Data security and integrity are key capabilities within any satellite ground system – large or small – and have been performed by ground front end processors or custom functionality has been built into a ground modem. Typical solutions often required unique customization of the ground hardware and digital processing algorithms, using tailored firmware on proprietary platforms, making modifications costly and time-consuming. Leveraging the years of experience designing and deploying numerous ground systems for leading satellite operators, Kratos created a purely software implementation for the digital processing on the ground, quantumFEP.

quantumFEP’s new software technology and innovative approaches lower the cost of implementation, improve reliability, and allow for maximum scalability as a constellation grows. In addition, the system has been specifically designed to match the requirements, schedules, and budgets of quick turn programs.

quantumFEP avoids the complexity of that legacy approach and provides the digital processing and network connectivity needed between the Command & Control (C2) system and the RF Signal Processing equipment. All of the digital processing functions in a typical small satellite ground system are included - command and telemetry processing, recording, AES COMSEC security, CSSDS processing, packet level FEC, and network gateway interface support. Monitoring and control can be done using the HTML5 user interface or using one of the following APIs: REST or GEMS.

**Key Features**
- quantumFEP can be used on bare metal machines, a private cloud or with cloud provider
- Suitable for all types of Small Sat programs – cubesats, nanosats, microsats, and small sats
- Compatibility tested with widely used ground modems
- Built-in test functions reduce Integration and Test (I&T) effort – ultimately reducing cost
- Configurable as mission requirements change or as new missions come online
- Commercial AES Encryption / Decryption standard feature with built in AES Key Manager
- Standard TCP/IP, GEMS, REST and VITA-49 interfaces make integration a snap and protect
- Pure Software Implementation for signal processing functions
- Access and control from anywhere through the web. No client software to install or maintain
quantumFEP Key Specifications

<table>
<thead>
<tr>
<th>Commanding (Transmit)</th>
<th>Telemetry (Receive)</th>
<th>Features</th>
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</table>
| • Transfer Frame Services  
  - Master Frame Service | • Framesync  
  - User definable | • CCSDS Packet Processing  
  - 132.0-B-1 (TM Space Data Link Protocol)  
  - 133.0-B-1 (Space Packet Protocol)  
  - 231.0-B-1 (TC Sync & Channel Coding)  
  - 232.0-B-1 (TC Space Data Link Protocol)  
  - 732.0-B.2 (AOS Space Data Link Protocol) |
| • CLTU Formatting | • Supported Transfer Frame Versions  
  - AOS & TM | • Reed-Solomon Encoding: (223, 255), (239, 255)  
  - Interleave: 0 to 8 |
| • Reed-Solomon Encoding: (223, 255), (239, 255)  
  - Interleave: 0 to 8 | • Reed-Solomon Decoding: (223, 255), (239, 255)  
  - Interleave: 0 to 8 | • AES Decryption |
| • OTAR | • AES Encryption | • HDLC Decoder  
  - Bitwise |
| • AES Encryption |  |  |

Cloud Enabled Technologies
quantum leverages our proven experience in RF and C2 solutions to develop pure software applications that are modular and extensible. This includes the ability to integrate with cloud-enabled satellite antenna services.

quantum is comprised of three modular elements that make a complete small satellite ground package.

quantum FEP pure software satellite front end processor that provides digital processing and network connectivity needed between the Command & Control (C2) system and the RF signal processing equipment.

quantumRadio pure software based signal processing solution when C2 and digital front end processing are already in possession. Supports a wide range of uplink/downlink frequency bands at low to high data rates.

quantumCMD pure software based command & control of single satellites up to large constellations. Manages contact scheduling and execution on all passes, provides a single portal for viewing all ground and space status and consolidates data, security and system administration tasks.

Contact us today about cloud-enabled technologies that bring cost-optimization, flexibility and reliability to your operation.