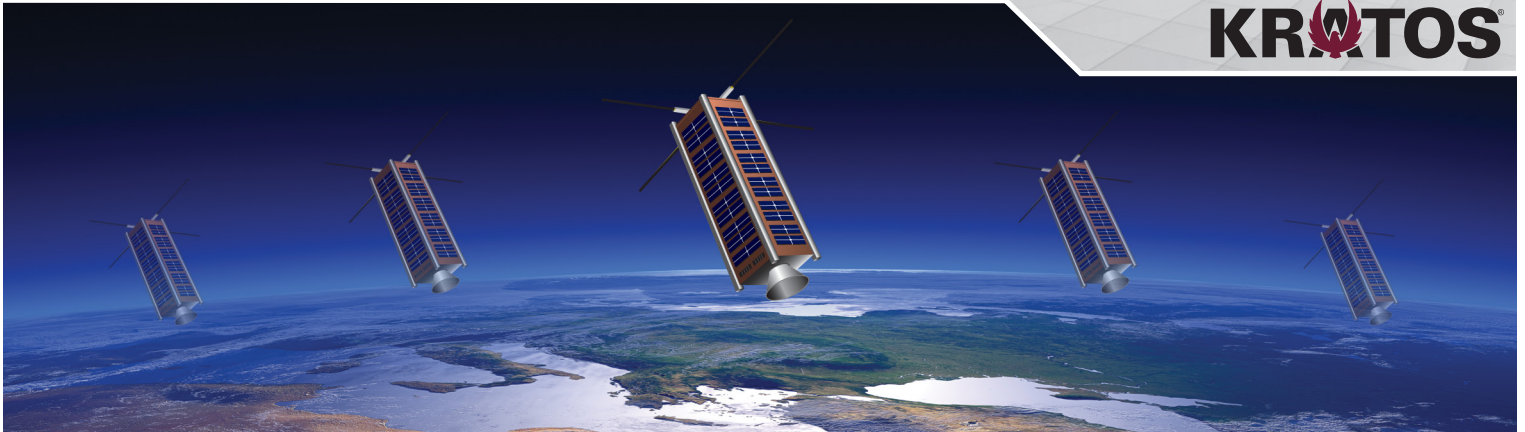# Command & Control for Small Satellites
quantumCMD®

KRATOS®

Kratos leveraged its 25 years of satellite TT&C experience to design and develop quantumCMD, the command & control (C2) system specifically for small satellites. As a commercial-off-the-shelf software application, quantumCMD is available out of the box with all the traditional functionality expected by large satellite missions; reliability, security, and automation. Unlike many of the traditional C2 systems, quantumCMD is designed specifically for small satellite missions and operators which means extra emphasis was expended to reduce ground system integration time / cost, decrease learning curves, and increase customization. All of which leads to a quicker turn-around to standing up an operations-ready ground system at lower costs.

quantumCMD employs industry standards such as Ground Equipment Monitoring Service (GEMS) and XML Telemetric and Command Exchange (XTCE) to streamline integration, reduce cost and dramatically shrink the time to full operation.

A standardized command and telemetry database ingest format increases the efficiency of system set up, as well as consolidating the ingest of ground equipment variables and directives. In addition, standardized ground equipment interfaces allow quantumCMD to be plug-and-play with the rest of the ground system.

The price of traditional C2 systems is not just about the hardware and software. Integration and unique mission customizations also drive costs during development and pre-launch operations. Operations and maintenance of the resulting complex ground system compounds Total Cost of Ownership (TCO) even after fully developed.

Flexibility To Meet A Variety of ConOps

As a pre-configured software application, quantumCMD can be online and supporting missions in a fraction of the time and cost of traditional C2 systems. Set up is reduced to a few steps for streamlined implementation and operation, leading to a TCO far below traditional solutions. quantumCMD is available in two configurations:

Everything Needed, All In One Application

quantumCMD is a purely software application designed from the "ground" up to meet the specific technical, mission, schedule and budget of small satellite operations. Architected to support the core command, telemetry, trending and ground M&C needs common to small sat missions, out of the box functionality includes:

- Frame or Packet Decommutation
- Point Context Check
- Engineering Unit Conversion
- Measurand Limit Check and Alarming
- Point and Track File Generation
- Ground Device Monitor and Control
- Command Generation
- Command Formatting
- Command Authority Check
- Transmission & Tracking
- Verification
- Logging & Messaging
- Procedure Scripting
- Display Building
- Real-Time User Interface
- Ops Automation
- Plotting and Trending
- Raw Telemetry and Processed File Retrieval
- Mission Data File Generation

quantumCMD's Key Specifications

	Essential	Enhanced
Focus	Core set of capabilities and functions needed to support a basic small sat mission	Complete set of capabilities that support more complex missions and ConOps. Includes playback utility.
Number of Simultaneous Contacts	1	1
Maximum Telemetry and Command Database Size	2000 Telemetry Points 500 Commands	2500 Telemetry Points 1000 Commands
Support Included	8 hours Q&A support via telephone Tutorial Document	16 hours Q&A support via telephone Tutorial Document
Automation	Yes	Yes
Hardware Requirements	2CPU, 8GB RAM, 60GB HDD	
Operating System Requirements	Linux	

Ready for What's Next

quantum is a complete small sat ground system package that includes the three major elements you need: Command and Control (quantumCMD) coupled with digital front end processing (quantumFEP) and RF signal processing (quantumRadio).
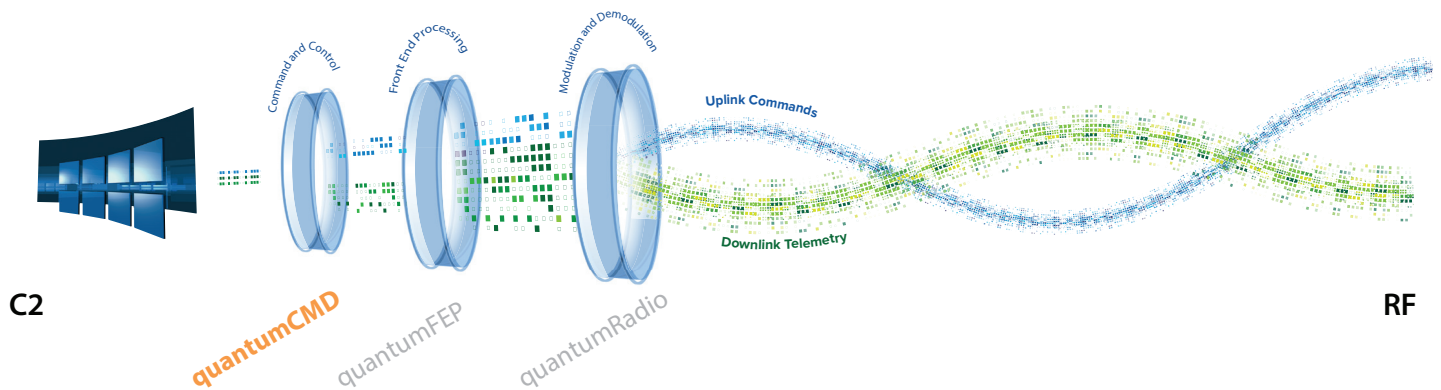

Figure 1: quantum Product Line

quantum leverages our proven experience in RF and C2 solutions to develop pure software applications that are modular and extensible, a ready to use "out-of-the-box" solution.

Some small sat ground systems already have a C2 solution selected. Some are planning on using a third party ground network to provide signal processing and antenna resources. Whatever your preferred approach to communicating with your satellite or constellation, the modular elements of quantum are available to complete your ground system architecture:

- **quantumFEP** connects C2 systems to RF signal processing equipment - handling command and telemetry stream formatting, encryption/decryption devices, CCSDS processing, and network interfaces to either quantumRadio or third party ground antenna networks.
- **quantumRadio**, the signal processing solution when you have your C2 and digital front end processing already covered. Supports a wide range of uplink/downlink frequency bands at low to high data rates.

Unless your satellites are already flying and your end-to-end ground system is 100% complete... call us! Give us a call and let us show you how easily and quickly you can be ready to fly your satellite.