SWIM, A NEW KU-BAND SCATTEROMETER DEDICATED TO WAVES OBSERVATION

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The instrument SWIM (Surface Waves Investigation and Monitoring) on the CFOSAT program (Chinese French Oceanographic Satellite) is a state of the art radar for several reasons.

At first, SWIM is the first ever space radar concept that is mainly dedicated to the measurement of ocean waves directional spectra ([1-2]) and surface wind velocities through multi-azimuth and multi-incidence observations. Orbiting on a 500 km sun-synchronous orbit, its multiple Ku-band (13,575 GHz) beams illuminating from nadir to 10° incidence and scanning the whole azimuth angles (0-360°) provide with a 180 km wide swath and a quasi global coverage of the planet between the latitude of –80 and 80° ([3]).

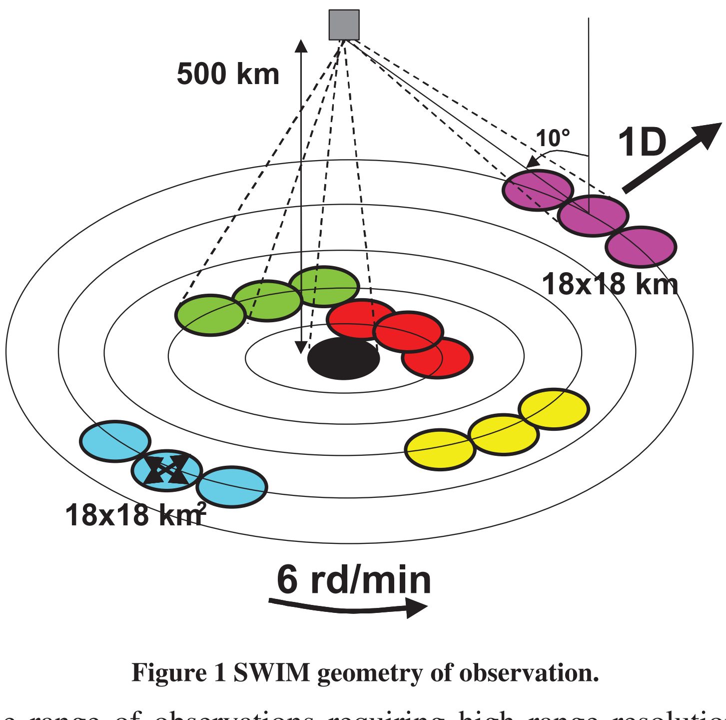

Figure 1 SWIM geometry of observation.

Secondly, such a wide range of observations requiring high range resolution (about 20 m on the ground) have led to design an instrument whose architecture and technology goes beyond what has been done on altimeter and scatterometer systems.

The global coverage and the reduction of telemetry budgets have required performing onboard range compression. The variety of signals at different incidences, the impact of the complex moving geometry of observation and the required real-time signal processing have led to propose onboard complete digital range compression on backscattered 320 MHz bandwidth signals. The design of the onboard compression and processing resulted from a trade-off between the instrument high level performances required, the needed correction for geometrical effects such as range migrations and performance of the acquisition and tracking loops.

Finally, multi-azimuth multi-incidence observations requirements have led to design an ambitious antenna subsystem that rotates at 6 rounds per minute while transmitting high power RF signals towards tunable directions.

Thales Alenia Space started in January 2009 under CNES contract phase B studies on the design of the instrument that have led to a System Preliminary Design Review in January 2010. We have now come out with a consolidated and detailed architecture of the instrument and are about to start the development (phase C).

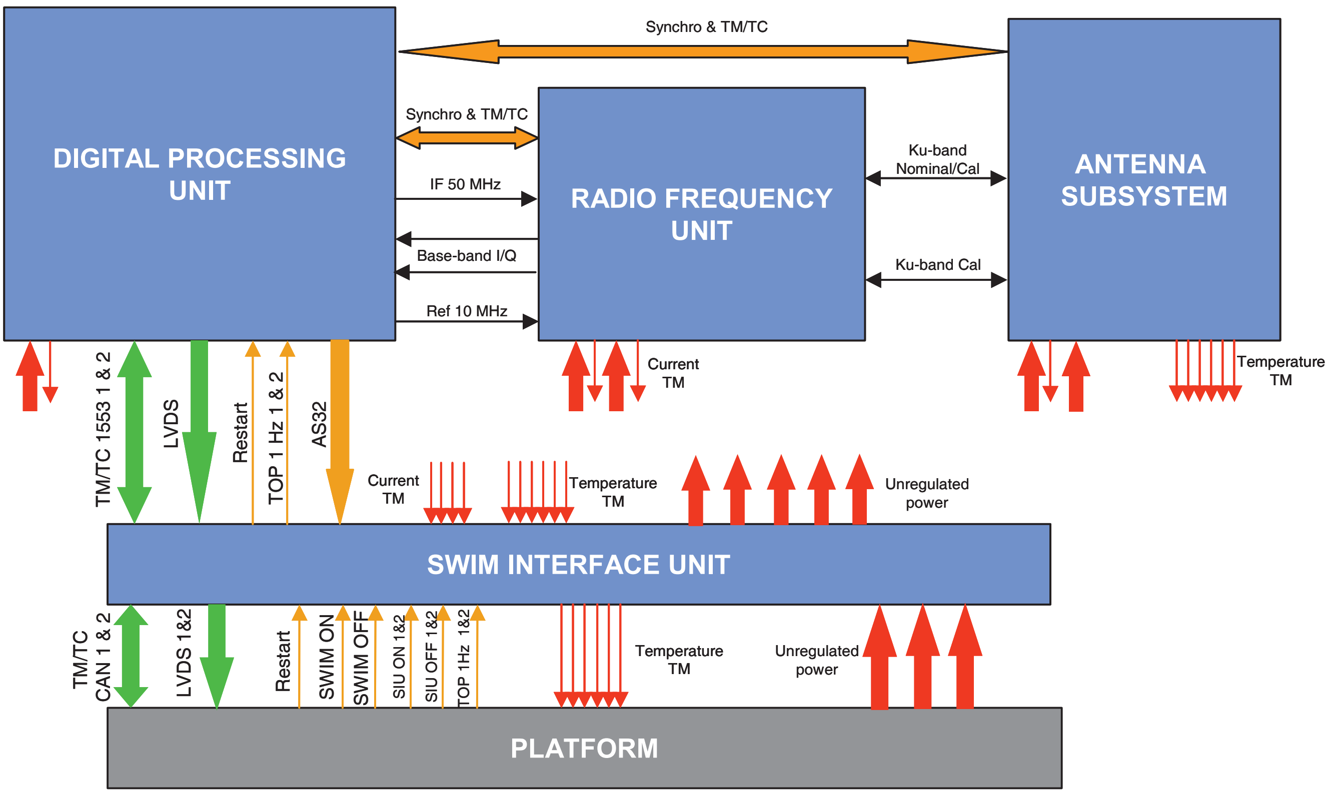

Figure 2 SWIM overall architecture.

This paper aims at giving an overview of the phase B studies that have been performed at Thales Alenia Space during year 2009 and that are now followed by the start of the instrument development through breadboarding.

A first section will quickly recall SWIM main parameters and operating modes that have been extensively described in [3]. A second section will then provide with the most update architecture coming out of the system preliminary design review, especially stressing the state-of-the-art improvements proposed on the Radio Frequency Unit (RFU), the Digital Processing Unit and the complex rotating antenna subsystem. A third section will look into detail on the Radio Frequency Unit which has been designed more compact compared to past radar products. A fourth section will deal with the Digital Processing Unit (DPU), characterized by a complex onboard processing performing digital pulse compression, range migrations correction and acquisition and tracking loops.

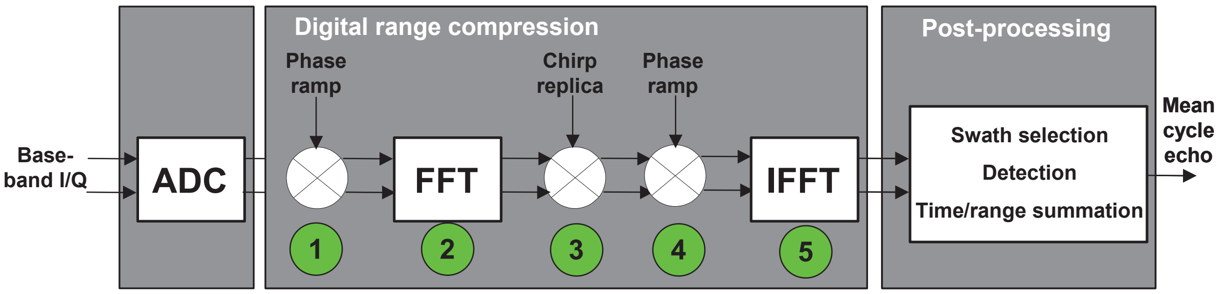

Figure 3 Main onboard processing in the Digital Processing Unit.

A last section will show outputs of instrument performances simulations, showing on the one hand the validation of the onboard processing, and on the other hand samples of radar echoes from which the scientific products (mainly ocean waves spectra) are retrieved.

The complex rotating antenna subsystem will also be extensively described in a side-paper submitted to the same conference [5].

Keywords: radar, instrument, architecture, RF, onboard processing, rotating antenna, performance, ocean wave,.

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