picoRTU-Demonstrator (PECS activity)

For several years space industry and agencies have been recognizing the need to increase the level of standardization, interoperability, and modularity on S/C avionics systems and their subsystems to increase overall efficiency of space programmes by lower the development efforts and shorten the schedules. Beside essence of higher interoperability and modularity between S/C subsystems, space industry also faces another inevitable demand of extending the lifetime of avionic platforms and to find ways to reduce funding in less critical systems by pursuing more commercial parts and manufacturing processes. As a solution to these challenging objectives, SkyLabs has developed new approach of Remote Terminal Unit function, i.e. an intelligent distributed picoRTU system.

picoRTU system addresses the objective of technology reuse, whereby standardised building blocks are developed once and used across multiple missions. Such an approach requires the rationalisation of system/subsystem architectures as such that the recurring picoRTU units may be identified and functionally specified along with the interfaces and protocols for interconnection. Decentralisation of S/C avionic systems is strongly pursued to achieve Technical Dossier objectives. Decentralization of a system decreases overall system complexity of avionics, simplifies harnessing and consequently reduces the S/C mass. Furthermore, development efforts, and efforts required for assembly, integration and verification during the AIV phase are also lower. In addition, long term expenses like future upgrades and scalability expenses become lower with proposed picoRTU system.

Within the activity a miniaturized intelligent picoRTU demonstrator unit was developed, with a mixed set of ECSS compliant spacecraft discrete interfaces in order to demonstrate applicability of such overall distributed approach. An intelligent distributed picoRTU system primarily offloads main S/C computer from analogue and discrete digital data acquisition and actuators control tasks. Intelligent picoRTU system provides to main S/C computer an information and not raw samples data and this approach truly represent a distributed system. Despite the modularity standardization path, SkyLabs demonstrates how its core technologies can present added value in next generation RTUs. However, these technologies represent an added value also many other applications such as: propulsion system control, sensor bus control, robotics applications control, simple motor control, mechanism control, power control, particle detector, instrumentation, radiation environment monitoring, thermal control, antenna pointing control, AOCS/GNC (Gyro, IMU, and MTM), etc.

picoRTU demonstrator is based on a single commercial radiation tolerant FPGA, with EDAC protected external code memory. System-on-Chip implementation incorporates SkyLabs's small PicoSkyFT processor core, which is Fault Tolerant and Radiation Hardened by Design. PicoSkyFT within picoRTU demonstrator enables local intelligence for simple computations, data acquisitions, health monitoring, controlling, communication, and on top of that still ensures high determinism where required. picoRTU interoperability on Remote Terminal Interface is provided by utilizing standardized redundant ECSS CANbus extension protocol. In such a way, interoperability between supplier equipment is enabled, as well across different equipment suppliers. picoRTU system enables its utilization as either a standalone unit or, using a stacked modular approach, as a collection of interconnected units. The system enables ease stacking of the units, where power bus and RTI is shared over internal extension connector, but only one of the stacked units provides external RTI. picoRTUs do not require any reconfiguration to operate in stacked or standalone operation mode therefore autonomous "Plug-and-Play" approach is assured. picoRTU system feature list is concluded with intuitive picoRTU-EGSE software. The tool enables initial parameterization of picoRTU firmware, verification of picoRTU user interfaces and their real-time analysis and monitoring.