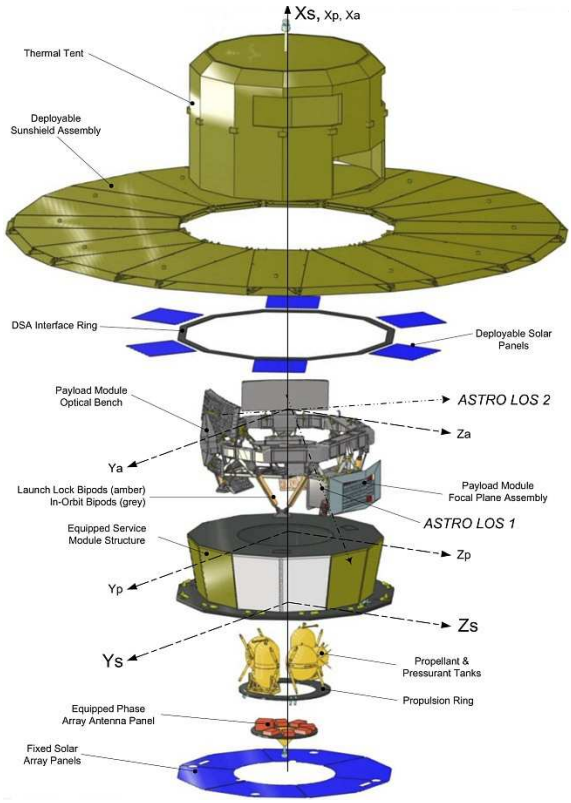

Schematic view of the adopted design of the Gaia spacecraft. Image courtesy of EADS Astrium.

The Gaia spacecraft provides all necessary support to the payload instrumentation. Generally, the spacecraft subsystems follow well-established spacecraft engineering approaches, although specific innovative features are needed for Gaia, for example for the mechanical and thermal configuration, and for the telecommunication subsystem.

Mechanical design: the main structure, of hexagonal conical shape to avoid turning shadows on the sunshield, is an aluminium structure with carbon-fibre reinforced plastic (CFRP) walls, and a central tube supporting the propellant tanks. The deployable solar array is made of 12 panels (CFRP structure back-insulated with multi-layer insulation, and shape-memory alloy hinges) and completed with a sunshield made of multi-layer insulation sheets with Kevlar cables for deployment post launch.

Thermal control: the very high stability thermal control is achieved through optical solar reflector material, multi-layer insulation sheets on the outer faces of the service module, and a black painted cavity with a heat pipe network.

Propulsion and attitude control: after injection into its L2 transfer orbit, a chemical bi-propellant propulsion system is used for the transfer phase: attitude acquisition, spin control, mid-course corrections, L2 orbit injection, and safe mode. One redundant set of cold-gas thrusters will control the operational orbit and spin motion once at L2. Three Sun acquisition sensors plus one gyroscope provide spin-axis stabilisation during the transfer phase, with one large field of view star tracker plus use of the main instrument for the 3-axis controlled operational phase.

Payload data handling: dedicated processing electronics are provided for the computationally intensive tasks of on-board object detection, attitude determination, window allocation, data compression, and temporary storage (a solid state memory of 800 Gbits). The typical (continuous) payload data rate is about 1 Mbps.

Power and electrical subsystem: the required solar-array area is split into a number of deployable and fixed panels, with GaAs cells on a CFRP structure. A lithium-ion battery is used for launch and early-orbit operations.

Communications: telemetry and telecommand employs X-band up- and down-links with a few kbps capacity and an omni-directional coverage. The science telemetry X-band down-link has a 4–8 Mbps capacity which is used during each ground station visibility period (of about 8 hours per day), based on a set of electronically-scanned phased array antennae accommodated on the service module panels.