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TAKING THE PULSE OF OUR PLANET FROM SPACE
esa

Satellite Design for a Formation Flying L-band Aperture Synthesis mission

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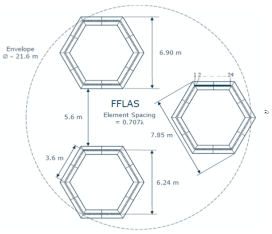
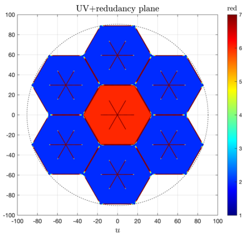
ESA's Soil Moisture and Ocean Salinity mission, **SMOS**, in operation since November 2009, is producing global maps of soil moisture and sea surface salinity with an average resolution of 40 km. In the context of a future L-band mission, it is necessary to address the future needs for a range of applications over land and ocean that call for much **enhanced spatial resolution.**

In this context Formation Flying L-Band Aperture Synthesis (FFLAS) mission focuses on the study of **aperture synthesis at L-band using formation flying as a potential way to increase the spatial resolution significantly.**

FFLAS mission concept consists of **3 hexagonal antenna arrays,** of about 7 m in diameter (slightly smaller size than SMOS), **each antenna hexagon with 24 receivers** per side and flying with their centres at the vertices of an equilateral triangle of about 13m side.



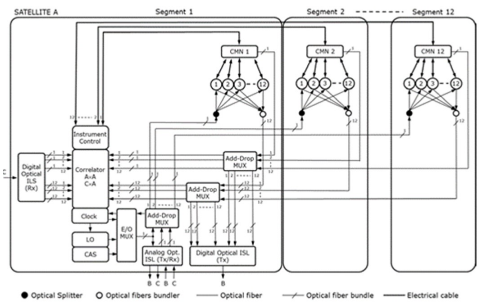


Such rigid formation would be **equivalent to an aperture of 21 m diameter achieving 9 km nadir resolution** with an effective sensitivity better than SMOS.

	Array		Spatial resolution (Nadir)	Receivers (per arm / total)	
	Shape	Envelope diameter		Number	Spacing
SMOS	Y-shape	8m	33 km	21/69	0.875 λ
FFLAS	FF of 3 Hexagons	3x 7,2m	8,8 km	24/432	0.707 λ

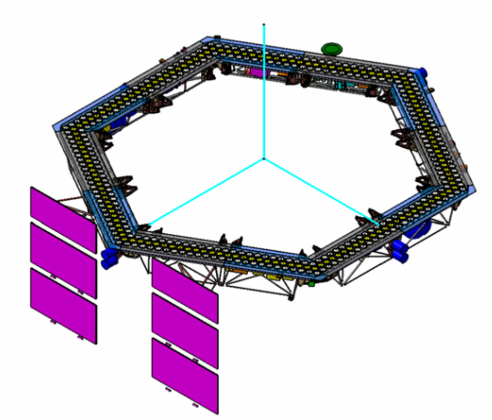
Each payload is a **fully-polarimetric two-dimensional aperture synthesis microwave radiometer** operating in the protected band of 1400-1427 MHz. This payload shall achieve, when operated individually, a spatial resolution of 26.6 km at nadir, 1370 km alias-free swath and 0.07 K per-pass effective sensitivity over ocean.

To achieve that, the spacing between radiating elements is s=0.70724λ=15 cm. The array has the shape of an hexagon with a mean diameter of D = 48s = 7.2 m (s being the spacing between elements) and a width of W = 7s×cos30 ≈ 91 cm. The array is segmented in M=12 identical (or symmetrically identical) segments. Along the centre line of the hexagon lies an array of N=144 receiver elements, distributed linearly in number of N/M=12 along each of the M=12 segments.



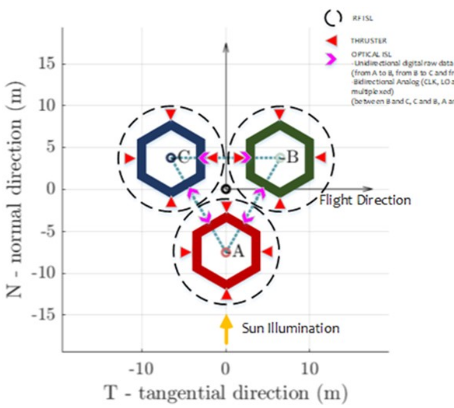
To embark such a payload a **deployable satellite** of 8.25m external diameter is designed. In **cylindrical stowed configuration** the base diameter is 4.5m with a height of 2.2m

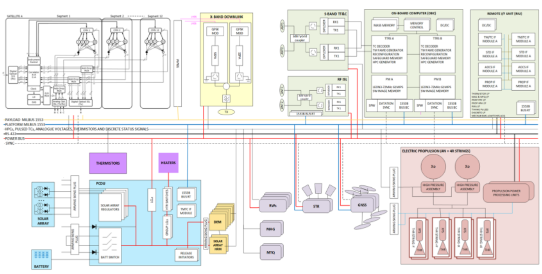
Throttled electrical propulsion up to 25mN has been selected as the **main actuator for formation flying** (FF)



autonomous operations. Such propulsion system can cope with the required delta-V of above 2 km/sec for rigid formation control over 10 years.

Concerning **relative navigation sensors,** the baseline assumes, as per the formation flying analysis, relative navigation performed by **GNSS carrier data differentiation on board.** GNSS raw data is to be exchanged between the satellites through a dedicated RF inter-satellite link (ISL), additional to the optical link required for payload raw data exchange.





The wet mass of the satellite is 1680 kg, compatible with an **Ariane 6 triple launch** of 3 identical satellites into a 6 am – 6 pm orbit of 775 km altitude by means of a dedicated S/C dispenser structure.

A new avenue to achieve a major **step in spatial resolution improvement in L-band passive remote sensing** has been explored **based on the lessons learnt and as a potential future follow up to ESA's SMOS mission**. The new approach consists of applying formation flying to the aperture synthesis concept, leading to the formation flying L-band aperture synthesis FFLAS system.