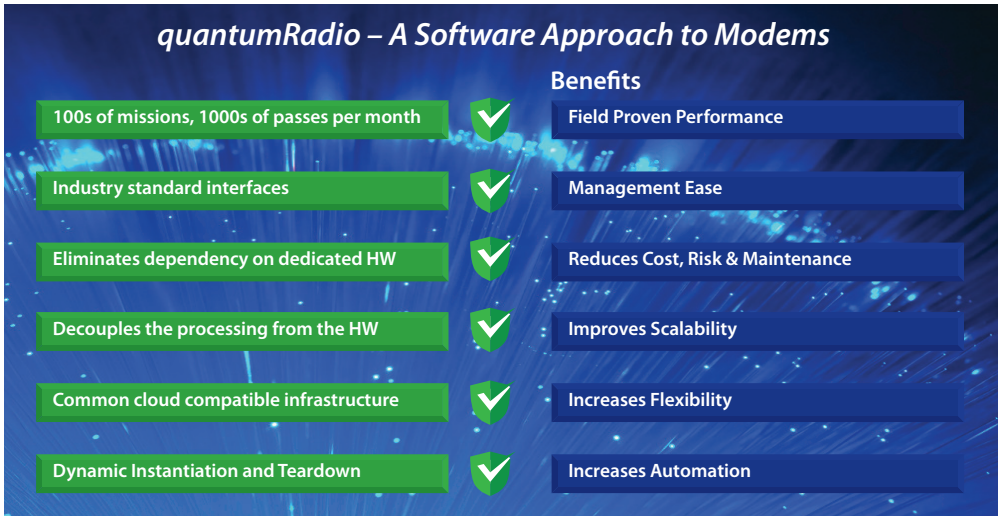
RF Signal Processing for a Cloud-Based Software Modem World

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.

While other industries have capitalized widely on the benefits of virtualization and cloud technologies, satellites have been more limited due to the challenges of digitally processing RF signals. Until now. Leveraging the years of experience designing and deploying ground systems for leading satellite operators, Kratos has developed quantumRadio, a purely software modem for RF signal processing on the ground… or in the cloud.

quantumRadio is built based on more than 30 years of experience designing and implementing ground system products for some of the most critical commercial and government missions. The software modem is very cost-effective and offers a feature-rich set of functions that have been pre-integrated and pre-tested to capitalize on cloud-based architectures. quantumRadio offers a way to quickly scale your ground station infrastructure to meet growing signal processing demands.



Key Features

- 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
- 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
- Access and control from anywhere via the web. No client software to install or maintain

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quantumRadio leverages advanced software technology and innovative approaches specifically designed to match the requirements, architectures and evolving budgets of satellite operators. Delivering signal processing functions for satellite space-ground operational requirements, quantumRadio includes modulation/demodulation of several common waveforms and several Forward Error Correction (FEC) methods. 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.

Due to its performance and economic efficiency, the quantumRadio is an ideal solution for new satellites and/or ground stations. 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. Built for applications spanning the lifecycle of the satellite–from assembly and test, to launch and on-orbit checkout, to full operation–the quantumRadio modem empowers satellite management with confidence.

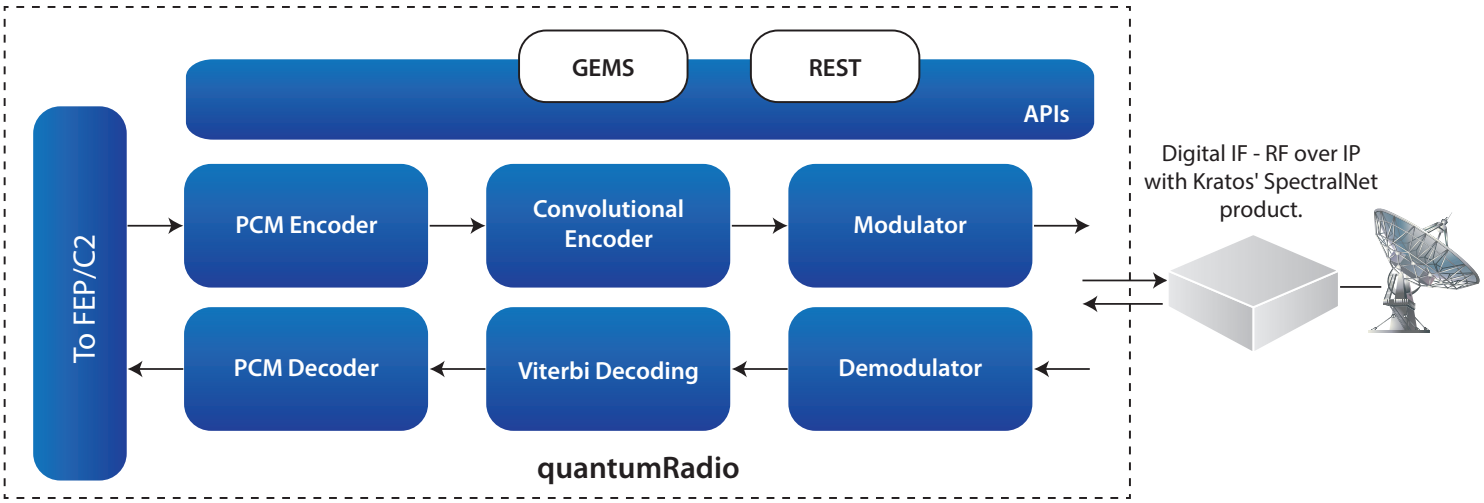

Figure 1: quantumRadio System Architecture

quantumRadio's Key Features

Modulation (Transmit)	Demodulation (Receive)	Features
• Number of Channels: 1 - Digital Spectrum up to 10MHz instantaneous bandwidth	• Number of Channels: 1 - Digital Spectrum up to 10MHz instantaneous bandwidth	• Reference Signals - External generated 1PPS - External generated IRIG - Monitoring and Control
• Compatible Hardware Front-ends - SpectralNet	• Compatible Hardware Front-ends - SpectralNet	• 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 - Modulation Index (PM): 0.0 to 3.0 Radians - Frequency Deviation (FM): 0 to 4 MHz	• BPSK/PM or BPSK/FM - Symbol Rate: 7 sps to 5 Msps - 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	
• Direct PSK (BPSK/QPSK/OQPSK) - Symbol Rate: Up to 5 Msps	• Direct PSK (BPSK/QPSK/OQPSK) - 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	
• 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		