

SPACE SYSTEMS SYMPOSIUM (D1)  
Enabling Technologies for Space Systems (2)

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FIBER OPTICS: AN ENABLING TECHNOLOGY IN SPACECRAFT ENGINEERING

**Abstract**

The European Space Agency has engaged since 2002 in a comprehensive program investigating the applicability of fiber optic technology in satellite and launcher engineering. Fiber optics have the distinct properties of being dielectric, lightweight, low volume and mechanically flexible that make them extremely useful in an intense EMI environment that operates minimalistically in power consumption, launched-mass and volume like this of a spacecraft. In addition, when used as the communication medium, fiber optics offer practically un-limited bandwidth with lossless transmission. They can also be employed as sensors offering high level of multiplexing and operating in intense EMI environments while they can convey safely power in pyrotechnic applications in launchers. This makes them an enabling technology for a number of applications.

Fiber optic based solutions have been developed for all types of digital communication links in the spacecraft. OHB's so-called "Small-GEO" will be the first Telecom satellite to use optical fibers for the Telecommand links. ESA funds the development of photonic transceivers for Multigigabit links in High Throughput Telecommunication Processors where planned satellite capacity of 50 Gbps leads to Intra-processor traffic of several Tbps. Only such optical links can convey efficiently such traffic. Results from very recent ESA studies depict that the complexity of such Payloads measured in number of PCBs and Equipment boxes can be reduced by 70% when optical links are employed for IC to IC communications in the same or in different PCBs. Analog fiber optic links for the distribution of the LO signals are also developed as they allow significant mass savings and remoting the units from the FGU. Furthermore, incorporating optical switching by means of MEMS that switch optical beams from and to optical fibers enables opto-microwave Payloads. Fiber Optic Sensors have been developed for all type of monitoring needs. ESA's technology demonstration satellite PROBA II, launched in November 2009 is the first one to demonstrate the use of this technology in orbit in monitoring its propulsion subsystem.

The technologies described above are at TRL4/5 and the effort over the coming 5 years are to qualify them to space-grade. As the introduction of fiber optics in S/C gains ground novel ideas are considered like the high throughput "Photonic Payload" and the "Photonic-Wired Smart Panels" where all communication and sensing wiring is embedded in the S/C panels providing "photonic sockets" for interconnection with the equipment boxes in an effort to reduce the costs involved in S/C AIT.