EDMon nanosat Payload: risk management implementation in hardware and software design

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NIMPH (Nanosat to Investigate Microwave Photonic Hardware) is a project led by the Centre Spatial Universitaire de Toulouse (CSUT) and involving several institutions and industrial partners which are Université Toulouse 3 Paul Sabatier, LAAS-CNRS, Toulouse Institut National Polytechnique (INP), Thales Alenia Space, IRT St Exupéry, iXblue, TRAD, Sercalo and CNES. The objective of NIMPH is to quantify the influence of solar and cosmic radiation on optoelectronic telecom devices through the measurement of the induced aging effect. NIMPH will carry two payloads. The first one, RadMon (Radiation Monitoring), will monitor the received instantaneous and cumulative radiation doses. The second one, EDMon (Erbium Doped Monitoring), embeds the main scientific experiment which consists in quantifying the gain and noise figure degradation of three different Er^{3+}-doped fiber amplifiers (EDFA) fully exposed to spatial environment (Fig. 1). The mission is expected to last two years on a sun-synchronous low earth orbit (LEO) crossing the South Atlantic anomaly.

To limit the development time and especially the cost, electronic functions surrounding the EDMon scientific experiment have all been validated with selected Commercial off-the-Shelf (COTS) components. Knowing the weaknesses of this approach with respect to radiation, a fault protection and recovery strategy must be implemented to limit the risk of mission failure. But this strategy must remain as simple as possible so as not to complicate the design of the electronic boards and the on-board software. The chosen approach will be presented during the symposium.

To design the embedded software, we use a model-based systems engineering (MBSE) approach. The software architecture and dynamic behaviors are defined in SysML (Fig. 2). In the NIMPH payload, electronic failures will be managed by software which makes possible to partition the electronic parts and allow operation in degraded mode. In partitioned mode, routine tasks cannot be performed because some failures can be significant. In this context of a constrained on-board system, the systemic study makes it possible to identify cases of failure, service levels, and the continuity of the mission.

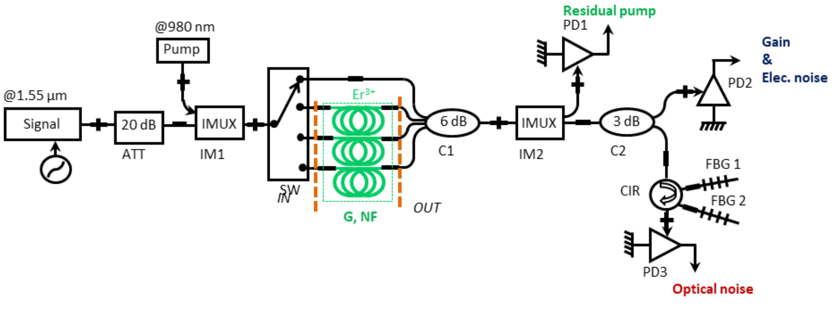

Figure 1: NIMPH/EDMon photonic payload

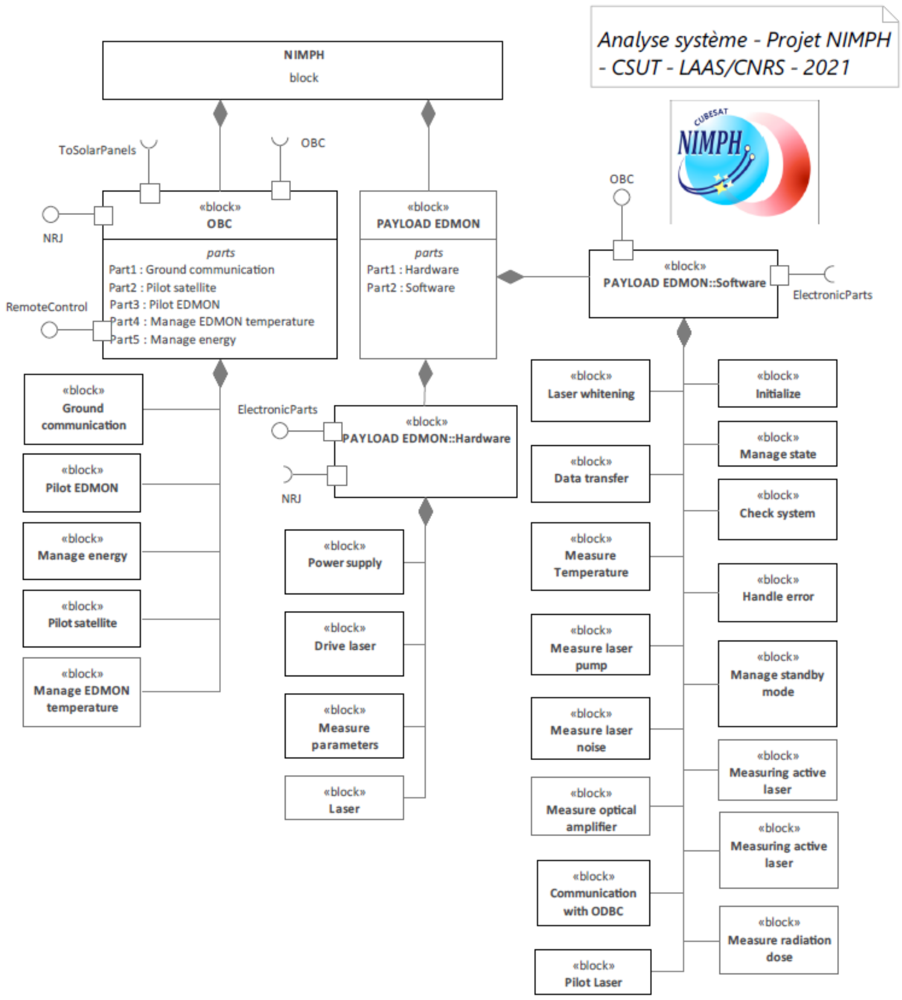

Figure 2: EDMon payload task scheduling

Preference for presentation: Poster

Symposium topic(s): Cubesat missions, Cubesat Subsystems and Technologies, Poster session

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