



OpenSpace quantumFEP – Virtualized Front-End Processing for Telemetry, Tracking, and Command (TT&C) Operations

Data security and integrity are key capabilities within any satellite ground system – large or small. Front-end processors play a critical role in performing this function.

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 Telemetry, Tracking, and Command (TT&C) that lowers the cost of implementation, improves reliability, and allows for



OpenSpace quantumFEP is a software front-end processor that handles the digital processing on the ground for Telemetry, Tracking, and Command (TT&C) operations.

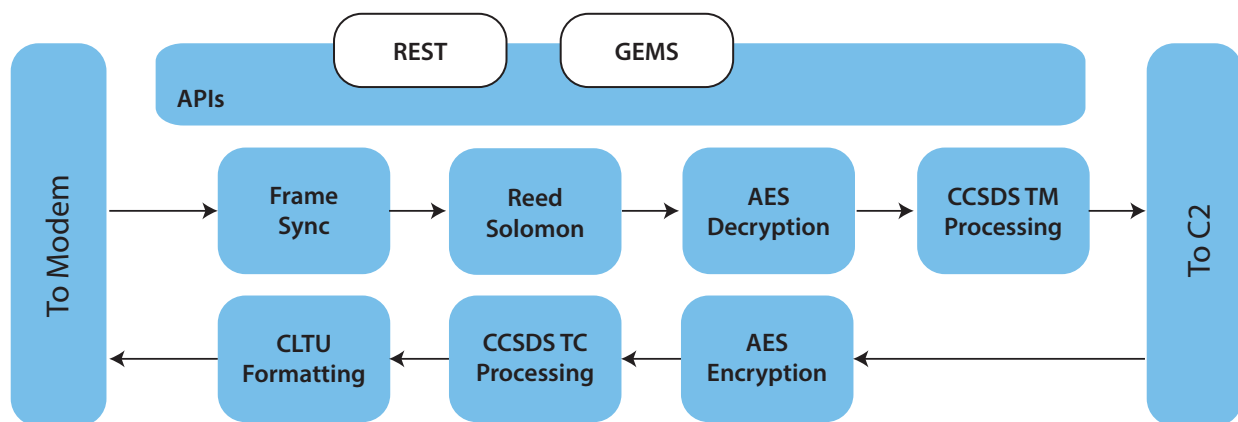
maximum scalability with growth. In addition, the system has been specifically designed to match the requirements, schedules, and budgets of quick turn programs.

OpenSpace quantumFEP connects C2 systems to RF signal processing equipment - handling command and telemetry stream formatting, encryption/decryption devices, CCSDS processing, and network interfaces to either quantumRadio or third party ground antenna networks.

OpenSpace quantumFEP supports virtual machine environments, and its small memory footprint allows for more efficient use of system resources. In addition, the product achieves independence by eliminating custom drivers, firmware and hardware cards.

The OpenSpace quantumFEP offers the following benefits:

- Access and control from anywhere through the web



OpenSpace quantumFEP architecture

- Scale digital processing and network connectivity with growth
- Secure data with encryption compatibility
- Lower costs with software based implementation

The key features of OpenSpace quantumFEP include:

- Pure software implementation for signal processing functions
- Deploys on bare metal machines, a private cloud or with cloud provider
- Suitable for all types of satellite programs
- Compatibility tested with widely used ground modems
- Built-in test functions reduce Integration and Test (I&T) effort and costs
- Configurable as mission requirements change or as new missions come online
- Commercial AES Encryption/Decryption standard feature with built in AES Key Manager
- Standard TCP/IP, GEMS, REST and VITA-49 interfaces make integration seamless
- Access and control from anywhere through the web. No client software to install or maintain

All of the digital processing functions in a typical satellite ground system are included in OpenSpace quantumFEP - command and telemetry processing, recording, AES COMSEC security, CCSDS processing, packet-level FEC, and network gateway interface support. Monitoring and control can be done using the HTML5 user interface or using the API, REST or GEMS.

The virtualized front-end processor also provides encryption services at many different levels. Management of AES keys, their storage, and over The Air Re-keying (OTAR) are functional capabilities baselined into the quantumFEP.

The OpenSpace quantum narrowband system, in its typical configuration, includes a digitizer in the form of OpenSpace SpectralNet®, for the conversion and transport of RF signals over an IP network. The OpenSpace quantumRadio for modulation and encoding of the transmit signal and demodulation and decoding of the receive signal. The OpenSpace quantumFEP provides transmit signal formatting and encryption and receive signal framesync and decryption.

Commanding (Transmit)	Telemetry (Receive)	Features
<ul style="list-style-type: none"> • Transfer Frame Services <ul style="list-style-type: none"> - Master Frame Service • CLTU Formatting • Reed-Solomon Encoding: (223, 255), (239, 255) <ul style="list-style-type: none"> - Interleave: 0 to 8 • OTAR • AES Encryption 	<ul style="list-style-type: none"> • Framesync <ul style="list-style-type: none"> - User definable • Supported Transfer Frame Versions <ul style="list-style-type: none"> - AOS & TM • Reed-Solomon Decoding: (223, 255), (239, 255) <ul style="list-style-type: none"> - Interleave: 0 to 8 • AES Decryption • HDLC Decoder <ul style="list-style-type: none"> - Bitwise 	<ul style="list-style-type: none"> • CCSDS Packet Processing <ul style="list-style-type: none"> - 132.0-B-1 (TM Space Data Link Protocol) - 133.0-B-1 (Space Packet Protocol) - 231.0-B-1 (TC Sync & Channel Coding) - 232.0-B-1 (TC Space Data Link Protocol) - 732.0-B.2 (AOS Space Data Link Protocol)



OpenSpace® is a family of solutions that enable the digital transformation of ground systems to become a more dynamic and powerful part of space network. OpenSpace supports a variety of customer paths, goals and business models. OpenSpace SpectralNet serves as the on-ramp to digital transformation of ground systems, reliably converting and transporting RF spectrum to IP. The OpenSpace quantum products are individual virtualized network functions that replace traditional hardware. The OpenSpace Platform delivers a fully dynamic, service oriented, and orchestrated approach for ground operations.

