Drivers

In order to cope with depleting resources in orbital positions, satellite communication operators turn towards increasing capacity payloads, with higher number of beams and larger aggregate bandwidth. This trend is concurrently fueled by the demand for broadband communications. A new market based on broadband multimedia services, such as HDTV, Video On Demand and Triple Play is already emerging.

Operators expect that future broadband space systems will offer high data rate connections to very large numbers of low-cost terminals. Only satellites with very large capacity will be able to achieve affordable communication prices and the business case now suggests a trend towards large satellites with as much capacity as possible.

New satellite payloads need to be designed to meet such requirements of larger bandwidth, system transparency and flexibility. In this rationale multi-beam satellites have already been developed and have been launched recently, exhibiting large size and electrical power consumption to deliver tens of Gigabits of capacity.

The ROBIN project focuses on leveraging the capabilities of photonics and create new opportunities for space-born optical interconnects for transferring massive amounts of data between boxes, boards, modules and ASICs quickly, efficiently and at low cost.

Aim

Multi-Gb/s, multi-core, embedded optical modules for board-level high-speed interconnectivity: ROBIN will demonstrate packaged and pigtailed multi-core, vertically emitting/detecting modules for high throughput on-board digital processors. The employment of the multi-core fibre will enable for the first time fully hermetic single fibre feed-through packaging with enhanced reliability against state-of-the-art solutions that rely on vertical ribbon connectors. ROBIN will demonstrate for the first time a VCSEL-based solution delivering up to 150 Gb/s aggregate bit rate through a single optical fibre which corresponds to a 3-fold increase in aggregate bit rate compared to state-of the-art harsh environment products and demonstrate <10 mW / Gb/s.

Objectives

Advanced electro/photonic vertical integration platform for harsh environment

embedded opto-electronic engines: High performance and high reliability photonic components will be implemented by advanced integration technologies based on low-temperature co-fired ceramics (LTCC) circuit substrates. High-precision bonding and assembly as well as novel LTCC-embedded alignment structures will be used to achieve the required micron-scale optical alignment for multi-core optical fibres. When combined with metal lids/packages and MCF novel hermetic optical feed-throughs, low-weight and robust optoelectronic modules are implemented for space requirements. The integration and packaging platform will be directly suitable both for stand-alone multi-channel optical transceivers and for ASIC/FPGA packaging with embedded optical interconnects.

Multi-core compatible and energy-efficient harsh environment vertical photonics: ROBIN will fabricate energy efficient and extended temperature GaAs 850 nm VCSEL and photodiode arrays and match them to the core geometry of multi-core fibres. Within the project, component bandwidth will be further upgrade to >23 GHz (VCSELs) and >30 GHz (PDs) at temperatures as high as 85 degC addressing long term upgrade steps. The GaAs material and ULM manufacturing process are selected due to their proven radiation-hard performance, maturity and readiness for foundry-based industrial mass fabrication.

Low-power multi-channel VCSEL drivers and TIA ICs: ROBIN will fabricate multi-channel driver ASICs and will adapt them for co-integration and RF interconnection with the active photonics on the LTCC platform. The ICs will be developed for operation as high as 25 Gb/s. Multi-channel ICs will be integrated, reaching a total chip throughput of 150 Gb/s. The ICs will be the first radiation-hardened multi-channel driver operating at up to 25 Gb/s and with a 5-fold reduction in energy consumption against 10 Gb/s state-of-the-art rad-hard ICs. The ICs will be fabricated using IHP SiGe BiCMOS process which is suitable for electronics production for aerospace applications.

Radiation-hard multi-core multi-mode fibres: ROBIN will develop the first radiation-hardened multi-core multi-mode transmission fibres and will couple them to ROBIN opto-electronic chips. Advanced Modified Chemical Vapor Deposition (MCVD) technology will be employed for the fabrication of these fibres to precisely control the index of refraction of each fibre and enable up to 25 Gb/s multimode transmission.