skylabs

ATTM based on CANopen (ESA contract no. 4000140838/23/NL/GLC/adu)

ATTM CANopen - Product Development: Executive Summary Report

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The ATTM transceiver (attm-link-base-sb-1) is designed for receiving and transmitting high data rates over large distances, while maintaining small size and mass and being the most power efficient product in its class. Highly miniaturised, ATTM features in-orbit programmable SDR architecture, which enables the incorporation of various modulation schemes. High reliability is ensured via carefully selected parts and combined with an advanced FDIR approach that supervises the SDR logic and other critical parts of the subsystem. The full duplex communication subsystem is compliant with the SkyLabs CCSDS protocol, while supporting configurable modulation parameters and data rates. A highly efficient add-on RF amplifier module (ATTM boost) is available which boost the RF output power and together with ATTM is called ATTMboost (attm-link-boost-sb-2). ATTM features standard TM/TC channel via hot redundant CAN buses and a high speed LVDS interface.
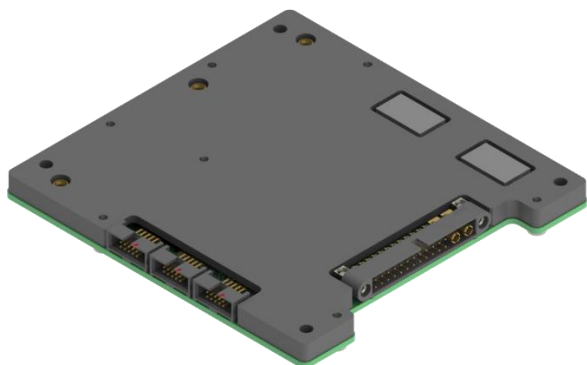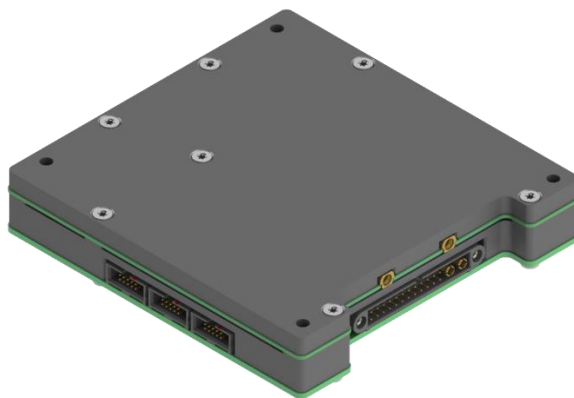
Figure 1: ATTM (attm-link-base-sb-1)	Figure 2: ATTMboost (attm-link-boost-sb-1)

ATTM device currently supports CAN-TS communication protocol over CAN bus. In this project we replace CAN-TS with more widespread CANopen protocol.
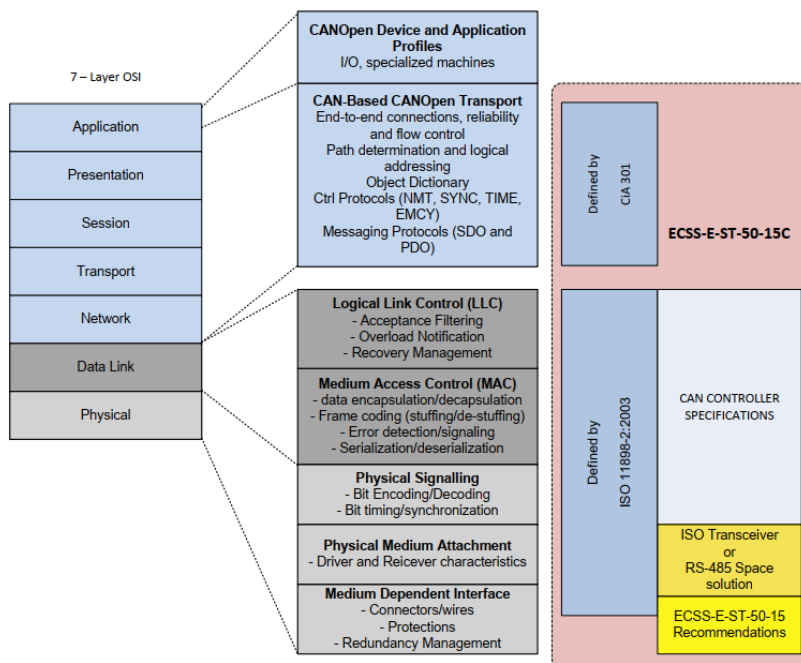
Figure 3: Relationship between ISO layering, ISO 11898, CiA 301 and ECSS CAN[1]

Main goals of this project are implementation of CANopen protocol compliant with ECSS-50-15C (ECSS specific CANopen based on CiA-301) standard on ATTM device (on-board segment), its corresponding

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[1] Image source: Figure 4-1 from ECSS-E-ST-50-15C

implementation in ground software skyEGSE-GUI (user application) and skyEGSE-comm (SDR server) and adaptation of test procedures which shall assure correct behaviour of newly developed functionality.

CANopen is a communication protocol based on CAN bus. It is a standardised protocol by CAN in Automation (CiA) organisation and is widely used in robotics, medical and automotive industry. In space industry it gained recognition with ECSS-E-50-15C standards which adapts CiA-301 standard for needs of the space industry. Diagram of ECSS CAN standard compared to OSI layers is display on Figure 3. It defines communication protocol on all layers, except of Application, which is product specific.

Conclusions

The ATTM project started in 2018 with Phase B, where the PicoSkyFT was expanded with the additional cores (NVIC, MPU, DIT, DMA) and their design was verified. The preliminary design of the ATTM was also performed during this phase. In Q3 2019 Phase C was started, where the ATTM module was manufactured and tested. This was followed in Q1 2020 by Phase D, where the QM of the ATTM module was successfully qualified.

The ATTM module is a full-duplex CCSDS compliant high data rate transceiver, with the best SWaP-optimized performance in its class. With the new CANopen communication stack, compliant to ECSS-E-50-15C, it can be integrated into many more satellites.

Within this activity, we selected CANopen stack, suitable for highly embedded systems, switched CAN communication to CANopen and adjusted communication to better fit this protocol. We also developed automated testing environment in order to test and verify CANopen communication.