OpenSpace quantumRadio - Virtualized Software Modem for Narrowband Missions

The OpenSpace quauntumRadio is a software-based radio for TT&C and narrowband payload missions.

Key Features

- *Performs telemetry, commanding and ranging functions*
- *Compatible with most widely used space radios*
- *Built in test functions that minimize Integration and Test efforts*
- *Reconfigurable for new missions and changing mission requirements*
- *Standard TCP/IP, GEMS, REST and VITA-49 interfaces including DIFI*

In satellite ground systems – whether large or small – RF signal processing has traditionally been performed by racks of hardware modems, creating an expensive, inflexible, and complex architecture. The increased complexity of Telemetry, Tracking and Command (TT&C) missions due to so many new satellites speaking different languages only adds to the challenge.

OpenSpace Family – Enabling Digital Transformation

Capitalizing on the benefits of virtualization, Software-Defined Networking (SDN) 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 the space network.

OpenSpace quantum – Virtualizing Ground Infrastructure

The OpenSpace quantum products are individual virtualized network functions that replace traditional hardware. OpenSpace quantumRadio is a software-based radio that provides the signal processing functions required for TT&C and narrowband payload mission on general purpose compute.

OpenSpace quantumRadio – Virtualized Software Modem

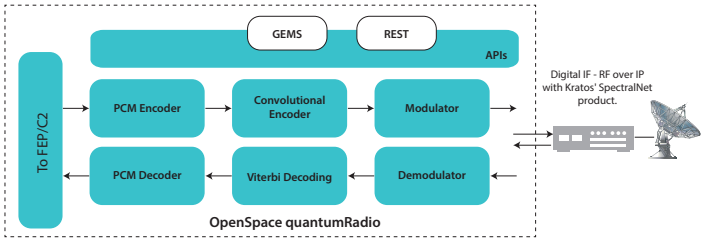
OpenSpace quantumRadio (qRadio) offers lower operating costs, increased scalability and dynamic operations beyond traditional hardware.

- Configure on the fly to support multiple satellites and payloads
- Scales on demand by spinning virtual instances up and down to meet demand growing signal processing
- Minimize hardware footprint and costs
- Deploys flexibly on bare metal, virtually or in the cloud

qRadio provides modulation, demodulation, error correction, and up/down frequency conversion all in software without the use of a Field Programmable Gate Array (FPGA) or Graphics Processing Unit (GPU). The virtualized function runs on standard x86 servers on premise or in the cloud.

Unlike traditional TT&C and data modems, quantumRadio embraces an open-standards approach. Monitoring and control can be done using the browser-based user interface or using one of the following open standards APIs: REST or GEMS.

The qRadio is an ideal solution for new satellites and/or ground stations due to its performance and economic efficiency. It is compatible with most common satellite buses and operates seamlessly alongside other modems in existing operations. Engineered to reduce operational costs and enhance troubleshooting, the qRadio supports newer digital IF signaling and provides unsurpassed scalability. The qRadio modem is built for applications spanning the lifecycle of the satellite–from assembly and test, to launch and on-orbit checkout, to full operation.



OpenSpace quantumRadio System Architecture

Technical Specifications

Demodulation (Receive/Telemetry) Description	**Specification**
Number of Receive Channels	Two - One Channel Telemetry, One Channel Command Echo
Format	VITA 49, DIFI 1.0, and DIFI 1.1
Direct Demodulation Types	BPSK, OQPSK, DQPSK (Normal/Alternate), OQPSK, 8PSK, FSK, MSK, GMSK, UAQPSK, PCM PM, PCM FM
Symbol Rate	7 sps to 5 Msps
PCM Decoding	NRZ-L,M,S, Blø-L,M,S, D-Blø-M,S, Dual PCM Decoders Supported
Viterbi Decoding	Rate = 1/2, 2/3, 3/4, 5/6, 7/8 (K=7) CCSDS Polynomial G1 / G2 Invert Support Reverse order mode (G1 / G2 output order is reversed) Dual Viterbi Decoders – Rate 1/2 Supported
Reed Solomon Decoder (223, 255) and (239, 255)	Virtual Fill up to 7 bits per frame Block Interleaving (CCSDS compliant) Viterbi Decoding can be concatenated with Reed Solomon Decoding Decoder output may be frame data only or frame data with ASM Check Symbol Removal
Turbo Convolutional Coding (TCC)	Optional decoder can be enabled on startup Rate 1/6 K=5, Rate 1/2 K=5
CCSDS Low Density Parity Check (LDPC)	Rate 1/2, 2/3, 4/5, and 7/8 Block Sizes: 1024, 4096, 16384, and 7136 Only Supported for BPSK, QPSK, OQPSK, and 8PSK and requires Bandwidth Enhancement* License
DVB-S	MPEG2 packet derandomization Reed Solomon Decoding
Modulation (Transmit/Commanding) Description	**Specification**
Number of Transmit Channels	1
Format	VITA 49, DIFI 1.0, and DIFI 1.1
Direct Modulation Types	BPSK, QPSK, DQPSK (Normal/Alternate), OQPSK, 8PSK, FSK, MSK, GFSK, GMSK, SOQPSK_TG, UAQPSK, PCM PM, PCM FM
Symbol Rate	7 sps to 5 Msps
PCM Coding	NRZ-L,M,S, Blø-L,M,S, D-Blø-M,S Dual PCM Encoders Supported
Convolutional Encoding	Rate = 1/2, 2/3, 3/4, 5/6, 7/8 (K=7) CCSDS Polynomial G1/G2 Invert Support Reverse order mode (G1/G2 output order reversed) Dual convolutional encoding
Reed Solomon Encoding (223, 255) and (239, 255)	Virtual Fill up to 7 bits per frame Block Interleaving (CCSDS compliant) CCSDS Randomization, with or without Reed Solomon encoding Convolutional Encoding can be concatenated with Reed Solomon encoding
Turbo Convolutional Coding (TCC)	Optional encoder can be enabled on startup Rate 1/6 K=5, Rate 1/2 K=5
CCSDS Low Density Parity Check (LDPC)	Rate 1/2, 2/3, 4/5, and 7/8 Block Sizes: 1024, 4096, 16384, and 7136 Only Supported for BPSK, QPSK, OQPSK, and 8PSK and requires Bandwidth Enhancement* License
Tone Ranging	
Standards	ESA, ESA-Like (7-tones), or USB (User Defined) up to 10 tones; up to 5 MHz of bandwidth
Modulation Type	PM, FM
Command Echo	
Number of Channels	1
Symbol Rate	7 sps to 5 Msps
Purchasable Upgrades	
*Bandwidth Enhancement	Standard license supports 10 MHz of instantaneous bandwidth and 5 Msps; a separate license is required to achieve rates of 20 MHz of instantaneous bandwidth and 10 Msps.
SGLS Upgrade	FSK/AM and PRN Ranging

OpenSpace®

OpenSpace® is a family of solutions that enable the digital transformation of ground systems to become a more powerful part of the 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.

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Phone: +1.703.254.2000 • Space@KratosDefense.com • www.KratosDefense.com