Flight Dynamics Services

Flight Dynamics Services encompass mission analysis and spacecraft orbit and attitude determination & control both in the launch and early orbit phase and during the routine phase.

Flight Dynamics Services are integral parts of any Spacecraft Operations service provided by Telespazio, but they can also be provided on a stand-alone basis. The relevant activities during the execution of the operations are summarized in the mission analysis. Depending on satellite platforms and mission requirements, the FDS team develops the mission dependent software applications related to the Orbital, Attitude, Payload and Ground Station Network support products. Operations support is mainly related to Orbit and attitude determination, manoeuvre planning and estimation and tracking data generation. Contingency support is provided by the Mission Analysis Team.
FLIGHT DYNAMICS SERVICES

SERVICE OVERVIEW
Flight Dynamics Services provide to the Mission Specialists in the Main Control Room all the information needed to accurately manage the attitude and orbit control as well as spacecraft manoeuvre calculations.

The two phases’ mission lifetime:

Launch and Early Orbit Phase - This is the period immediately after the separation from the launch vehicle up to the time when the satellite is safely positioned in its final orbit (this lasts from 5-10 days). During LEOP the FDS which operates 24/7 on-shift teams, must constantly and in real time monitor both orbit and attitude of the spacecraft and compute the optimized maneuvers (motor burns) needed to attain the target orbit. Acquisition and Tracking data for the Ground Station Network are also generated.

Routine Phase – This phase is all the remaining lifetime from the In Orbit Tests and Validation throughout the Operational Phase which ends with de-orbiting and de-commissioning. During the Routine Phase the FDS team monitors the orbit and attitude data of the spacecraft, reconstructs the satellite orbit and computes the required attitude and orbit maintenance manoeuvres as well as providing control and manoeuvre parameters to the Operations Team.

FLIGHT DYNAMICS ROOMS
Telespazio hosts two Flight Dynamics Rooms at the Fucino Space Centre with dedicated computer platforms and a Complete Network and Computer Redundancy. The FDS Rooms are connected to the TT&C stations’ network and the Main Control Rooms (MCR). All the FDS products are available to the MCRs via a dedicated web server. Mission managers and Spacecraft Engineers can obtain the data required to monitor the progress of the FDS activities, directly from the FDS web pages. Specialized tools are also available to the FDS team for Contingency Analysis and Resolution.
SERVICE CHARACTERISTICS

SERVICE PREPARATION PHASE
The activities of the FDS team start well in advance of a launch with the Service Preparation phase that can take from six to twenty-four months. In the pre-launch phase Telespazio Flight Dynamics specialists prepare the related strategies summarized in the mission analysis, in addition to Dedicated Mission Software to manage a specific satellite platform. They also carry out Mission Analysis in order to compute launch windows, define fuel budgets, and optimise manoeuvres to maximize the satellite lifetime. All the strategies are translated into operational procedures covering both nominal and contingency scenarios. To reach the Operational readiness all Ground facilities, interfaces, operations support procedures and timelines are tested in a realistic environment through simulations. Customer Staff may also participate in these activities pending prior agreement.

SERVICE PROVISION PHASE
During the Service Provision phase, the FDS team, or integrated Telespazio/Customer FDS team, conducts the FDS operations, covering tasks such as:
- Determination of orbit and attitude.
- Calculation of orbit and attitude manoeuvres for both orbit maintenance and payload support.
- Provision of the relevant telecommand parameters for the spacecraft on-board subsystems.
- Monitoring and calibration of on-board AACS sensors and actuators.
- Preparation of sequence of event data for the operations team and of spacecraft visibility information for ground stations, including antenna pointing predictions.

During LEOP the control of on board motors burn, target orbit acquisition manoeuvres’ planning and evaluation are supported by a 24/7 on-shift dedicated team, guaranteeing the mission re-planning support and contingency support with tightly constrained response times.

At the end of the operational phase the FDS team calculates the End-of-Life de-orbiting strategies and relevant manoeuvres required in compliance with the existing regulations.

CUSTOMERS
Eutelsat and Thales Alenia Space can be identified as the principal customers for Flight Dynamics LEOP services.

MAIN FLIGHT DYNAMICS SERVICES PROVIDED IN THE PAST
Since 1990 Telespazio has gained and mastered experience in all types of missions and orbits.
- LEO: SAX, TeMiSat, MITA, Agile, COSMO-SkyMed (SAR#1, SAR#2, SAR#3, SAR#4)
- MEO: GIOVE-B
- GEO: Italsat 1, Italsat 2, Artemis, Sicral, Sicral 1B, AtlanticBird 1, CH6B, CH9, CH12, CIEL2, GALAXY 17, NILESAT201, RQ1R, RC1, T3A, Thor 6, Thaiicom 5, PALAPA D, W2A, W3B, W3C, HB7, HB8, Yamal 402.

MAIN STRENGTHS OF FLIGHT DYNAMICS SERVICES
- Specialized, Experienced and Highly-qualified Flight Dynamics Engineers teams
- Tried-and-tested Flight Dynamics System & Mission Analysis Tools
- High reliability of Telespazio’s existing infrastructures: 2 Flight Dynamics Rooms with full Network and Computer redundancy.
- Proven effectiveness in contingency support (Artemis, Palapa D, RC1, Yamal 402)