	1	1150
Propulsion system	260	1	260
Data handling system	24	1	24
Structure and solar panels	6000	1	6000
Total mass			15126

Power budget – nominal mode

Number of solar cells: 336

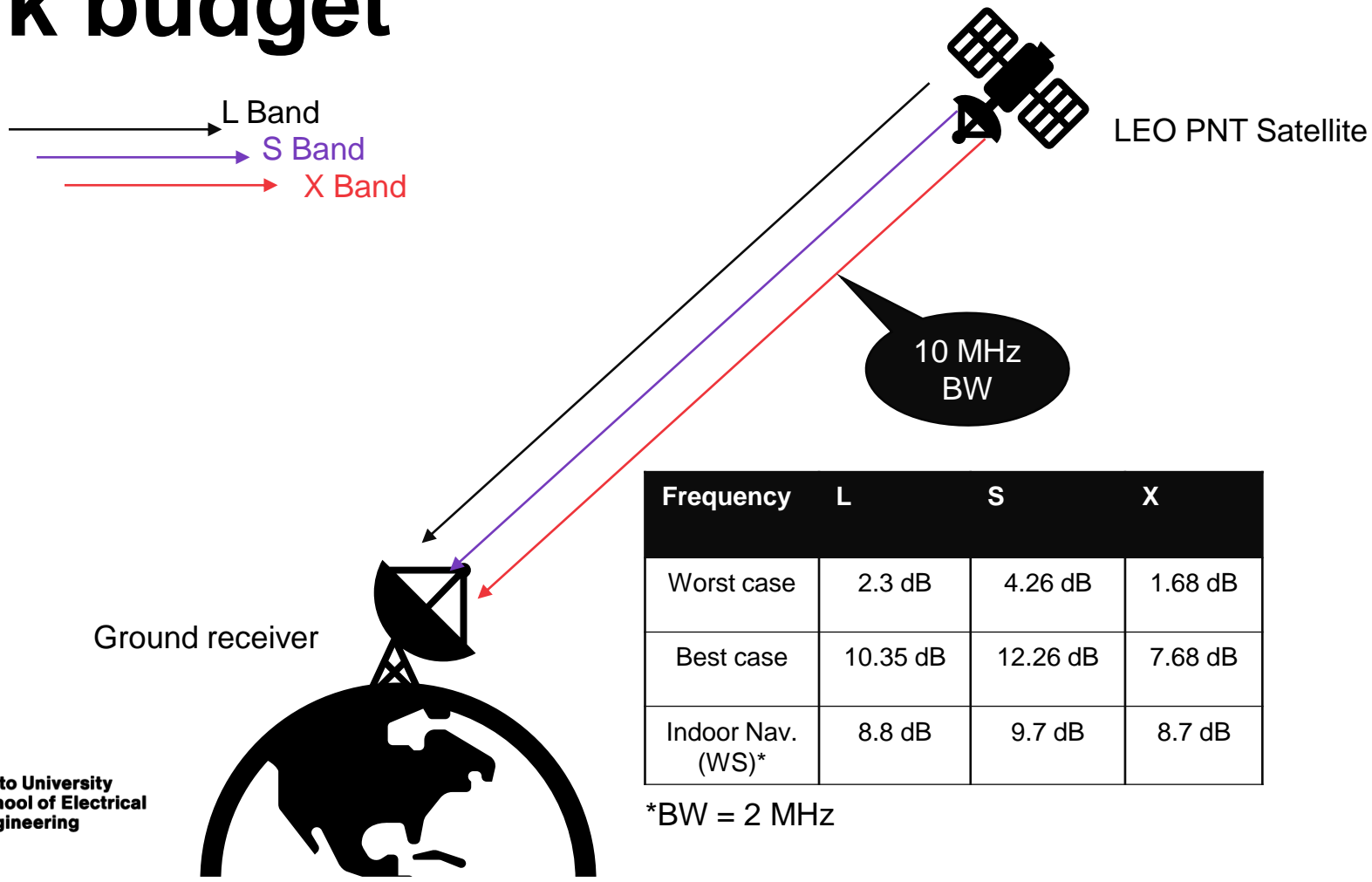
Power:

- BOL: 286 W/h
- EOL: 245 W/h

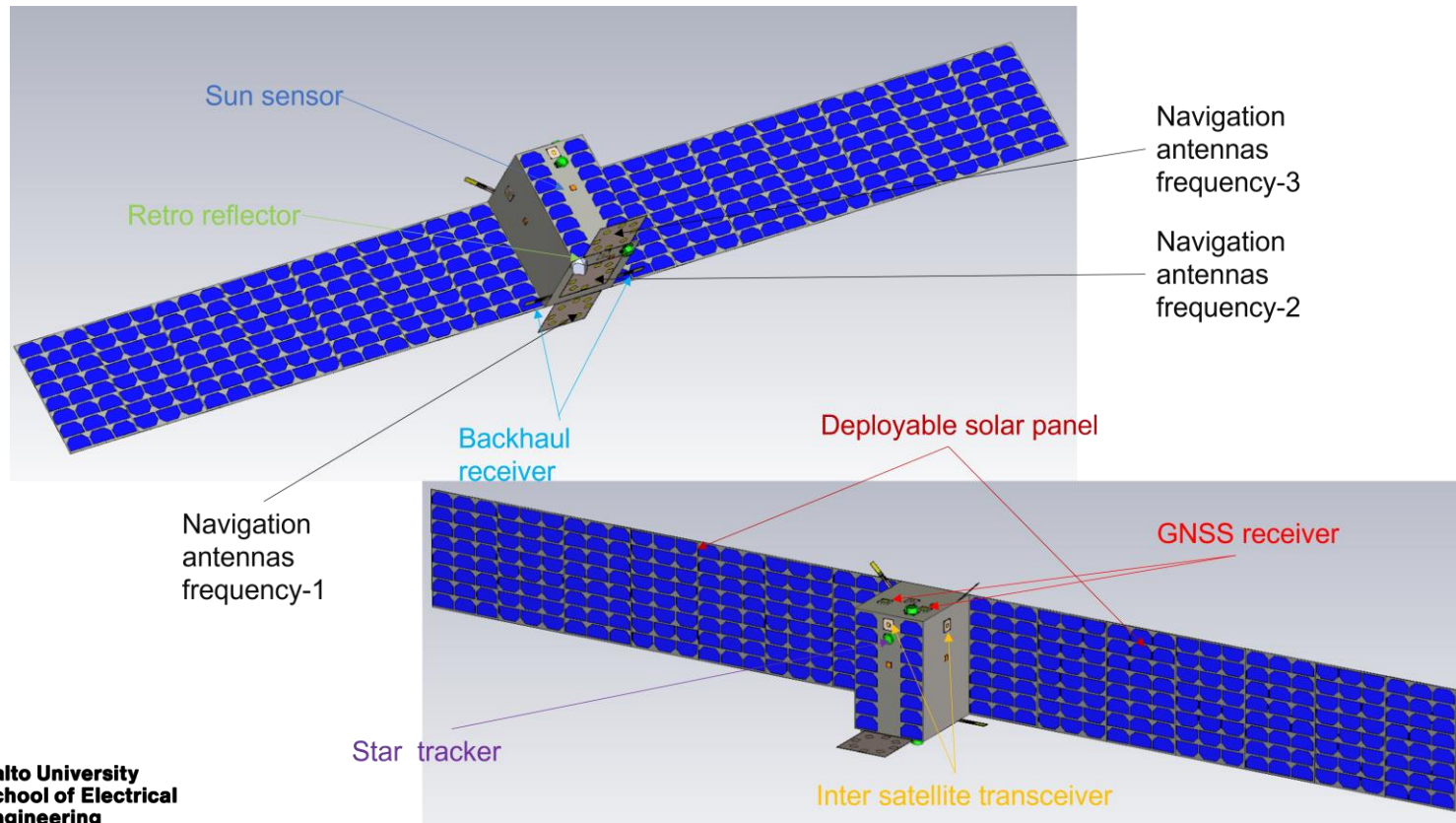
System	Power (W/h)	Margin	Overall power (W/h)
GNSS receiver	1.98	10	2.178
Backhaul receiver	2.31	10	2.541
LEO PNT payload (receiver)	2.2	10	2.42
Intersatellite transceiver	5.5	10	6.05
Navigation signal transmitter*	85	10	93.5
Power generation and distribution system	2.2	10	2.42
ADCS	1.1	10	1.21
Communication system	2	10	2.2
Data handling system	1	10	1.1
Total mass			113.618

* Reserved power, component selection pending

Link budget



Satellite concept design



Cost estimates

System	Selection	Cost (€)	Quantity	Cost Summary (€)
CMCU	<u>CSAC</u>	<u>2,000</u>	4	4,000
GNSS receiver and antenna	<u>OEM719</u>	<u>1800</u>	2	1,600
Backhaul receiver and antenna	<u>TOTEM SDR</u>	30,000	2	60,000
Navigation antennas	In house designed	2,000	4	8,000
Inter satellite transceiver	<u>Nano-link</u>		2	
EPS+Battery	<u>TITAN-1 350Whr Power Bank Module</u>	<u>53000 to 86000</u>	1	86,000
ADCS	<u>Reaction wheels</u>	58,000	1	58,000
Propulsion	<u>B1 thruster</u>		1	
Data handling	<u>Nano mind A3200</u>	<u>6,000</u>	1	6,000
Solar panels	<u>Endurosat & U panels</u>	11,400	4	45,600
Structure	Aluminum	1,500	1	1,500
Total development				270,700
Integration and Testing*				150,000
Launch *				300,000
Total cost				720,000

*Note: The values are estimates only

Thank you



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System level block diagram

