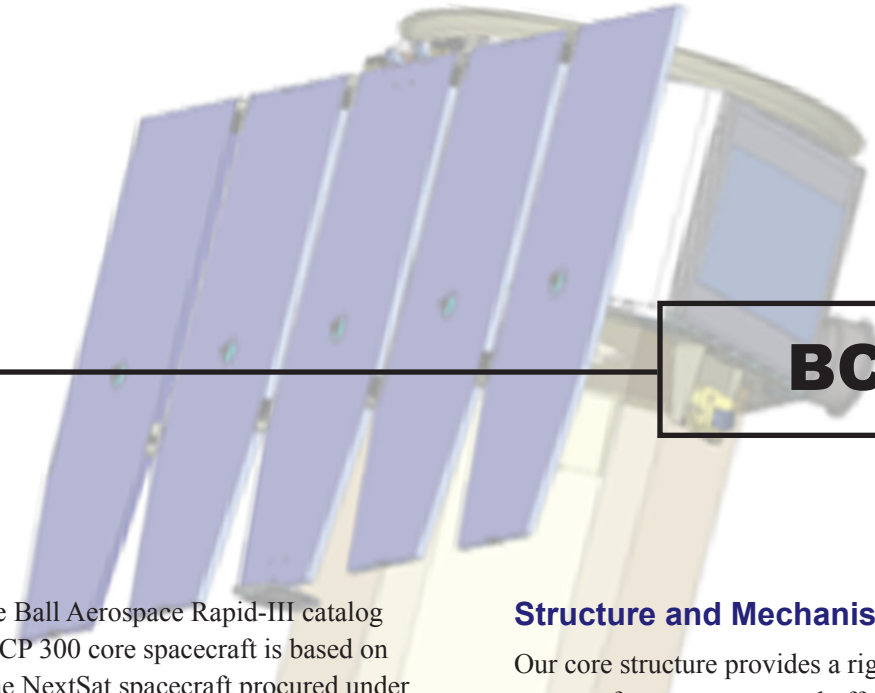


BCP 300

The Ball Aerospace Rapid-III catalog BCP 300 core spacecraft is based on the NextSat spacecraft procured under DARPA's Orbital Express program and the WISE spacecraft built for NASA. NextSat was launched March 8, 2007 mated to its servicing spacecraft, aboard an Atlas V. It was inserted into a 500 km, 46 degree inclined orbit. NextSat was decommissioned, as planned, July 20, 2007, after successful completion of all mission objectives.

The Ball Aerospace Rapid-III BCP 300 core spacecraft represents a natural evolution from the NextSat and WISE implementations. It is a single string design based on high quality parts and proven processes, producing a reliable platform for shorter duration missions (Ps >0.9 at 1 year). It has excellent pointing, agility, and data throughput capabilities that enable cost-effective mission designs.

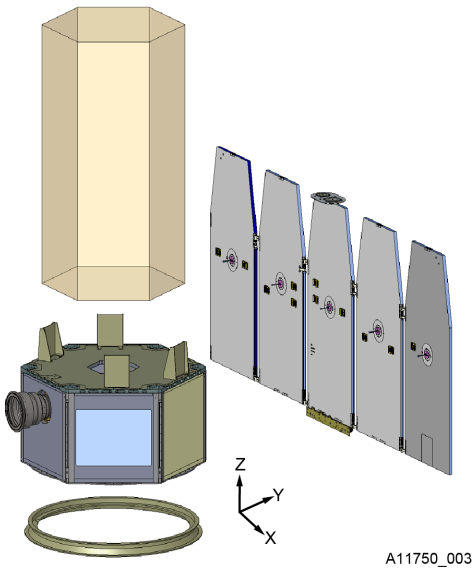
The BCP 300 design is highly configurable, and can accommodate earth-pointing or space-pointing instruments, or support technology demonstration applications. The BCP 300 is compatible with low-earth orbits from 400 to 900 km and all inclinations. This spacecraft is compatible with Pegasus, Taurus XL, Delta II and Atlas V secondary, Falcon 1/1e, and other launch vehicles.

Structure and Mechanisms

Our core structure provides a rigid platform for mounting spacecraft components, and offers clean interfaces to the instrument and launch vehicle. The compact structure provides a large instrument volume fitting within the fairing dynamic envelope of many candidate launch vehicles.

The BCP 300's structure accommodates spacecraft components mounted on interior panels, enabling a deployable solar array wing to be folded around the structure for launch on smaller launch vehicles. The external panel surfaces provide thermal radiator areas.

The solar array is a simple flight proven foldout panel design, consisting of one fixed wing comprised of five rigid panels.



Deployed Spacecraft. *Large payload volume supports instrument mounting and FOV requirements with a minimum of incursions.*

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Characteristic	Previous BCP 300 Implementations		Rapid III BCP 300
	OE/NextSat	WISE	
Observatory Mass	215 kg	661 kg	389 kg
Payload Mass	63 kg	363 kg	250 kg
Bus Mass (dry)	152 kg	298 kg	139 kg
Observatory Power	215 W	288 W	335 W
Bus Power (orbit avg)	147 W	197 W	135 W
Payload Power (orbit avg)	58 W	91 W	200 W
Battery Capacity	29 A-Hr	29 A-Hr	24 A-Hr
Mission Life Requirement	4 months	7 months	>12 months
Launch Vehicle	Atlas V (shared)	Delta 7320	Pegasus XL
Downlink Data Rate	0.524 Mbps	100 Mbps	2 Mbps
On Board Memory Storage	0.256 Gbits	768 Gbits	8 Gbits
Pointing Knowledge (3-sigma)	0.5 deg	0.007 deg	0.08 deg
Pointing Control (3-sigma)	2.89 deg	0.007 deg	0.08 deg

The range of performance achieved by the BCP 300 systems built to date is consistent with our core spacecraft's performance and demonstrates the ability of our design to support a variety of mission specific needs.

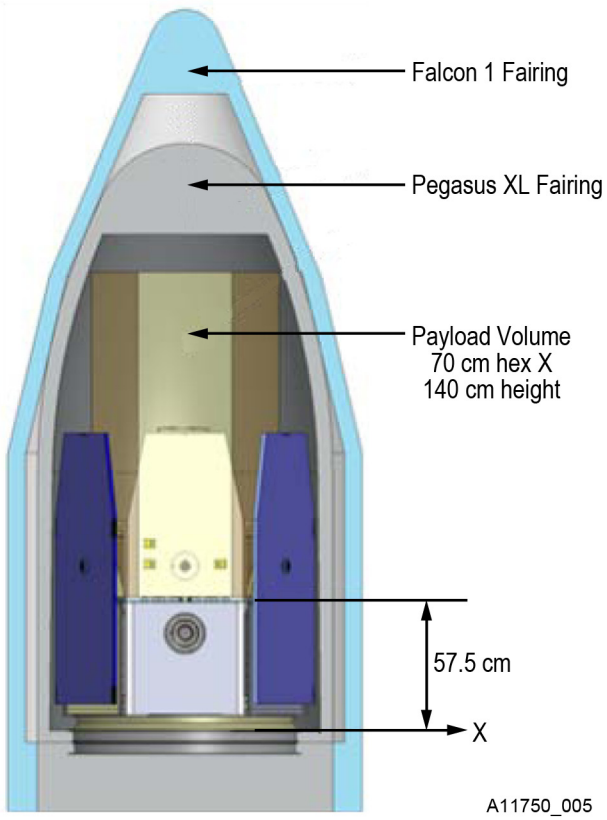
Electrical Power

The Electrical Power and Distribution Subsystem (EPDS) provides reliable power generation, energy storage, and power distribution to support payload and spacecraft power demands. The EPDS implements an unregulated, direct energy transfer system connecting the solar arrays and the lithium ion battery directly on the power bus.

The BCP 300 uses a single Li-ion battery pack. The high efficiency battery was selected based on its overall performance, long cycle life and significant flight heritage.

Communication

The BCP 300 communications subsystem provides the interface between the spacecraft and the ground. The uplink/downlink uses a STDN-compatible transponder, ensuring compatibility with NASA ground stations. The communications subsystem includes low gain antennas located on opposite sides of the spacecraft and passively coupled together to provide near 4π steradian coverage. The command channel supports multiple uplink rates, and the telemetry channel provides up to 4 Msps BPSK downlink.



Stowed Spacecraft. *Compact spacecraft bus allows for ample payload volume even in small launch vehicle fairings.*

Attitude Control

The BCP 300 is a three-axis stabilized system, providing a highly stable and agile platform for fine pointing payloads. The ADCS uses reaction wheels as the primary control actuators and a star tracker as the primary sensor. The system also employs sun sensors and a magnetometer to complement the primary sensor and provide data in fault/safe mode, and magnetic torque rods for backup control authority and momentum management. A zero-momentum control system provides precise control torques and momentum storage.

The BCP 300 ADCS uses flight-proven algorithms and a modular table-driven design to provide capability and flexibility for on-orbit operations. Table parameters affecting ADCS performance are adjusted via table loads rather than FSW changes, to simplify operations and optimize performance.

The ADCS implements distinct mission (fine pointing), de-tumble, and safe modes based on heritage, flight proven algorithms.

Command and Data Handling

The C&DH subsystem performs all command, telemetry processing and routing. In addition, it controls the central data network; collects, formats, and stores all spacecraft housekeeping data; and provides the flight software the ability to monitor and control all other spacecraft functions. The C&DH subsystem provides a platform not only for command and telemetry processing, but also for execution of attitude determination and control system algorithms, payload commanding/data interfacing, mass storage and power distribution services.

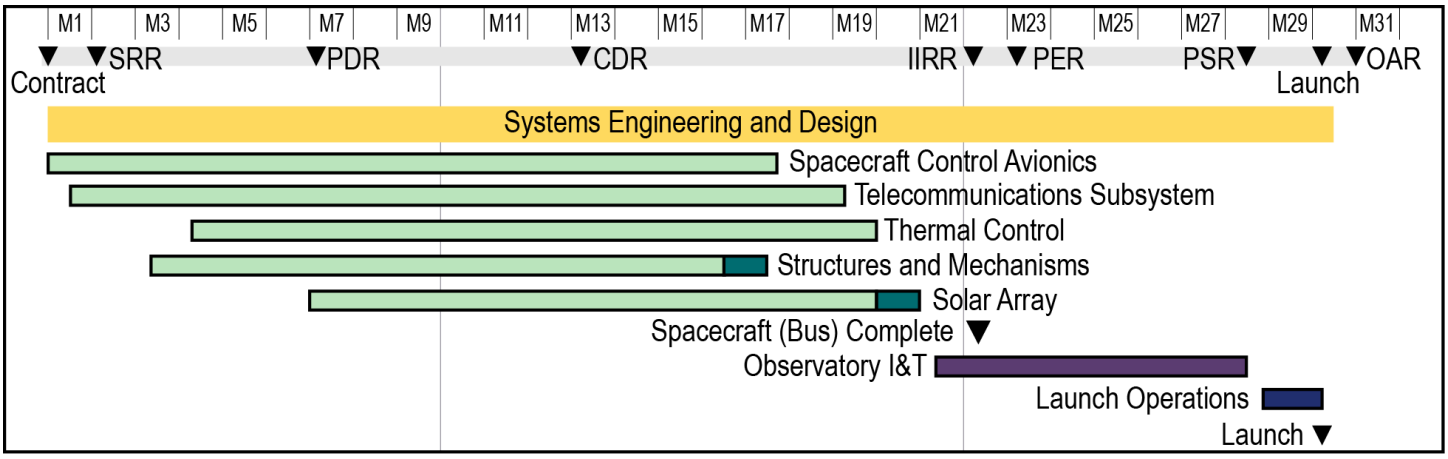
The subsystem is built around a Rad750 processor, and incorporates 1Gbyte of SDRAM. The C&DH subsystem supports the upload of new flight software to the computer on-orbit. Because two or more copies of the flight software image are stored in the computer, the spacecraft can be operational while new on-orbit software is loaded.

Flight Software

BCP 300 uses the heritage BCP 2000 Flight Software (FSW) flown on QuikSCAT, CloudSat, and ICESat. It runs on the Rad750 single board computer. The FSW performs the following functions: command processing; FSW table and code loads; absolute and relative time-tagged stored command management; telemetry collection, filtering, monitoring, and packetization; current time bulletin, position, attitude, and attitude rate information to the payload instrument and telemetry and mission data collection from the payload instrument; fault detection and response; spacecraft pointing, attitude determination and control, and orbit propagation; and battery charge control.

Thermal Control

The BCP 300 Thermal Control Subsystem (TCS) design employs standard, proven, passive thermal control techniques, such as: heaters, multi-layer insulation (MLI), radiator surfaces, and thermal control surface finishes to satisfy thermal requirements with margin. Payloads and payload electronic boxes are isolated from the bus with isolating mounts and MLI. Temperature telemetry is provided for payloads and critical bus components.



The typical Rapid III program is a 30-month program which includes two months of schedule margin and a one-month commissioning phase.

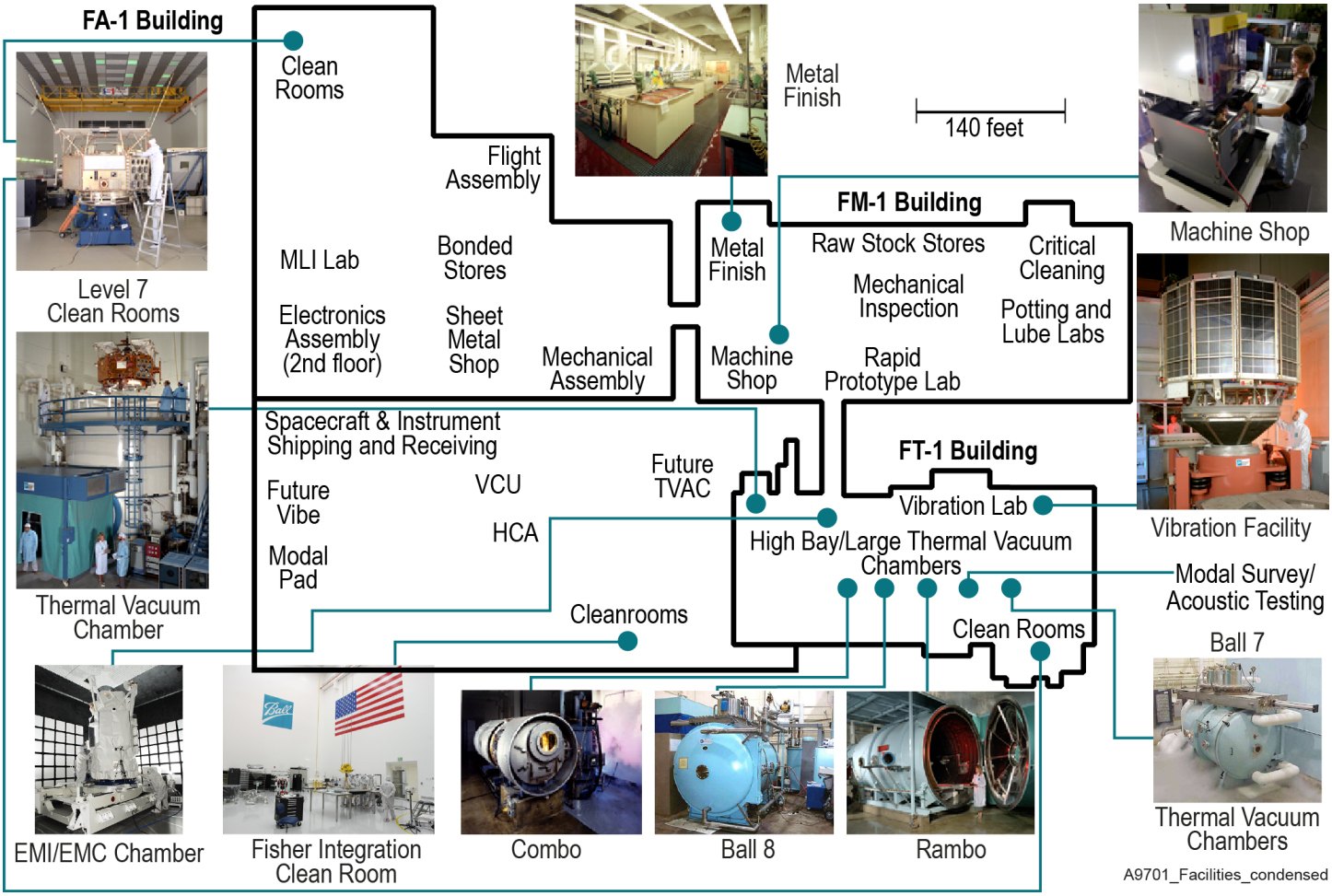
Payload Electrical Interface

The Payload Interface Board (PIB) provides four identical high-rate data, command, and real-time telemetry interfaces to the payload(s). Each high-rate interface can be either a synchronous interface (clock, data, and enable) operating at up to 2.000 Mbps or an asynchronous interface (UAR) operating at a BAUD rate of up to 460800. The PIB also provides each payload electrical interface with an identical 1 PPS timing signal.

Specific command and telemetry interfaces can be adjusted to accommodate the specific payload.

Facilities

As an end-to-end producer of space systems, Ball Aerospace has all of the development and production facilities required for the design, production, assembly, integration, and test of components, spacecraft, space instruments, and fully integrated observatories. Ball Aerospace facilities accommodate instrument needs from initial delivery, through integration with the spacecraft, and on to integrated system-level testing.



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