**PROMISE, PROgrammable MIxed Signal ASIC Electronics Framework**

L. Berrojo (TASiS), A. Alvaro (TASiS), F. Veljkovic (TASiS), P. Ayzac (TASiF), V. Lebre (TASiF), K. Tukkiniemi (VTT), J. Guilherme (IT), N. Horta (IT), R. Povoa (IT), L. Berti (IMEC), G. Thys (IMEC), D. Baramilis (ISD), Y. Dupret (Menta)

Topic:

Analogue intellectual property and re-usability of analogue circuits in space

Radiation-hardened technologies for analogue ICs

The PROMISE project gathers IC experts from 7 European institutions. This project has received funding from the European Union’s Horizon 2020 research and innovation program under grant agreement No 870358. It was launched in early 2020 and is planned to run for the next 3 years. PROMISE stands for PROgrammable MIxed Signal Electronics. It’s tailored to bring a flexible mixed-signal ASIC architecture design ecosystem built on a portfolio of silicon qualified hardened IP blocks to the space community. Moreover, the project is intended to provide a flexible mixed-signal ASIC manufacturing and qualification ecosystem. Last but not the least, PROMISE will deliver IP dissemination, commercialization and intellectual property management to allow efficient reuse of the project’s outcomes by all the space community, and will provide a design environment for new IPs and mid-range ASIC for space applications.

Space Market is living a mutation with the emergence of ‘New Space’, promoting integration/ miniaturization, satellite acceleration, cost-efficient and cost-reduction approaches for all mission types: Earth Observation, Science, Telecom, Navigation and Robotic Exploration. The market for mega constellations is in full swing and several initiatives promoted by different operators are already underway. Accordingly, middle range ASIC solutions are in competition with high performance/high capacity FPGA, new multicore devices and Rad Tolerant parts and COTS. In particular, Mixed Signal ASIC solutions offer functional added value for testability of electronic units and digitalization of full analog functions. The PROMISE project objectives are to optimize the design cost, shorten schedule and de-risk analog and mixed ASIC radhard design, manufacturing and qualification according to the needs of the space industry. PROMISE, led by Thales Alenia Space, encompasses diverse European partners, subcontractors, potential users or solution providers, all top actors of the European Mixed Signal ASIC ecosystem. The partners involved are: TASiS (in Spain who leads the project), top level SMEs as ISD (Greece) and MENTA (France), key technological institutes such as IMEC (Belgium), IT (Portugal) and VTT (Finland); and a leading satellite manufacturer as Thales Alenia Space in France.

PROMISE shall specify a modular architecture based on the DARE180X/XFAB XH018 0.18 micron Mixed Signal HV CMOS Technology that allows the end users to target both simple and complex applications of Mixed-Signal ASICs such as signal conditioning and acquisition, motion control, signal processing, signal synthesis and others. This architecture will pivot around a central eFPGA module that shall provide extra flexibility during the lifetime of the mixed-signal ASIC.

PROMISE shall design an IP library oriented towards the fast design of mixed-signal ASICs by the suitable aggregation of pre-validated modules with the minimum added specific circuitry. It will enable mixed-signal ASIC and ASSP approach. IP reuse will ensure a shortest and secured schedule and de-risk the design hardening for mixed-signal ASIC/ASSP.

As first population for this library, based on the proposed architecture, PROMISE shall design a set of Radiation hardened and reusable analog, high voltage and digital IPs that will cover the most common functions for data acquisition, conditioning, processing and control. This proposed initial portfolio of IPs shall cover, at least, the following functions:

* Digital IPs: Standard digital cells; Standard digital IOs; Non-Volatile Memory (NVM); Embedded Field Programmable Gate Array (eFPGA) core.
* Analog IPs: Analog to Digital Converter (ADC); Digital to Analog Converter (DAC); Phase Locked Loop (PLL); Low Drop Out (LDO) for digital core; BandGap (BG) with second order temperature compensation; Local Oscillator (LO) with no external component and consistent with CAN bus; Power On Reset (POR); High Voltage MOS transistors (HV).

All IPs shall be compliant with the radiation requirement defined within the project. PROMISE shall generate a library of IPs ready to be integrated into fully functional mixed-signal ASIC designs including the Qualified Radhard IPs: digital, analog and high voltage MOS transistors.

Those IPs will be embedded in the Pilot Circuit for electrical performances and radiation tests. The tests will provide:

* Measured Electrical compliance of the IP blocks through the electrical validation of the Pilot Circuit;
* Get the electrical Safe Operating Area for high Voltage MOS;
* Evaluated Radiation hardness of the IP blocks through the radiation evaluation on the Pilot Circuit.

As pursued by the H2020 work-program, this project will generate a new ecosystem fully based on European suppliers and open to all the European Space Industry. PROMISE will enable the development of complete mixed-signal System on Chip solutions for the next generation of space data handling and data processing units. These units, in turn will become the core of new space missions for telecommunications, Earth observation or space exploration. The project results will be presented to all the community on a specific workshop planned for late 2023.

The new PROMISE based circuits will position European space industry on the front line of the development of low cost solutions oriented towards the ‘New Space’ paradigm. As a consequence, the European space actors will be able to take the leading role in the development, production and operation of satellite mega-constellations which are of paramount importance in the XXI century space development. This leading role, assumed without the burden of third party technological dependence, will foster the growth of the European space sector both inside and outside our borders and will generate high quality employment and technological leadership multiplying the return to the European citizens of the investment provided by this H2020 initiative.