# RADIANT

## Spacecraft Flight Software

Radiant is the Space Dynamics Laboratory's (SDL) fully reusable core flight software solution for small spacecraft. For compatibility with various architectures and systems, SDL developed Radiant without ties to specific hardware platforms. Radiant targets a real-time Linux environment with possible future support for additional real-time operating systems.

### MODULAR, FLEXIBLE ARCHITECTURE

Radiant is designed as a decentralized system of independent applications where each application independently describes its own control and telemetry using XML. These XML capability descriptions also act as well-defined simulation boundaries for the system.

This decentralized architecture enables new missions to completely reuse applications without any modification to the core Radiant flight software. Tasks often hard-coded, such as telemetry aggregation, health monitoring, mode transitions, system states, and memory protection, are all driven through XML configuration files. Relying on configuration rather than coded logic decreases development time while increasing flexibility on orbit. This adaptability enables SDL to fulfill a broad range of missions while minimizing software development and qualification. Radiant is currently in use on over 10 small satellite missions.

### SEAMLESS INTERFACING

Radiant's modular architecture enables users to easily interface with mission-specific applications, hardware, ground test equipment, and software without core code modification. Radiant-based systems interface with test software across an Ethernet link. This provides full access to system telemetry and commanding and does not require a special mode of operation.

### APPLICATION DEVELOPMENT

Users can develop new applications against the Radiant Application framework, which provides a structured development paradigm and simple access to other applications or subsystems.

### ISO 9001 COMPLIANT

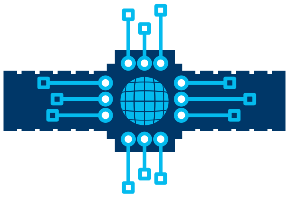
SDL developed the Radiant software suite in compliance with its ISO 9001 registered Quality Management System software development procedures. These procedures include a documented method to control and verify software development to ensure that the finished product meets specified requirements within schedule and budget constraints.

This is accomplished through measurable benchmarks and traceability using the following:

- Feature-driven agile development
- Formal inspections & peer reviews
- Static & dynamic code analysis
- Formal validation & acceptance tests
- Automated regression tests
- Managed configuration control & change processes
- Deficiency tracking & reporting

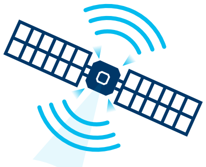
### FEATURES

- Modular, flexible architecture enables reusability & minimizes development costs
- No ties to specific hardware components
- Seamless interfacing without code modification
- XML-defined messaging for universal compatibility



PAYLOAD INTERFACING

FAULT DETECTION & RECOVERY



FLIGHT SOFTWARE

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# **RADIANT** Spacecraft Flight Software

## RADIANT MINIMUM REQUIREMENTS

- 100 MHz CPU
- 32 MB RAM
- Linux-based operating system
- Read/write file system

## RADIANT MODULES

### Command Processor

- Handles command routing, command execution timing, command schedule management & stored command sequences

### Telemetry Processor

- Oversees telemetry collection, telemetry routing for downlink, throughput management, storage & logging

### State of Health Monitor

- Conducts condition monitoring, autonomous events & application health monitoring

### File Manager

- Enables file uplink, file downlink, file system access, on-orbit flight software updates, package management & memory scrubbing

### Mission Manager

- Manages spacecraft state, mode transitions & framework for handling autonomous events

### CCSDS Comm Link Module

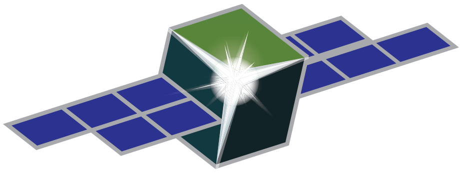
- Provides a reusable interface for full CCSDS TC/AOS framing, packetization, virtual channels & FARM-1 frame validation

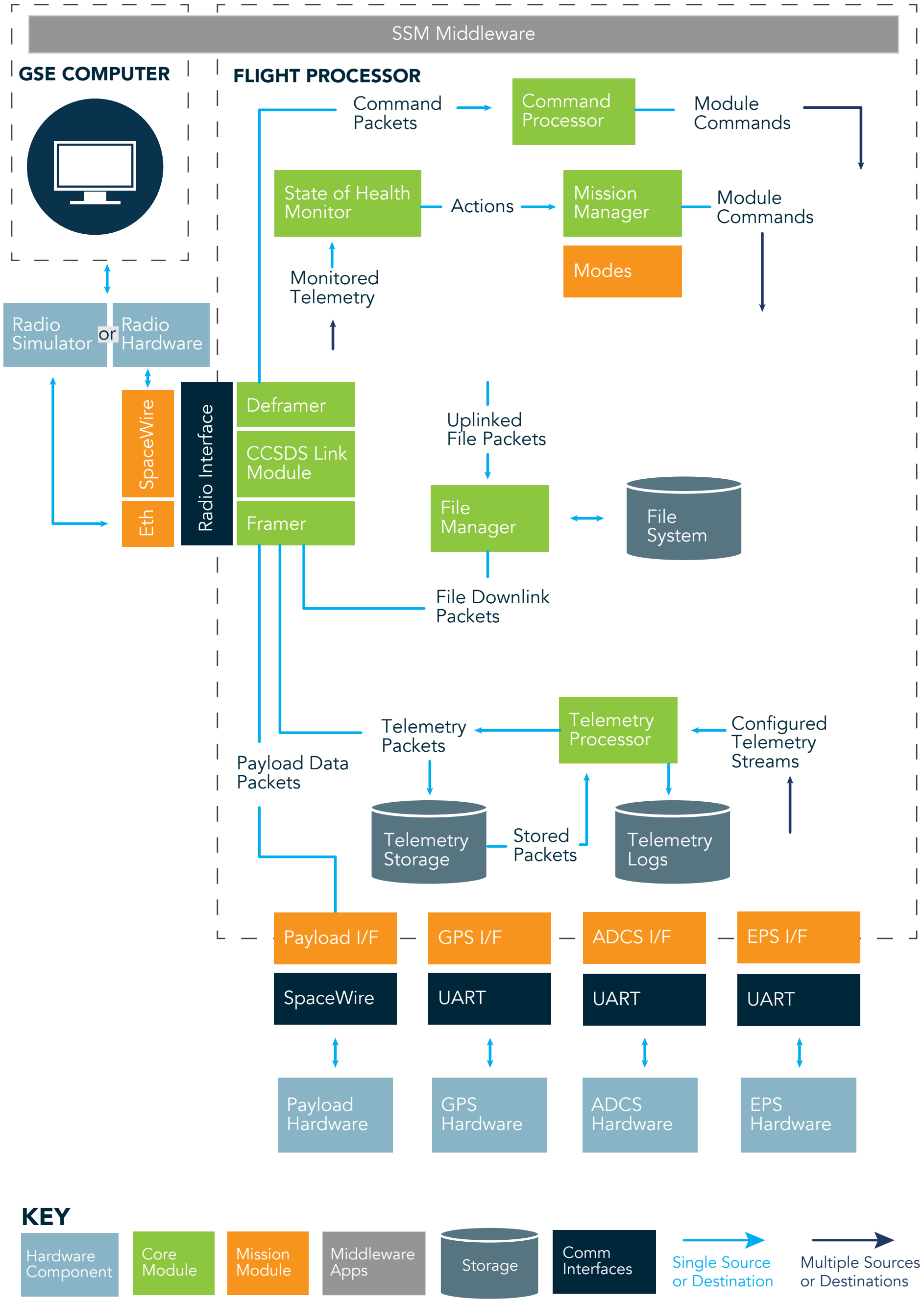
### SSM Middleware

- Facilitates inter-process communication, publish-subscribe paradigm, capability registration/querying & GSE interfacing

## RADIANT SAMPLE SYSTEM SETUP

The following diagram outlines a possible setup using the Radiant flight software and illustrates Radiant's modular architecture and flexibility.




SSM Middleware
GSE COMPUTER
FLIGHT PROCESSOR
Command Packets
Command Processor
Module Commands
State of Health Monitor
Actions
Mission Manager
Module Commands
Modes
Monitored Telemetry
Radio Simulator
or
Radio Hardware
SpaceWire
Eth
Radio Interface
Deframer
CCSDS Link Module
Framer
Uplinked File Packets
File Manager
File System
File Downlink Packets
Telemetry Packets
Telemetry Processor
Configured Telemetry Streams
Payload Data Packets
Telemetry Storage
Stored Packets
Telemetry Logs
Payload I/F
GPS I/F
ADCS I/F
EPS I/F
SpaceWire
UART
UART
UART
Payload Hardware
GPS Hardware
ADCS Hardware
EPS Hardware
KEY
Hardware Component
Core Module
Mission Module
Middleware Apps
Storage
Comm Interfaces
Single Source or Destination
Multiple Sources or Destinations