



OpenSpace quantumTX -Software Transmitter for Wideband Missions

With the increasing amount of information being collected and transmitted to current and next-generation of wideband and software-defined satellites, there is increasing pressure for ground systems to evolve to be more agile, cost-effective and scalable to meet evolving missions and on-the-fly changes in demand.

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.

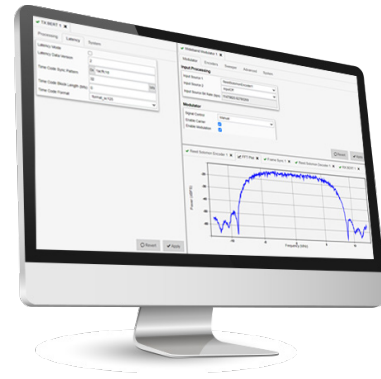
OpenSpace quantum – Virtualizing Ground Infrastructure

The OpenSpace quantum products are individual Virtualized Network Functions (VNFs) that replace traditional hardware. OpenSpace quantumTX is a complete wideband software transmitter that uses no FPGAs or GPUs on general purpose compute.

OpenSpace quantumTX – Virtual Wideband Transmitter

quantumTX (qTX) takes advantage of standard x86 server architectures and can be deployed easily on bare metal, virtual machines or in containers to meet different scalability needs, to drive higher capacity utilization and to reduce costs.

The software-based transmitter offers high performance for carriers from 1 Msps up to 250 Msps, supporting over 1 Gbps of throughput for uplinks.



OpenSpace quantumTX displays signal performance and the spectrum.

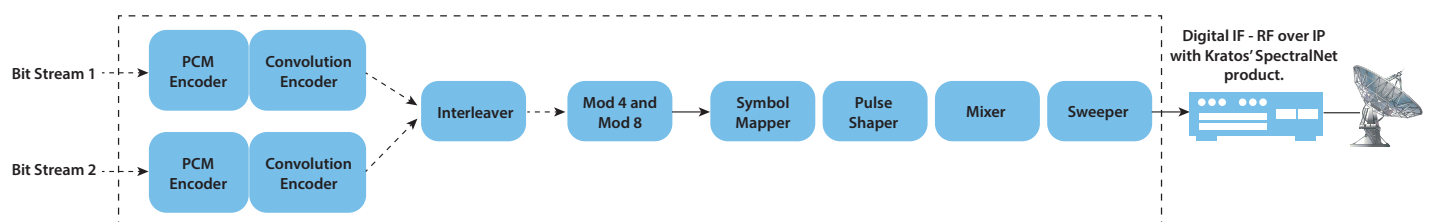
qTX is an ideal solution for new satellites and ground stations due to its performance and economic efficiency. The virtualized transmitter reduces operational costs, enhances troubleshooting, and supports the newer digital IF signaling capabilities.

qTX provides modulation of several common waveforms, decoding, and forward error correction methods. Monitoring and control is performed using the HTML5 graphical user interface, using the REST API or GEMS.

Key Features and Benefits of quantumTX

OpenSpace quantumTX provides the following features and benefits for satellite operators, service providers and Ground Station-as-a-Service providers (GSaaS):

Features	Benefits
Software defined radio solution enabling multiple waveform modulation and encoding options	Provides high performance and pass-to-pass configurability
Uses industry standard interfaces	Web-based GUI, REST API and GEMS
Decouples the processing from purpose-built hardware	Lowest costs by using generic x86 compute resources
Eliminates dependency on dedicated hardware	Deploys flexibly on bare metal, virtually or in the cloud
Common cloud compatible infrastructure	Easily fits into existing ground architectures from private to public cloud
Instantiate application instances through automation and virtualization	Scales on demand by spinning virtual instances up and down as needed



OpenSpace quantumTX System Architecture

Technical Specifications

Description	Specification
Number of Transmit Channels per Instance:	1
Direct Modulation Types:	BPSK, QPSK, OQPSK, 8PS, 16 APSK (Inverted Gray 1 mapping , Natural 1 with TCM enabled) 16QAM
Direct Symbol Rate:	1 Msps to 250 Msps QPSK, BPSK, OQPSK, and 8PSK (LEO, MEO, GEO)
Direct Information Rate:	250 Mbps / BPSK 500 Mbps / QPSK 500 Mbps / OQPSK 750 Mbps / 8PSK
DVB-S2 Modulation:	QPSK to 32APSK Short & Normal Frames Variable Coding & Modulation (VCM) with Pilot Frames Adaptive Coding & Modulation (ACM) with quantumRX 1.3 or later
DVB-S2 Symbol Rate	500 Ksps to 250 Msps on Intel scalable 2nd generation processor 500 Ksps to 350 Msps on Intel scalable 5th generation processor
DVB-S2X	500 ksps to 250 Msps on Intel scalable 2nd generation processor 500 Ksps to 350 Msps on Intel scalable 5th generation processor QPSK to 32 APSK Short and Normal Frames ACM with quantumTX v1.0 or later Variable Coding & Modulation (VCM) with Pilot Frames Higher Order Modcodes - 64 APSK (Max 166 Msps) 128 APSK (Max 145 Msps)
PCM Encoding:	NRZ-L,M,S, Modulo-4 (QPSK only), Modulo-8 (8PSK Only)
Streaming Encoding:	<i>Convolutional Encoder: Single Convolutional Encoder per Channel BPSK, QPSK, OQPSK, 8PSK 375 Mbps per channel Maximum Bit Rate Rate = 1/2, 2/3, 3/4, 5/6, 7/8 (K=7) CCSDS Polynomial</i> <i>G1=1111001</i> <i>G2=1011011</i> <i>G1 / G2 Invert Support Reverse order mode (G1 / G2 output order is reversed) Bypass mode supported</i> <i>4D-8PSK-TCM: Rate = 2, 2.25, 2.5, 2.75 bits per Symbol</i>
4D-8PSK-TCM	<i>Rate = 2, 2.25, 2.5, 2.75 bits per Symbol</i>
Block Encoding:	Reed Solomon Encoding (223, 255), (239, 255) - Virtual Fill up to 7 bits per frame - Block Interleaving (CCSDS compliant) - Convolutional Encoding can be concatenated with Reed Solomon Encoding - Can support up to 19 code blocks at an interleave of 2 - Output supports w/ or w/out ASM re-appended 750 Mbps per channel (Data rate includes ASM and check symbols; Max Bit Rate assumes 8PSK)
Matched Filter	RRC values 0.2-1.0 support performance at all modulation types
Vita49 Support	8 or 12 bit samples only
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LDPC/CCSDS	CCSDS 131.0-B-5 TM Synchronization and Channel Coding
Matched Filter	RRC values 0.2-1.0 support performance at all modulation types
Vita49 Support	8 or 12 bit samples only



OpenSpace® is 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 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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