**KLARA: AN ARIANEGROUP-CNES INITIATIVE FOR MONITORING SATELLITE FRAGMENTATION.**

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**Introduction:** More and more objects are present in space, but what happens to them when entering the atmosphere? With the exponentially increasing number of satellites, it is essential to minimize the risk of falling elements in habited areas. To best predict what happen, it is necessary to predict with the highest accuracy the behavior of objects during their atmospheric reentry and destruction. Models exist for this, but observation and measurement in real conditions are not yet available. To this end, within the leagacy of the development of capsules from the Space Case family[1] [2], developed for different experiments in flight and calibration of multiphysical models, a version named KLARA is being developed in cooperation with CNES. This effort directly supports the needs identified in the CNES roadmap in the frame of the validation of DEBRISK /PAMPERO certification tool

**Figure 1. Atmospheric Re-entry of KLARA**

**Small capsule:** This very small capsule (< Ø200 mm), when embeded within a satellite, will aim at collecting a number of information and measurements during the destructive entry of its host, before transmitting them to the ground. This represents many challenges. Among the major design issues, the following subjects presented in this abstract can be evocated:

**Miniaturization of equipment**: It is necessary to be able to house electrical power in a small volume as well as a mother board and other peripheral cards. They have to sustain the mechanical loads during launch and re-entry environments as well as orbital electromagnetic threats. Three months in autonomy lifetime length is also a challenge.

**Stable shape:** In all aerodynamic phases, a stable shape allows avoiding the introduction of an attitude control systems, and guarantying communication link.

**Transmission of collected data**: The objective is to be able to transmit directly to the ground or via a constellation, the information collected during the fragmentation of the satellite but after the blackout phase. The implementation of antennas was also an important topic to tackle.

**Mastering of the center of gravity:** The structures of the Frontshield and the Backshield represent also an important work. The implementation of ballast must also be possible, to fulfil stability constraints

**Thermal protections:** An adapted thermal protection system, for a un-controlled atmospheric re-entry is proposed. Based on ArianeGroup's experience and available thermal protections, a material has been selected for the Frontshield. This material is the best compromise between density allowing a correct mass centering and inertia, thermal efficiency, and a reduced cost near net shape manufacturing process. Its theoretical ablation is a few millimeters. For the Backshield, an off the shelf radio transparency protection is selected efor its rapid manufacturing process and its thermal properties

**Conclusion:** The capsule design is being finalized.. The development program will involve tests using a balloon to verify the proper telemetry and communication, aerodynamic in free fall at subsonic and transonic speeds,.. After plasma tests, the KLARA capsule will undergo flight tests (on sounding rocket), with integration planned for 2028.


**Figure 2. SpaceCase Micro Re-entry capsule**

**References:**

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**Acknowledgments:**

This work is co-funded by CNES Research and Technology (R&T).