OpenSpace quantumRadio - Virtualized Software Modem for Narrowband Missions

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.

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 quantumRadio is a software-based radio that provides the signal processing functions required for TT&C and narrowband payload missions.

The software modem offers lower operating costs, increased scalability, and dynamic capabilities beyond traditional hardware.

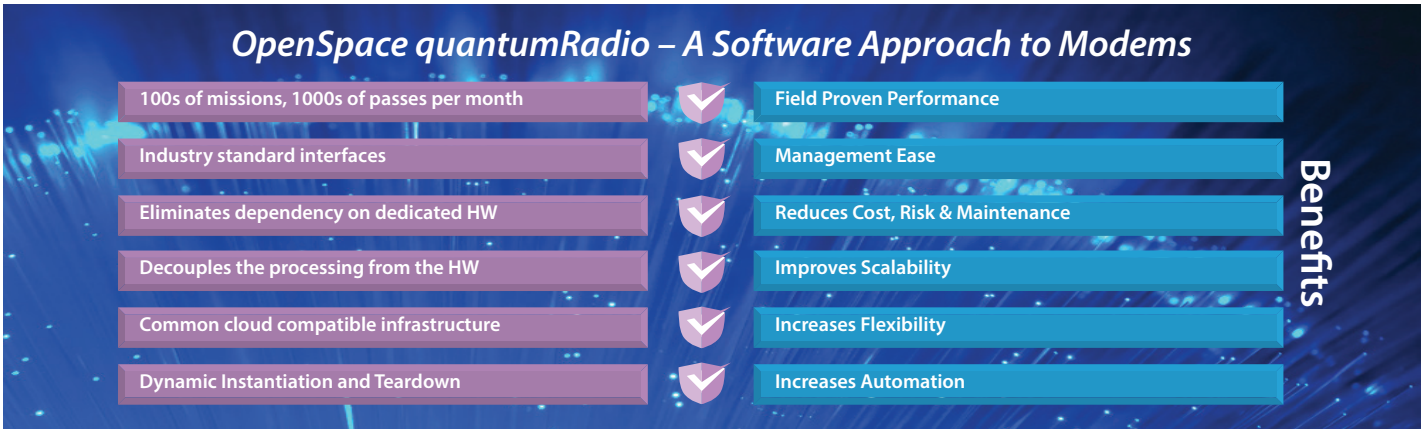
- Offers configuration on the fly to support multiple satellites and payloads
- Scales on demand by spinning virtual instances up and down to meet growing signal processing demands
- Lowers hardware costs
- Deploys flexibly on bare metal, virtually or in the cloud

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

Key Features

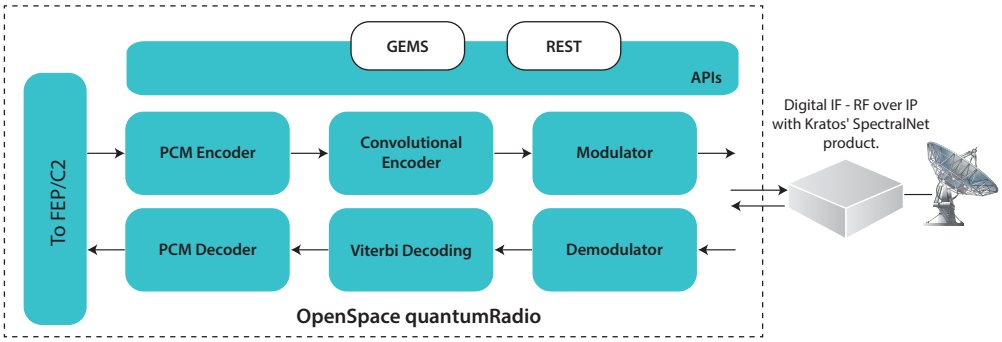
- *OpenSpace quantumRadio can be used on-premise, in a private cloud or with a cloud provider*
- *Suitable for all types of programs from single satellites to large constellations*
- *Compatible with widely used space radios*
- *Performs telemetry, commanding and ranging functions*
- *Built in test functions that reduce costs and minimize Integration and Test (I&T) efforts*
- *Configurable as mission requirements change or as new missions come online*
- *Standard TCP/IP, GEMS, REST, and VITA-49 interfaces make integration simple and protects long term investments*
- *Minimize hardware footprint and costs with pure software implementation*

The OpenSpace quantumRadio 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 quantumRadio 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 quantumRadio supports newer digital IF signaling and provides unsurpassed scalability. The quantumRadio 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

OpenSpace quantumRadio's Key Features

Modulation (Transmit)	Demodulation (Receive)	Features
• Number of Channels: 1 - Digital Spectrum up to 20MHz instantaneous bandwidth[2]	• Number of Channels: 1 - Digital Spectrum up to 20MHz instantaneous bandwidth	• Reference Signals - External generated 1PPS - External generated IRIG - Monitoring and Control
• Compatible Hardware Front-ends - SpectralNet Narrowband - SpectralNet Wideband	• Compatible Hardware Front-ends - SpectralNet Narrowband - SpectralNet Wideband	• Ethernet TCP/IP remote M&C interface - Web-based GUI - File record/playback
• BPSK/PM or BPSK/FM - Symbol Rate: 7 sps to 5 Msps[2] - Modulation Index (PM): 0.0 to 3.0 Radians - Frequency Deviation (FM): 0 to 4 MHz • FSK/AM - Symbol Rate: 1, 2, and 10 Ksps	• BPSK/PM or BPSK/FM - Symbol Rate: 7 sps to 10 Msps[2] - Number of Subcarriers (Per Channel): 1 - Subcarrier frequency: 1 kHz to 4 MHz - Modulation Index (PM): 0.0 to 3.0 Radians - Frequency Deviation (FM): 0 to 4 MHz	• Ranging - Tone Ranging - ESA, ESA-Like - SGLS PRN[1] - Up to 5 MHz of bandwidth
• Direct PSK (BPSK/QPSK/OQPSK/UAQPSK) - Symbol Rate: Up to 10 Msps[2]	• Direct PSK (BPSK/QPSK/OQPSK/UAQPSK) - Symbol Rate: Up to 10 Msps[2]	• Command Echo[3] - Single Channel - Symbol Rate: Up to 5 Msps
• PCM Coding: NRZ-L,M,S, and BIØ-L,M,S	• PCM Coding: NRZ-L,M,S, and BIØ-L,M,S	CPU instruction set architecture: x86_64; AVX512[4]
• Convolutional Encoding: Rate ½, k=7	• Viterbi Decoding: Rate ½, k=7	
• Reed-Solomon Decoding: (223, 255), (239, 255) - Interleave: 0 to 8	• Reed-Solomon Decoding: (223, 255), (239, 255) - Interleave: 0 to 8	
• HDLC Encoder - Bitwise		

[1] SGLS functionality is not part of standard quantumRadio baseline; a separate license is required. SGLS requires a separate export license as it is EAR controlled.
[2] 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.
[3] Command echo requires either two SpectralNet Narrowband units or a single SpectralNet Wideband unit with dual RF cards to support.
[4] Higher bandwidths and symbol rates require an AVX512 instruction set.

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.

KRATOS
READY FOR WHAT'S NEXT™

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