

IAF SPACE OPERATIONS SYMPOSIUM (B6)
Interactive Presentations - IAF SPACE OPERATIONS SYMPOSIUM (IP)

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PYTHON IMPLEMENTATION OF CCSDS FILE DELIVERY PROTOCOL TO SUPPORT
FILE-BASED OPERATIONS

Abstract

The CCSDS File Delivery Protocol (CFDP) was developed by the Consultative Committee for Space Data Systems (CCSDS). The CFDP protocol provides reliable transfer of files from one endpoint to another, and has been designed to work well over space links that suffer from outtakes and long delays. The basic operation of CFDP is to transfer a file from a sender to a receiver (referred to as entities). The sender and receiver must be configured and running at the same time to perform a file transfer. It can be used to perform space to ground, ground to space, space to space, and ground to ground file transfers. For example it can be used to transfer science data from satellite over mission control to the science center in an automated fashion with minimal to no human intervention.

We have developed a Python library that implements all the features as specified in the CCSDS Blue Book Standard [CCSDS 727.0-B-5, July 2020] and published it as an open source under a permissive MIT license. To our knowledge it is the only Python implementation that exists to-date, and one of the first open source implementations of CFDP.

Our implementation is written in Python 3 with minimum dependencies and thus runs on all major operating systems. A porting to MicroPython for embedded usage is planned. It supports Class 1 (unacknowledged) and 2 (acknowledged) file transfers. A native file system for the virtual file store is provided which can be extended for other data stores such as packet stores. Currently two transport layers are available: ZeroMQ and UDP.

We demonstrate that our implementation is fully CCSDS conform through cross-testing with existing ESA implementation of CFDP. In addition to command-line interface we have also developed a GUI application to ease the testing and usage of Python CFDP. Next milestone is to implement CCSDS space link communication stack as transport layer, namely space packets and CCSDS frames. This will allow to use our CFDP implementation over RF link as used for satellite communication.

This CFDP implementation is free and open source and we welcome developers and users to adopt it for their space missions for space and terrestrial file transfers. As indicated by many upcoming and planned space missions file-based operations will play an essential part in mission operations. At the very least, our implementation allows users to get a quick grasp of how CFDP works in practice.