OpenSpace quantumFEP - Virtualized Front-End Processor for TT&C, Mission Data and Payload Operations

OpenSpace quantumFEP is a software front-end processor that handles datalink protocol processing to communicate TT&C, mission data and payload with space vehicles via a highly configurable feature set.

Spacecraft datalink protocol and ground interface functions are key capabilities within any satellite ground system - large or small. Front-end processors play a critical role in performing these functions.

Typical solutions often require unique customization of the ground hardware and digital processing algorithms, using tailored firmware on proprietary platforms, making modifications costly and time-consuming.

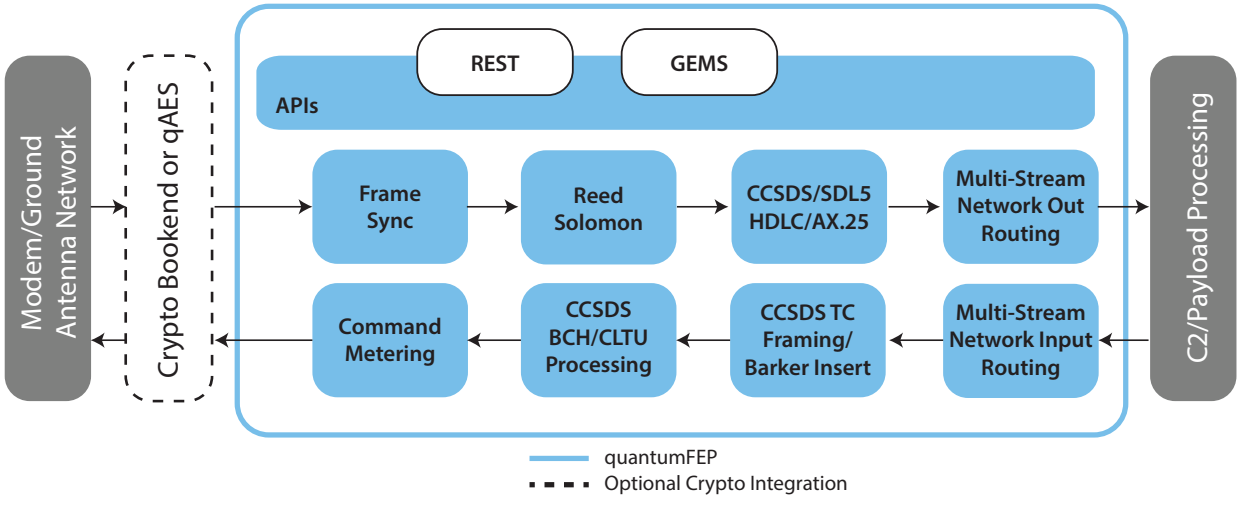
Capitalizing on the benefits of virtualization and cloud technologies, Kratos has developed OpenSpace® a family of solutions that enable the digital transformation of ground systems to become a more dynamic and powerful part of space network.

The OpenSpace quantum products are individual virtualized network functions that replace traditional hardware. OpenSpace quantumFEP is a virtualized front-end processor for TT&C, mission data and payload operations. In addition, the system has been specifically designed to match the requirements, schedules, and budgets of quick turn programs.

OpenSpace quantumFEP connects C2 systems to crypto devices and to RF signal processing within satellite ground providers such as SCN and commercial/cloud. It performs command and telemetry stream formatting, multiple protocols, C2 and crypto-bookend interfacing, and network interfaces to quantumRadio, quantumRX, or third-party ground antenna networks.

qFEP Features / Benefits

- *Command Transmit / Receive Channels for full CCSDS and Blocked/Barker Command processing*
  - *Standards-based Command formatting functions with Command Metering, Idle insertion, Command Generator, and full command receive chain for test*
- *Telemetry Transmit / Receive Channels for full CCSDS, HDLC, AX.25, and TDM processing of TT&C or Mission Data/ Payload*
  - *Standards based Telemetry processing with Reed Solomon, HDLC, and AX25 support for full functionality*
- *DVB-S2 Multi-Stream Transmit / Receive support*
  - *Configurable options supporting GSE, GFP, SNDU and CCSDS 131.3-B-2 SMTF Stream Formatting*
- *Built in Test functions*
  - *Allows testing before mission live status, and testing configuration changes before putting into operation ensuring compatibility and accuracy.*



OpenSpace quantumFEP high-level architecture.

Technical Specifications

Description	Specification
Command Transmit channel for uplink CCSDS or Blocked/ Barker processing	• Multiple command input sources: UDP/TCP/IP ports/raw-socket, CMD Generator, Tx BERTs • Multiple command input formats: CommandReq, Raw, CCSDS Space/Encap Packet, MAP-SDU • Tele-Command (TC) *Transmit* functions: CCSDS 231.0-B-4 (Frame), 232.0-B-4 (BCH, CLTU) • Command Metering: Generates constant uplink rate via Fill/Idle commands/TCs • Command Generator: Configurable manual, automatic, and file-based CMD testing
Command Receive channel for Echo Checking, Full CCSDS TC Reception & Verification	• Tele-Command (TC) *Receive* functions: CCSDS 231.0-B-4 (Frame), 232.0-B-4 (BCH, CLTU) • Burst Command Synchronizer (Auto or Manual Polarity), Barker Synchronizer, Barker Remove
Telemetry Receive channel for downlink CCSDS, TDM, HDLC, or AX25 processing	• Frame Synchronization (TDM/CCSDS), Timestamp bit adjustment, Manual/Auto/External Polarity • Reed-Solomon Decoding (223,255) and (239,255) • HDLC and AX25 Decoding • *Receive functions for CCSDS 131.0-B-3, 132.0-B-3 (TM), 732.0-B-4 (AOS), 732.1-B-3 (USLP)* • Data Adjuster for padding, header and/or trailer stripping
Telemetry Transmit channel for multi-layer TLM Assembly and TLM Transmission	• Multiple TLM input sources: UDP/TCP/IP ports, Raw File Player (PCM Sim), Tx BERTs • Multiple TLM input formats: Raw, Frame, Space/Encap Packets, VCA/OCF/FSH/etc. • *Transmit* functions for CCSDS 131.0-B-3, 132.0-B-3 (TM), 732.0-B-4 (AOS), 732.1-B-3 (USLP) • Reed-Solomon Encoding (223,255) and (239,255) • HDLC and AX25 Encoding
Space Packet Protocol Support	• CCSDS 133.0-B-2 Space Packet Protocol for all Command and Telemetry channels
Encapsulation Protocol Support	• CCSDS 133.1-B-3 & 702.1-B-1 Encapsulation Protocols for all Command and Telemetry channels
Transmit & Receive Channel Security	• CCSDS 355.0-B-2 Space Data Link Security (SDLS), Full protocol and SA database support
DVB-S2 Downlink Receive Channel	• Supports DVB-S2 Multi-stream Rx capability, Configurable 1 – N streams (resource limited • Standard GSE or GSE-Lite Deframing (of BBFRAMES) • Standard GFP protocol Deframing (of Byte-stream) • Standard SNDU Deframing • Standard CCSDS 131.3-B-2 SMTF Stream Formatting from BBFRAMES • Configurable selection of active or bypassed GSE/GFP/SNDU functions
DVB-S2 Uplink Transmit Channel	• Supports DVB-S2 Multi-stream Tx capability, Configurable 1–N streams (resource limited) • IP or MPLS Network Filtering and Mapping to selected Transmit DVB-S2 Stream by ISI Number • Standard SNDU Framing of filtered IP packets or MPLS Frames • Standard GFP Framing of filtered IP packets or MPLS Frames • Standard GSE or GSE-Lite Framing of filtered IP packets or MPLS Frames (into BBFRAMES) • Standard CCSDS 131.3-B-2 SMTF Stream Formatting into BBFRAMES • Configurable selection of active or bypassed Filtering/SNDU/GFP/GSE functions
TX / RX BERTs File and Session-based Recording / Playback	• Bit Error Rate Testers for CMD, TLM, and Mission Data/Payload loopback testing • High-rate recording & playback of Commands, Telemetry, Mission Data (persistent/disk storage)
Additional Specifications	• Baseband data rates up to 500 Mbps, downlink and uplink simultaneously (nominal) • Real-time Data Monitoring and Capture at configurable points within each Data Channel • NTP-Based Timestamping • Control/Status via GEMS/TCP or REST/HTTP(S) • Secure certificate-based Control/Status over encrypted and authenticated SSL/TLS link • HTML5 Graphical User Interface (GUI) accessible over standard web browsers (HTTP/HTTPS) • Fully configurable and bypass-enabled functions to meet different user missions • Runs on commodity x86 hardware • Delivered as a Docker container or RPM/ISO installer for bare-metal OS/Virtual Machine • Web-based application download, Revision Notes, User Guide, and ICD
Options	• KG-255XJ, KS-252, KIV7 crypto integration via Kratos Crypto-Bookend and Crypto-Control • Integrates with Kratos quantumAES Commercial 128/192/256 bit AES Encryptor/Decryptor • Linux Operating System options available • IA Hardening Plans available