



Wideband Receiver Scalable & Cost-Effective Signal Processing for Earth Observation & Remote Sensing Missions

Challenge – Static and Inflexible Ground Infrastructure

As more and more Earth Observation (EO) and Remote Sensing (RS) data is being beamed from satellites, the infrastructure on the ground has to be more flexible, cost-effective and scalable to meet the demand.

Enabling a More Dynamic Ground - OpenSpace Platform

Kratos' OpenSpace platform is the industry's only fully virtualized, software-defined and orchestrated satellite ground system platform that addresses this need for highly EO/RS dynamic services.

Fully Virtualized EO and Remote Sensing Service Chain

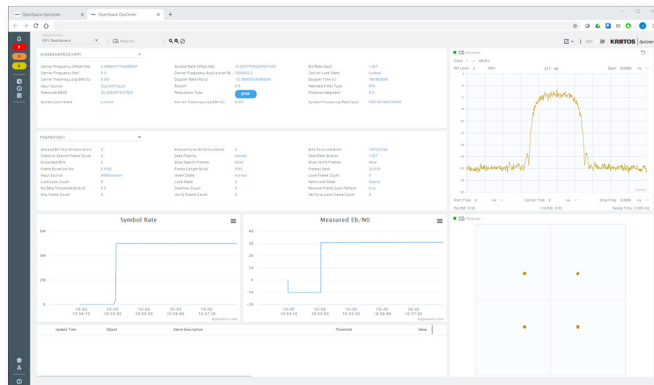
As part of the OpenSpace Platform, Kratos offers a completely virtualized and software controlled service chain that enables a fully automated EO sensing mission downlink from the digitizer all the way to post satellite pass processing.

In the platform, dedicated analog RF hardware devices are turned into software in the form of Virtual Network Functions (VNFs) that run on commodity servers on premise or in the cloud.

These OpenSpace VNFs are service chained together to deliver an EO and RS downlink without having to make changes in hardware.

The process starts by digitizing the RF at the antenna using Kratos' SpectralNet Wideband product, the OpenSpace WAN Transport Protector (OWTP) VNF can then be used to assure the transport of digitized IP packets across any potential impaired WAN links.

The VITA 49 digital stream is then processed by the OpenSpace Receiver (ORX) VNF and the OpenSpace



The OpsCenter management interface manages and controls ORX as part of the OpenSpace platform.

Stream Processor/Recorder (OSPR) VNF records satellite-based sensor telemetry data during a spacecraft pass and supports real-time streaming of downlink data and routing to other processing chains in real-time.



Kratos' OpenSpace EO and Remote Sensing Service Chain.

Unmatched Signal Processing Performance in Software

As part of the EO/RS service chain the OpenSpace Receiver (ORX) offers wideband signal processing capabilities to meet the needs of EO data processing ground stations. ORX is an open-standards based and completely virtual receiver with no FPGAs or GPUs that delivers the highest data rates for downlinks in software.

The software based receiver offers high performance with 600 Mbps of throughput to support downlinks and takes advantage of standard x86 server architectures.

The performance of ORX is equivalent to hardware based EO and remote sensing receivers in the market. As a software only receiver, ORX easily scales unlike traditional hardware receivers that are proprietary and purpose built.

Key Features of ORX

- Proven to support 100s of missions, 1000s of passes per month
- Uses industry standard interfaces
- Eliminates dependency on dedicated hardware
- Decouples the processing from the hardware
- Cloud native infrastructure

Key Signal Processing Capabilities

ORX utilizes a powerful Software Defined Radio (SDR) developed from more than 30 years of experience designing and implementing ground system products for some of the most critical commercial and government missions.

The software receiver includes the capability to demodulate, error correct and bit-sync payload data at rates up to 600 Mbps. ORX provides demodulation of several common waveforms, decoding, and forward error correction methods. Monitoring and control is performed using the OpsCenter management product.

- Carrier tracking, demodulation, bit-synchronization and digital processing of digital IF signals at rates adjustable up to 600 Mbps
- Digital signal processing implementation for flexibility to support different demodulation and processing schemes, and unlike legacy analog implementations, requires no calibration
- Supports downlink processing of BPSK, QPSK, OQPSK, and 8PSK
- The demodulation processing is supplemented by bit synchronization, Pulse Code Modulation (PCM) code conversion, digital filtering, and adaptive signal equalization for transmission optimization
- Multiple Forward Error Correction (FEC) options are currently supported including Viterbi and Reed-Solomon (RS)

Key Benefits

- Provides an unmatched level of signal processing in software
- Delivers high performance and pass-to-pass configurability
- Scales on demand by spinning virtual instances up and down
- Lower costs by using less purpose built hardware
- Deploy flexibly on bare metal, virtually or in the cloud
- Easy to access and control with unified OpsCenter management interface

- Output from the application is 1 GbE and 10GbE IP packets over Ethernet

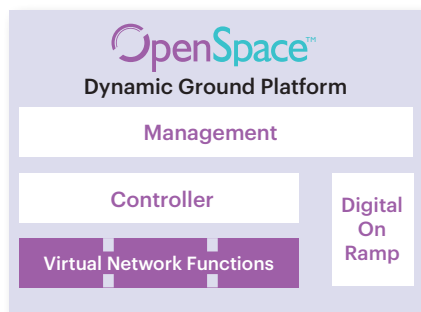
Seamless, Scalable and Low Cost Deployment

ORX easily fits into existing ground architectures and provides great scalability, resilience and security, while remaining cost-effective.

As customer demands increase, additional virtual instances of ORX can be instantiated to meet these dynamic missions, while also adapting to changing requirements to ensure delivery on Service Level Agreements (SLAs). ORX also lowers costs by minimizing the use of proprietary and purpose built hardware.

Technical Specifications

Demodulation	
Description	Capability
Number of Receive Channels:	1
Direct Demodulation Types:	BPSK, QPSK, OQPSK, 8PSK
Direct Symbol Rate:	20 Msps to 200 MSPS
Forward Error Correction (FECs):	Single Viterbi Decoder per Channel Rate = 1/2 (K=7) CCSDS Polynomial Reed Solomon Decoding (223, 225), (239, 255)



OpenSpace is the industry's first and only fully virtualized, software-defined and orchestrated satellite ground system platform. The OpenSpace platform includes Virtual Network Functions, such as ORX for signal processing as part of the EO/RS service chain. The OpenSpace Controller to administer how service chains are deployed and OpenSpace OpsCenter to provide unified management across the entire satellite ground system.



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