The H2020-SPACE-SIPHODIAS Project: Space-grade Opto-electronic Interfaces for Photonic Digital and Analogue Very-High-Throughput Satellite payloads

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ABSTRACT

The satellite market experiences a paradigm shift with the rise of VHTS that is challenging the capabilities of existing SatCom systems. Under increasing capacity and stringent SWaP requirements, primes are embracing a technology switch that relies on photonics. Thales Alenia Space is the first prime to introduce optical interconnects in a commercial digital processor and this is expected to open the opportunity for photonics penetration in every part of the satellite payload (P/L). However, the current critical photonic building blocks need to be further improved to deliver the big promise of future high-performance and low SWaP photonics-enabled VHTS. These are the opto-electronic (O/E) interfaces - transceivers, modulators and photodetectors - that are deployed in the highest volumes and interconnect equipment at the edge and within the payload. Their current performance in speed, bandwidth, reliability and, most importantly, in size and power consumption can be significantly enhanced. SIPhoDiAS aims to advance these components to address O/E performance, size and power, and at the same time, enhance their reliability and demonstrate parts at TRL 7, enabling photonic P/L systems that hit better SWaP targets. In this paper, we report the design and fabrication activities on the developed family of digital and microwave photonic components. Specifically, we report the design and fabrication of 25 Gb/s radiation hard (RH) VCSEL driver and TIA integrated circuits in IHP 0.13 um SiGe BiCMOS process. In addition, we present the development of 100 Gb/s (4x 25 Gb/s) digital optical transceiver sub-assemblies developed using flip-chip mounting of electronic and opto-parts on a hi-rel Borosilicate glass platform. With respect to microwave photonic links, we report the design of Ka and Q-bands analogue photodetectors that will be assembled in compact packages allowing for >4 times more bandwidth per unit area than the current state-of-the-art commercial products. Similarly, we will report the design of compact V-band GaAs electro-optic modulator arrays, which use a folded-path

optical configuration to manage all fibre interfaces packaged opposite direct in-line RF feeds for ease of board layouts and >three-fold mass and size benefits.