R-PLANCK

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# PLANCK

## SCIENCE OPERATIONS

## IMPLEMENTATION REQUIREMENTS

## DOCUMENT

## (SIRD)

PL-000249 (DRAFT #2)
30 September 1997

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## ACRONYM LIST

*It is assumed that an overall **PLANCK** acronym list will be available at a later time. Th e present list therefore only contains the acronyms which are used in the context of th e PLANCK operations and Ground Segment definition.*

| | |
|---|---|
| **AIV** | Assembly Integration Verification |
| **AMS** | Archive Management System |
| **AO** | Announcement of Opportunity |
| **AOT** | Astronomical Observation Template |
| **APH** | Attitude Pointing History |
| **AWG** | (ESA) Astronomy Working Group |
| **CC** | Configuration Control |
| **CMB** | Cosmic Microwave Background |
| **CCS** | Central Command Schedule |
| **C/O** | Check-Out |
| **Co-I** | Co-Investigator |
| **Co-PI** | Co-Principal Investigator |
| **CRP** | Contingency Recovery Procedure |
| **DPC** | Data Processing Centre |
| **DPDD** | Data Processing and Delivery Document |
| **DSRI** | Danish Space Research Institute |
| **D/Sci** | (ESA) Director of Scientific Programmes |
| **EGSE** | Electrical Ground Support Equipment |
| **EM** | Engineering Model |
| **ESA** | European Space Agency |
| **ESOC** | (ESA) Space Operations Centre |
| **FCP** | Flight Control Procedure |
| **FD** | Flight Dynamics |
| **FINDAS** | FIRST Integrated Network & Data Archive System |
| **FIRST** | Far Infrared & Submillimetre Telescope |
| **FM** | Flight Model |
| **FOIRD** | FIRST Operations Interface Requirements Document |
| **FSCOM** | FSC Operations Manager |
| **FOP** | Flight Operations Plan |
| **FSCOT** | FSC Operations Team |
| **FPLM** | FIRST Payload Module |
| **FSC** | FIRST Science Centre |
| **FST** | FIRST Science Team |
| **FTP** | File Transfer Protocol |
| **GSID** | Ground Segment Interface Document |

| | |
|---|---|
| **GSAG** | Ground Segment Advisory Group |
| **GTO** | Geostationary Transfer Orbit |
| **Gb** | Gigabit |
| **HFI** | High Frequency Instrument |
| **HK** | Housekeeping |
| **H/W** | Hardware |
| **ICC** | Instrument Control Centre |
| **ICD** | Interface Control Document |
| **ICS** | Instrument Command Sequence |
| **IFOP** | Instrument Flight Operations Plan |
| **IFCP** | Instrument Flight Control Procedure |
| **ICRP** | Instrument Contingency Recovery Procedure |
| **IIA** | Instrument Implementation Agreement |
| **IID** | Instrument Interface Document |
| **IS** | Instrument Station |
| **ISO** | (ESA) Infrared Space Observatory |
| **ITT** | Invitation to Tender |
| **KAL** | Keep Alive Line |
| **kb** | kilobit |
| **LAN** | Local Area Network |
| **LEOP** | Launch & Early Orbit Phase |
| **LOS** | Loss Of Signal |
| **L2** | L2 Lagrangian point of the Earth-Sun System |
| **Mb** | MegaBit |
| **MCC** | Mission Control Centre |
| **MCR** | Main Control Room |
| **MIRD** | Mission Implementation Requirements Document |
| **MIP** | Mission Imlementation Plan |
| **MMU** | Mass Memory Unit |
| **MOC** | Mission Operations Centre |
| **OBDH** | On Board Data Handling |
| **OBSW** | On Board SoftWare |
| **OHF** | Observation History File |
| **OP** | Observing Programme |
| **PC** | Personal Computer |
| **PI** | Principal Investigator |
| **PID** | Packet Identifier |
| **PPLM** | PLANCK Payload Module |
| **PM** | Project Manager |
| **PR** | Public Relations |

| | |
|---|---|
| **PRP** | Public Relations Plan |
| **PROM** | Programmable Read Only Memory |
| **PS** | Project Scientist |
| **PST** | Project Scientist Team |
| **PV** | Performance Verification |
| **PWG** | Payload Working Group |
| **QLA** | Quick Look Analysis |
| **QM** | Qualification Model |
| **Ra** | Right Ascension |
| **RAM** | Random Access Memory |
| **ROM** | Read Only Memory |
| **RTA** | Real Time Assessment |
| **SAG** | (FIRST) Science Advisory Group |
| **SCOS** | SpaceCraft Operations Control System |
| **SCP** | Satellite Commissionning Phase |
| **SIRD** | Science Implementation Requirements Document |
| **SIP** | Science Implementation Plan |
| **SPACON** | Spacecraft Controller |
| **SMP** | Science Management Plan |
| **SPR** | Software Problem Report |
| **SPC** | (ESA) Science Programme Committee |
| **SRD** | Software Requirements Document |
| **SS** | Survey Scientist |
| **SSAC** | (ESA) Space Science Advisory Committee |
| **SSD** | (ESA) Space Science Department |
| **ST** | Science Team |
| **SVM** | Service Module |
| **S/C** | Spacecraft |
| **S/N** | Signal to Noise |
| **S/W** | Software |
| **TBC** | To Be Confirmed |
| **TBD** | To Be Defined |
| **TC** | Telecommand |
| **TM** | Telemetry |
| **TOO** | Target Of Opportunity |
| **TP** | Telescope Provider |
| **TTC** | Telemetry, Tracking & Commanding |
| **URD** | User Requirements Document |
| **UT** | Universal Time |
| **UTC** | Universal Time Cordinated |
| **WWW** | World Wide Web |

# 1. INTRODUCTION

## 1.1 SCOPE OF DOCUMENT

The Science Operations Implementation Requirements Document (SIRD) is the highest level document defining the requirements for the scientific operations of the PLANCK mission.
It also defines the related responsibilities and tasks of the various participants in the PLANCK mission.

These requirements are compatible with the overall PLANCK mission concept and with the requirements levied on D/OPS in the Mission Implementation Requirements Document (MIRD) for the implementation of the overall Mission.

Implementation of the SIRD requirements shall be compatible with the programmatic, schedule and budgetary constraints applicable to the FIRST/PLANCK Programme.

During the design and development phases (phase B and phase C/D) the scope of the SIRD encompasses all tasks required for the provision of the necessary PLANCK Science Operations facilities.

During the in-orbit operations phase (phase E), the scope of the SIRD encompasses all tasks required to carry out PLANCK scientific operations and data processing in the optimal way compatible with the available resources. For this phase, the detailed activities required to support the scientific operations will be covered in the relevant operations-related documents which will be subordinate to the SIRD.

For the Post-Operations phase the scope of the SIRD encompasses all tasks required to establish the PLANCK "Archive" of data products which is the ultimate legacy of the PLANCK mission. As for the previous phase the corresponding detailed activities and supporting documents must be compatible with the SIRD.

The SIRD will be placed under formal Configuration Control starting with Issue 1 (draft versions are not subjected to this mechanism). Changes in the contents of this document will normally result in changes in cost, schedule and/or performance. Any modification to the SIRD requires formal approval of the FIRST/PLANCK Project Manager and agreement of the PLANCK Project Scientist, Data Processing Centre (DPC) Managers and the ESOC Ground Segment Manager.

Chapters 1 to 3, and 6 provide background information.
The response to the SIRD will be contained in the Science Operations Implementation Plans (SIPs) generated by the Data Processing Centres (DPCs). In case differences arise between the SIRD requirements and the SIPs, the SIRD will have precedence. **The SIPs shall be limited to responding to the requirements set in chapters 4,5, 7 and 8 of the SIRD.** They shall clearly identify the tasks and resources required to fulfil the SIRD's requirements.

*Note: The SIPs -one per DPC- correspond to the Data Processing and Deliver y Documents (DPDD) referred to in the Planck S cience Management Plan (SMP). The SIPs will be used as reference and control documents and will be kept up to date by the DPC managers.*

## 1.2 APPLICABLE / REFERENCE DOCUMENTS

### Applicable documents

AD1: FIRST/PLANCK Satellite System Spec. (PT-SP-00211)
AD2: FIRST/PLANCK Mission Requirements Document (TBW)
AD3: PLANCK Science Management Plan
AD4: FIRST/PLANCK Instrument Interface Document, part A
AD5: PLANCK Instrument Interface Document, part B
- High Frequency Instrument (IID-B: PT-HFI-04141)
- Low Frequency Instrument (IID-B: PT-LFI-04142)

AD6: FIRST/PLANCK Operations Interface Requirements Document (OIRD)
AD7: Guide to applying the ESA Software Engineering Standards (PSS-05-0) to small Software Projects, BSSC(96)2
AD8: ESA Packet Telemetry Standard (PSS-04-106)
AD9: ESA Packet Telecommand Standard (PSS-04-107)
AD10: PLANCK Packet Structure Definition (TBW)
AD11: FIRST/PLANCK Mission Implementation Requirements Document (TBW)
AD12: FIRST/PLANCK Ground Segment Interface Document (GSID)

### Reference documents

RD1: FIRST/PLANCK Science Operations Concept and Ground Segment Document (TBW)
RD2: The FIRST/PLANCK AO
RD3: FIRST/PLANCK Spacecraft User Manual (TBW)
RD4: FIRST/PLANCK Mission Implementation Plan (MIP) -TBW-
RD5: Instrument Proposal HFI
RD6: Instrument Proposal LFI
RD7: FIRST SIRD
RD8: FIRST Science Operations Implementation Plans (SIPs) for:
- The FIRST Science Centre (FSC)

RD9: PLANCK Science Operations Implementation Plans (SIPs) for:
- The HFI Data Processing Centre (HFI-DPC)
- The LFI Data Processing Centre (LFI-DPC)

RD10: Configuration Management and Control for ESA Space Systems (PSS-01-11)

## 1.3 PLANCK MISSION OVERVIEW

PLANCK, (formerly known as COBRAS/SAMBA) is the third Medium-sized mission (M3) of ESA's long-term scientific plan Horizon 2000. The main objective of the PLANCK mission is to image over the whole sky the temperature anisotropies of the Cosmic Microwave Background (CMB) radiation, with a sensitivity $\Delta T/T < 2 \times 10^{-6}$ and at angular resolution of approx. 10 arcminutes. PLANCK is essentially a survey-type project which will be developed and operated as a Principal Investigaror (PI) type mission.

### 1.3.1 Spacecraft

The spacecraft system (cf. figure 1.1) consists of the spacecraft and the five scientific instruments (3 for FIRST, 2 for PLANCK). The configuration follows a modular concept with a physical separation into a FIRST Payload Module (FPLM), located in the upper part, a Service Module (SVM) in the middle part and a PLANCK Payload Module (PPLM) in the lower part of the satellite when in launch position.

The SVM provides all the servicing functions to the two Payload Modules and instruments. In addition it accomodates the warm instrument electronics, the cryo electronics and the telescope's active thermal control electronics.

The PPLM houses the HFI and LFI instruments and the Gregorian telescope. It is protected from direct solar radiation by an outer baffle attached to the SVM.

### 1.3.2 Orbit

The nominal operational orbit for the FIRST/PLANCK mission is a "small" (seen from the Earth) amplitude Lissajous orbit around the 2nd Lagrangian Libration Point ($L_2$) in the Earth/Moon-Sun system.On such an orbit the maximum Sun-spacecraft-Earth angle is less than 15 deg.
Figure 1.2 shows the location of the $L_2$, the location of the other four Libration Points as well as the rotating orbit reference system $X_0Y_0Z_0$. The origin of this frame is at the Earth-Moon barycentre with the $+Z_0$-axis pointing towards the North ecliptic pole and the $+X_0$-axis pointing towards $L_2$.

The in-ecliptic and out-of-ecliptic motions are periodic with a period of about 6 months. The orbit amplitudes are approximatively (TBC)

$- A_Y = 390\,000$ kms
$- A_Z = 125\,000$ kms

The distance between the Earth and the spacecraft varies between $1.2 \times 10^6$ and $1.6 \times 10^6$ kms.

This type of orbit will be free of eclipses for a period of 4.5 to 6 years. The transfer trajectory can be designed such that it is also free of eclipses.

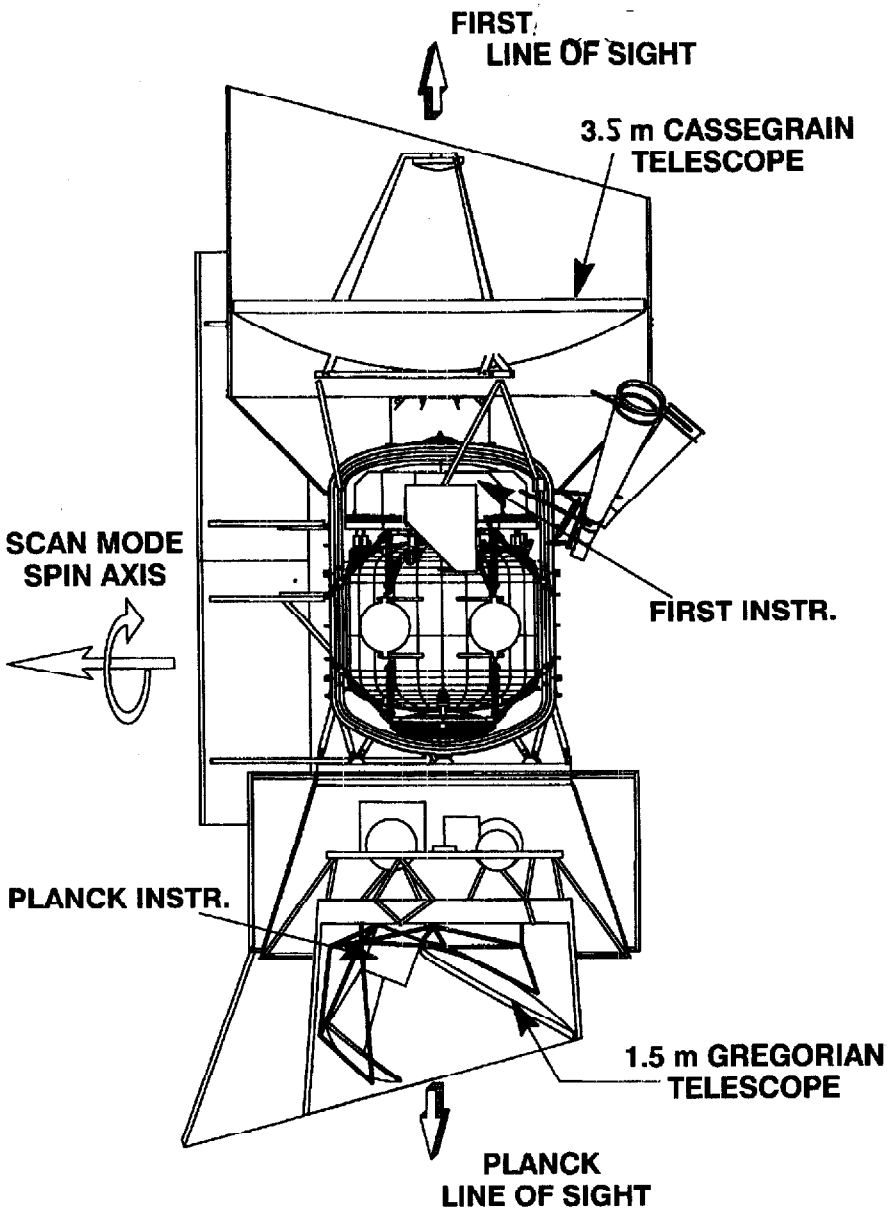


Figure 1.1 -- The FIRST/Planck Spacecraft (Preliminary)

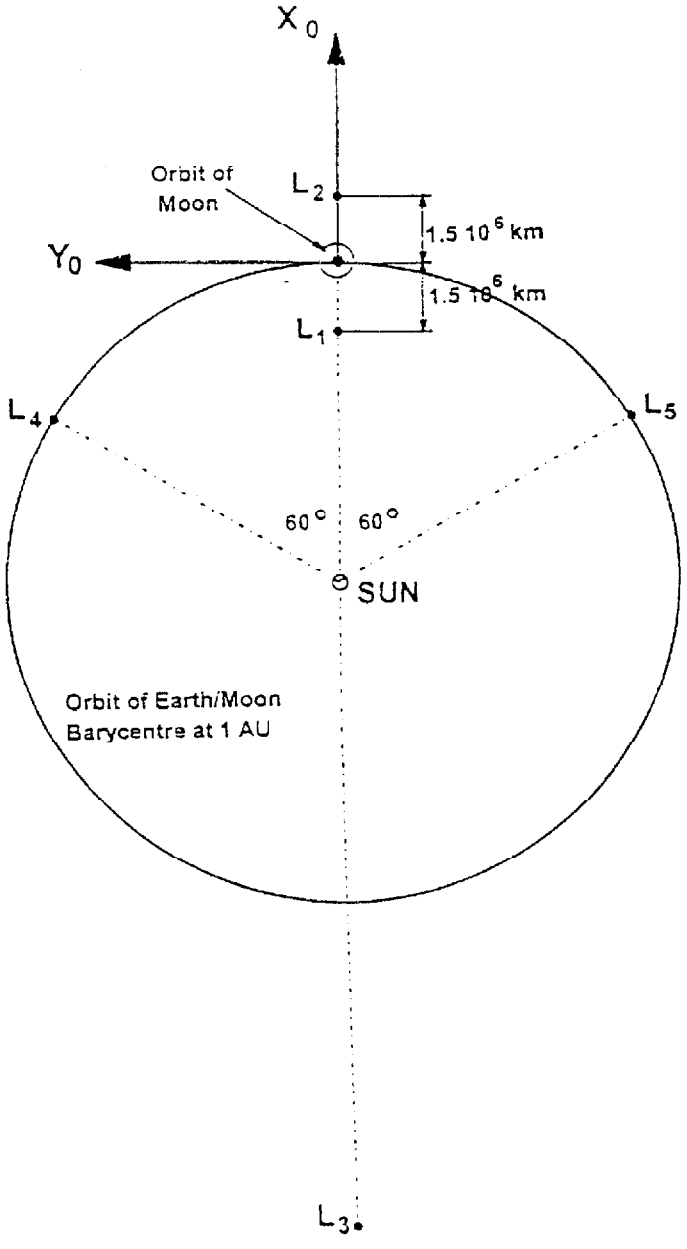


**Figure 1.2 -- The five Libration Points and the rotating orbit reference system**

The final orbit will be selected taking mass, total delta_V, launch window, an d telecommunications constraints into consideration.

### 1.3.3 Instruments

The scientific instrume nts are designed and built by single science institutes or consortia of institutes under the responsibility of a Principal Investigator (PI). Thc PI has the overall responsibility vis-a-vis ESA for the delivery of the instrument.
The Scientific Instruments are:

- The High Frequency Instrument (HFI)
  Principal Investigator: TBD

- The Low Frequency Instrument (LFI)
  Principal Investigator: TBD

Details of the Scientific Instruments can be found in the Instrument Interface Documents (IIDs) - AD4 and AD5-

### 1.3.4 Ground Segment

A single Ground Segment will support both the FIRST and the PLANCK missions.

The Ground Segment fo r FIRST/PLANCK in the operational configuration consists of the elements shown in Fig. 1.3.

The overall ground segment is implemented as a distributed architecture, where th e required facilities are located in seven distinct Centres:

- The Mission Operations Centre (MOC) located in ESOC
- For FIRST, three Instrument Control Centres (ICCs), one per Scientific Instrument.
- For PLANCK, two Data Processing Centres (DPCs), one per Scientific Instrument.
- The FIRST Science Centre (FSC) located at TBD.
  The FSC is also involved -through the FIRST Integrated Network and Data Archive System (FINDAS)- in the support of the PLANCK mission. (see chapter 3.4)

The dotted lines in Fig. 1.3 delimit the elements contributed by the various centres.

For FIRST, Mission scheduling is seen as a shared responsibility between the FSC and the MOC. Interface with the Observers is an FSC responsibility. The Observers interact with the Ground Segment via FINDAS.

For PLANCK Science Mission Planning (generation of the Operations Plan) is not carried out in the FSC but is a PLANCK Science Team's responsibility; Proposal Handling does not exist.

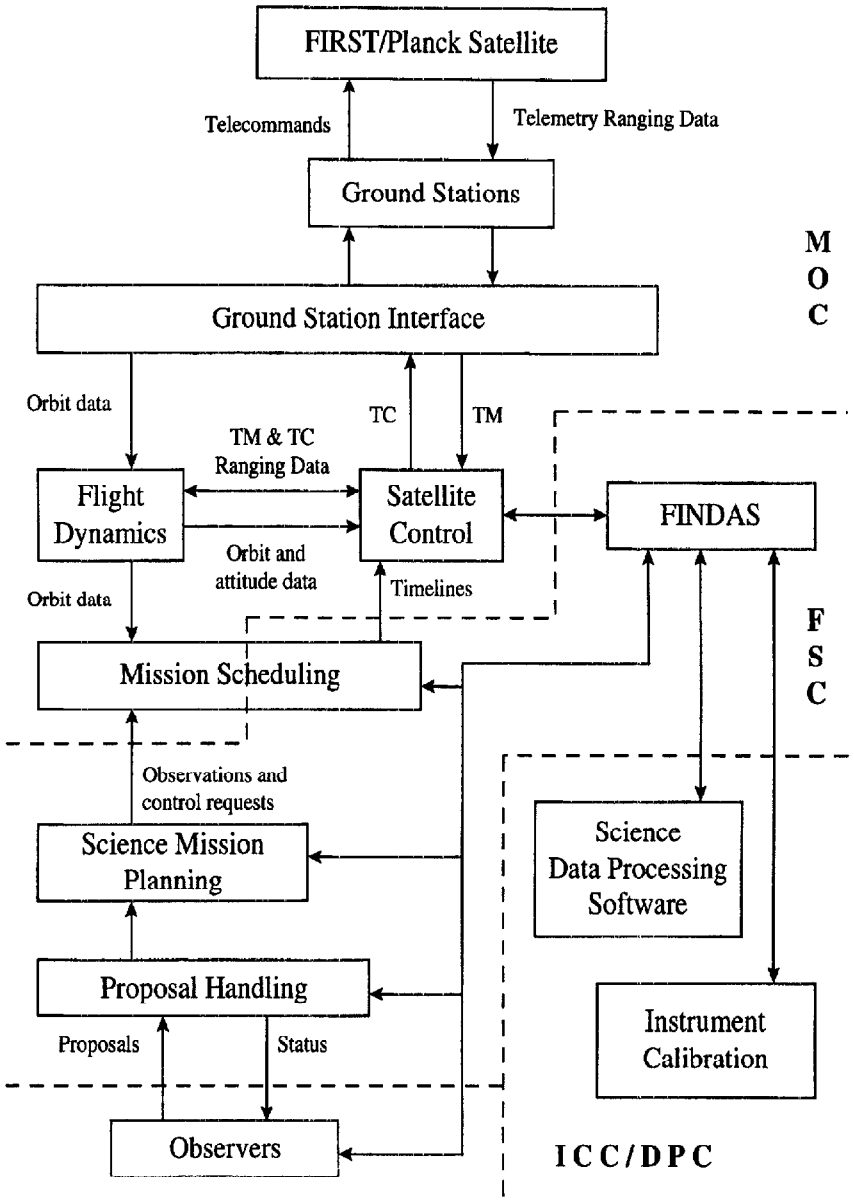


**Fig. 1.3 Ground Segment Overview**

Data Communication lines link the ICCs and the DPCs to the FSC, and the FSC to th e MOC. Non-operational communications between the centres are carried out via Internet (or equivalent), phone and mail.

### 1.3.5 PLANCK Operations

PLANCK will carry out two full surveys of the sky. The time required to complete a single full sky survey depends on t he detailed telescope configuration, and may vary between 6 and 7.5 months. Each survey must be carried out continuously (i.e. without interruptions). The entire PLANCK observation programme is carried out in the early part (i.e. first two years) of thc FIRST/PLANCK mission.

During PLANCK operations the FIRST instruments are switched off. (and vice-versa).

In the PLANCK mode of operations the spacecraft is spinning at 1 rpm (TBC) around the Z-axis and scans the sky in lar ge circles ($90^0$ between telescope line of sight and Z-axis). To maintain its anti-so lar orientation the spin axis is displaced along the ecliptic plane by $1^0$ every day. This is done in step of 5' every two hours.

During the Satellite Commissioning and Performance Verification phases two Groun d Stations -Perth and Kourou- (TBC) will provide nearly full coverage.

In routine phase all operations will be conducted through a single ground station (Perth).

The observation schedule will normally be executed autonomously from telecommand s stored on board. The command schedule will be up-linked daily fr om the ground station(s).

Telemetry gathered during periods of non-visib ility (routine phase) will be stored on board and transmitted in parallel with real time data when the satellite is in view of the ground station.

Spacecraft and instrument control will be performed by a single Mis sion Operations Centre (MOC) according to procedures. Specialists from the instrument developers will not b e required during routine operations but will be accommodated at the MOC with thei r equipment during the Satellite Commissio nning and Performance Verification phases and in case of contingencies (TBC).

All TM, TC and other operational data will be stored by the MOC in a data repositor y (Archive).This MOC archive is a short term store -a couple of weeks maximum- whic h could be used for MOC operations activities and as a buffer store for replay to th e permanent mission archive (FINDAS) in c ase of real time data transfer problems. Access to FINDAS will be controlled by the means of specific access rights.

During routine operations the HFI and LFI operate uninterruptedly i n a unique instrumental mode. Other modes (e.g. un-compressed data modes) are only required during th e commissioning phase or for technical characterisation/diagnostic of the instruments.

## 1.4 GLOBAL RESPONSIBILITIES

D/Sci has overall responsibility for all phases of the FIRST/PLANCK Project.

D/Ops has overall responsibility for execution of all FIRST and PLANCK in-orbit operations.

D/Ops has responsibility for the design, implementation and operation of the FIRST/PLANCK Mission Operations Centre (MOC), ground stations and related elements.

Responsibility for the design, implementation and operation of the ICCs for FIRST and DPCs for PLANCK rests with the corresponding PIs (each PI for the ICC or DPC corresponding to his/her instrument)

Responsibility for the design, implementation and operation of the FSC rests with ESA.

During Phase B and Phase C/D overall project management is ensured by the FIRST/PLANCK Project Manager located in ESTEC.The FIRST Project Scientist represents the interests of the FIRST scientific community.The PLANCK Project Scientist represents the interests of the PLANCK scientific community.

During Phase E, following successful completion of the Commissioning Phase, H/SA will take over the tasks and responsibilities of the Project Manager.

For all phases of FIRST and PLANCK development and operations a " Ground Segment Advisory Group" (GSAG) comprising representatives of the ICCs, the DPCs, FSC, MOC and ESA monitors the activities of the main Ground Segment elements. It advises the FIRST/PLANCK Project Manager during the development phase and the FIRST and PLANCK Project Scientists during the operational phase.

## 1.5 MAJOR PROJECT MILESTONES

The following information is provided for the purpose of cost assessment only. The Project will review and update the project plan and milestones as necessary, but milestone changes will not lead to a separate update of this section.

### 1.5.1 Satellite Milestones

| | | |
|---|---|---|
| (1) | System Review | Jul 1997 |
| (2) | Issue AO | Sep. 1997 |
| (3) | Mission Approval & Payload selection | May 1998 |
| (4) | Issue ITT (Phase B & CD) | Mar. 1999 |
| (5) | Start Phase B | Apr. 2000 |
| (6) | Start Phase C/D | Jul. 2001 |
| (7) | Instrument EM deliveries | May 2002 |

| | | |
|---|---|---|
| (8) | EM System Test (start) | Aug. 2003 |
| (9) | Instrument FM deliveries | Jan. 2004 |
| (10) | FM System Test (start) | Sep. 2004 |
| (11) | Launch Campaign/Contingency (start) | Jun. 2005 |
| (12) | Launch | Dec. 2005 |

### 1.5.2 Ground Segment Milestones

This list is *preliminary*. The milestones need to be reviewed when MOC, ICCs, DPCs and FSC have been established.

| | | |
|---|---|---|
| (1) | Ground Segment Requirements Review | May 2000 (TBC) |
| (2) | Ground Segment Definition Review | Oct. 2001 (TBC) |
| (3) | Ground Segment Design Review | Nov. 2002 (TBC) |
| (4) | Ground Segment Validation Review | Sep. 2004 (TBC) |
| (5) | End-to-End Test # 1 (EE-1) | Mar. 2005 (TBC) |
| (6) | End-to-End Test # 2 (EE-2) | Jul. 2005 (TBC) |
| (7) | Ground Segment Readiness Review | Oct. 2005 (TBC) |
| (8) | Start of Scientific Mission Phase | L + 3 months (TBC) |
| (9) | End of Nominal PLANCK Mission | L + 2 years (TBC) |
| (10) | End of Nominal FIRST/PLANCK Mission | L + 4.5 years (TBC) |

## 1.6 TOP LEVEL DOCUMENTATION

Fig. 1.4 shows the top level documentation relevant to the Ground Segment activities.

- The Mission Requirements Document (MRD) is prepared jointly by the FIRST and PLANCK Project Scientists. It is approved by the FIRST/PLANCK Project Manager (PM).

- The Science Management Plans (SMPs), one for FIRST and one for PLANCK are prepared by the Project Scientists, and, upon approval by H/SA and D/Sci, forwarded to the SPC for endorsement.

- The FIRST/PLANCK Ground Segment and Operations Concept Document is prepared jointly by the Project, Instrument representatives, the PSs and D/TOS. It is approved by the PM.

- The FIRST/PLANCK Satellite System Specification (SSS) is issued by the Project, as well as all other related lower level documents such as the Space-to-Ground Interface Document and Spacecraft User Manual (UM).

- The Instruments Interface Documents -IIDs- (one per selected instrument) are issued by the Project.They include the instrument performance requirements which must be met by the instruments in order to fulfill FIRST and PLANCK scientific objectives.

These requirements serve as a yardstick for evaluation of the instruments in-orbi t performances.

- The Mission Implementation Requirements D ocument (MIRD) is generated jointly by the Project and D/TOS. It is formally issued by the PM. D/TOS formal answer i s contained in the Mission Implementation Plan (MIP). The MIP must be approved by the PM.

- The Science Operations Implementation Requirements Document (SIRD) -thi s document- is prepared by the Project. It must be agreed by the PS, the DP C Managers and the ESOC Ground Segment Manager. The SIRD is formally issue d and approved by the PM.

- The FIRST/PLANCK Operations Interface Requirements Document (OIRD) is issued by D/TOS. It specifies the requirements which mus t be fulfilled by the spacecraft *and* the instruments in oder to allow D/TOS to operate them safely and efficientl y (mainly requirements on TM, TC, autonomy, internal redundancy, etc.). The OIR D must be approved by the PM.

*Note: Many of the interfaces between the various elements of the FIRST Groun d Segment will be defined via FINDAS. It is therefore foreseen to generate at an early stage (early 1999 -TBC-) the corresponding FINDAS Interface Document. The first DRAFT will be issued shortly after the completion of the FINDAS prototype implementation.*

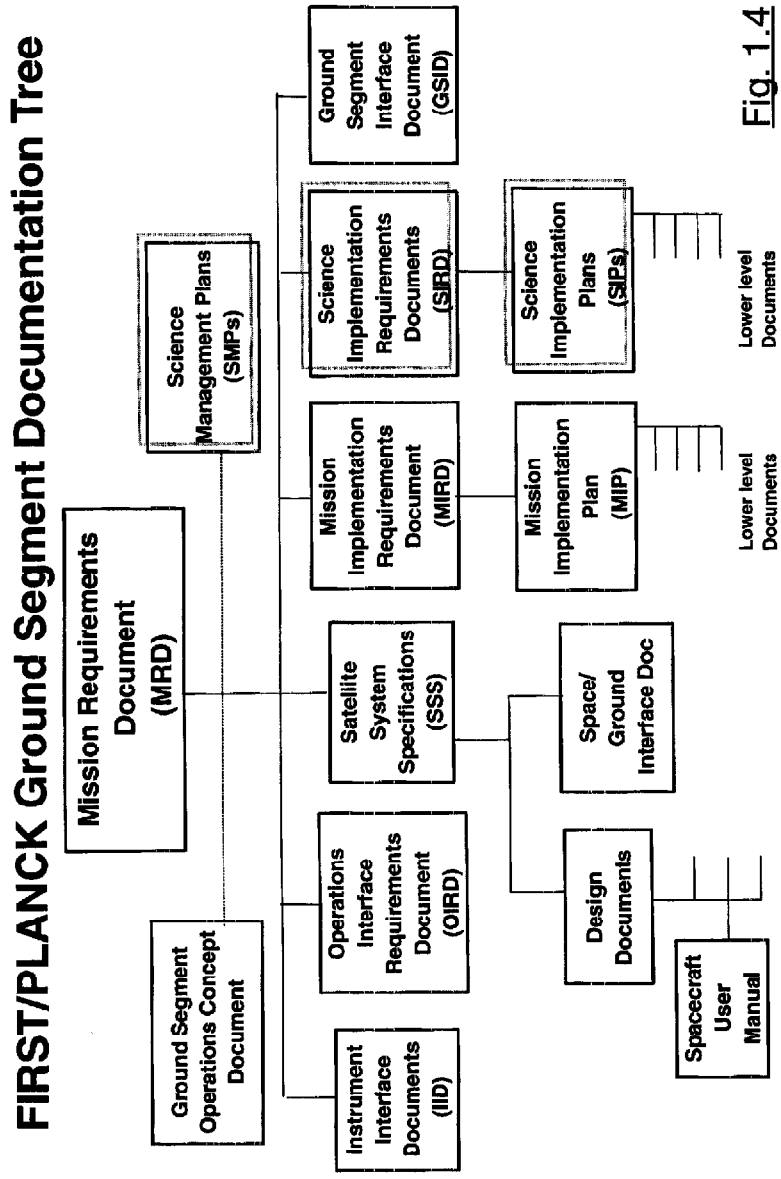


Fig. 1.4

Figure 1.4

# 2. ASSUMPTIONS

The following assumptions are used as a basis for the pla nning of the scientific operations related tasks. It is understood that changes to these assumptions may change the scope and resources required.

## 2.1 MISSION

The PLANCK mission and the FIRST mission will be carried out by a single "merged " spacecraft accomodating two payload modules with their complement of scientifi c instruments. The two missions are **not** carried out concurrently. When FIRST is active , PLANCK is dormant (i.e. the scientific instruments are switched-off), and vice-versa.

## 2.2 LAUNCH

FIRST/Planck will bc launchcd from thc Centre Spatial Guyanais ( CSG) in Kourou, Frcnch Guiana by a dedicated Ariane 5 into a direct transfer trajectory to the $L_2$ Point.

## 2.3 OPERATIONAL PERIOD

Assumed launch date: December 2005
Duration of orbital operations: minimum 4.5 years (includes cool-down, commissioning, performance verification, and routine phase). This is the *total* mission time for both th e FIRST and the PLANCK missions.

## 2.4 MISSION PHASES AND FACILITY UTILISATION

The following mission phases are identified (in agreement with AD1):

### 2.4.1 Development Phase

For the activities covered by this SIRD this phase formally starts at instrument/DP C selection and ends a t the start of the LEOP phase. The MOC and the DPCs are involved for PLANCK, The MOC, the FSC and the ICCs are involved for FIRST.

### 2.4.2 Pre-launch Phase

From six to eight weeks prior to launch till launch minus 8 hours . This phase encompasses the final simulations and data flow tests, including Dress Rehearsal and the final Mission Readiness Tests (MRTs) between the ground stations, the MOC, the ICCs (FIRST), the DPCs (PLANCK) and the FSC.

### 2.4.3 Launch and Early Orbit phase (LEOP)

This phase comprises 3 sub-phases as described in AD1. They are briefly summarise d here. During LEOP the FIRST and PLANCK instruments are switched off.

#### 2.4.3.1 Launch Countdown Phase

Connection of the launch vehicle to the launch table, start of the fin al countdown sequence (at $H_0$ - 6h00), RF flight configuration set up, switch over to internal spacecraft power.

#### 2.4.3.2 Launch Phase

Starts with the removal of the ombilical and ends at separation of th e spacecraft in a 3-axis attitude. Phase duration approximatively 110 minutes (TBC).

*Note: Spacecraft separation (i.e. end of the Launch phase) marks the beginning of th e Transfer phase to $L_2$. The transfer phase lasts several months, up to 8 months (TBC ) depending on initial conditions and final orbit characteristics.Commissionning, PV phase and part of the routine phase are thus carried out during the transfer phase.*

#### 2.4.3.3 Initial Orbit Phase (IOP)

After separation from the launch vehicule the ESA Network (Kourou, Perth, Villafranca ) establishes contact with th e spacecraft for TC, TM and Ranging. The first orbit correction takes place approximatively 6 h ours after injection. If necessary a second orbit correction is carried out about one day after the 1st correction. Subsequently, additional fine orbi t trimm manoeuvres will be executed, if necessary, to reach the correct conditions fo r entering the operational Lissajous orbit.

### 2.4.4 Commissioning Phase

Complete check-out of spacecraft functions and verification of all subsyste m performances. Both the FIRST and the P LANCK payloads are commissionned during this phase. The detailed scenario of the combined FIRST/PLANCK activities is TBD.
Duration of the commissionning phase is TBD (expected duration 6 weeks to 2 months).
Ground stations: Perth and Kourou (VILSPA as back up if required).

### 2.4.5 Performance Verification Phase

Starts after successful completion of the commissionning activities. In addition to th e normal, routine satellite control, includes determination of the satelli te pointing capabilities, calibration of the spacecraft sensors, determination of instrument performance in al l

modes, and initial instrument calibrations. For PLANCK the MOC and the DPCs ar e involved. The total duration of the PV phase for both FIRST and PLANCK is TB D (expected duration 2-3 months). The objective of this phase is to demonstrate th e observatory (satellite + Ground Segment) scientific capability. The way the PV time will be allocated between FIRST and PLANCK as well as the detailed PV scenario are TBD.

*Note: It is likely that part of the PV phase will have to be repeated when one of the two payloads has been dormant for some time, before the routine science operations ca n resume.*

#### 2.4.6 Predefined Science Demonstration Phase

The "cover letter" to the FIRST and PLANCK Science Management Plans foresees, after the Performance Verification phase, a "predefined Science Demonstration"phase before the start of the routine operations.
The duration of this phase will be maximum 0.5 to 1 month. Contents is TBD. Allocation of time between FIRST and PLANCK as well as detailed scenario are TBD.

#### 2.4.7 PLANCK Routine Operations Phase

Nominal duration 12 to 15 months.
Consists of two full sky surveys, of the same duration (6 to maximum 7.5 months).
The first PLANCK survey is carried out immediatly after the Sci ence Demonstration phase.
The second survey 7 to maximum 8 months after, following completion of the FIRST key programmes.

#### 2.4.8 Post-Operational Phase

For PLANCK the Post Operational Phase starts at the completion of the 2nd survey. It s duration is TBD. It comprises the following sub-phases:

##### 2.4.8.1 Data Reduction phase

This phase begins on completion of the secon full sky survey.
Nominal duration: < 1 year (TBC).
During this phase the complete set of raw data collected during the two surveys will b e analysed and th e corresponding data products will be generated (for a description of the various products see AD-3). It is e xpected that, at the end of this phase, the calibration of the data has reached sufficient maturity to ensure that the data products contain only well understood anomalies and/or peculiarities. The data products will be delivered by th e DPCs to FINDAS. If required, any tran sfer of knowledge between the MOC and the DPCs takes place during this phase. The MOC dedicated facilities are no longer used fo r PLANCK.

This phase ends with the deliv ery of the data products to FINDAS, but shall not last more than one year.

#### 2.4.8.2 Proprietary period

Nominal duration: 1 year.
This period starts when the DPCs deliver the data products to FINDAS, but in any case not later than 1 year after completion of the second survey.
Further deliveries of refin ed products to FINDAS may occur during this period. The major activity during this period will be the scientific analysis of the data products by members of the PI Consortia and the Telesco pe Provider team and preparation for product delivery to the community.
During this period, in collaboration with the FIRST Science Centre, the tools required by the PLANCK scientific community to access the products stored on FINDAS, will b e developed.
*Note: It is expected that some of these tools will form the basis for the Archive access tools needed for the support of the FIRST community.*

#### 2.4.8.3 Data Products distribution and access

Nominal duration: TBD
At the end of the proprietary period it is expected that some of the scientific products (e.g. maps), as well as the associated document ation (the "Explanatory Supplement" -see AD-3) will be distributed to the astronomical community via a convenient medium (e.g. CD - ROMs). Some products (TBD) will be accessed directly by the community using th e means provided by FINDAS. The community will access FINDAS at its own costs.

### 2.5 SATELLITE

Details on the Satellite, its performance and characteristics are contained in the applicable documents. Of particular note are the following:

- FIRST/PLANCK will combine two basic modes of operations. In FIRST mode it is a 3 axis stabilized satellite with 3 instr uments. In PLANCK mode it is a spinner (1 rpm) with two instruments. The optical axis of the PLANCK Tel escope is offset by $90^0$ from the rotation axis and scans one full circle in the sky every minute.

- Satellite telemetry (TM) and telecommand (TC) will be in accordance with ES A packet standards. The raw TM data acquisition rate on board will be 68 Kbs (TBC). This is the data generation rate, not the transmission rate.

- The satellite will be provided with a mass data store which will contain:

  - all commands for the observation schedule during TBD days.

- telemetry data gathered during the Dail y Science Operations Phase (DSOP). The transmission data rate will be 600 Kbs (TBC)

- The satellite provides for safe autonomous operation for a period of 72 hours.

## 2.6 ON-BOARD SOFTWARE

All instrument on board S/W will be maintained by the PIs pre- and post-launch. On board S/W management i.e. loading, dumping and comparing me mory images will be carried out by the MOC.

# 3. RESPONSIBILITIES

Responsibility for the implementation of the FIRST/PLANCK ground segment elements relevant to the PLANCK mission and its scientific operations is shared between:

- The FIRST/PLANCK Project Team
- The Directorate for Technical and Operational Support (D/TOS)
- The Project Scientist
- The PLANCK Science Team (ST)
- The Instrument Development Teams
- The Data Processing Centres (DPCs)
- The FIRST Science Centre (FSC) -for FINDAS-

D/TOS responsibilities are covered in the FIRST/PLANCK MIRD (AD11). The responsibilities of the other parties are defined in the following sections.

## 3.1 FIRST/PLANCK PROJECT TEAM RESPONSIBILITIES

The FIRST/PLANCK Project Team tasks w.r.t. ground segment implementation and operations cover both FIRST and PLANCK missions. FIRST-related Project's responsibilities are not listed.

*Note: Most of the corresponding tasks are carried out in close collaboration with the other parties which have ground segment and operations responsibilities.*

- assume overall coordination and management responsibility for the definition and implementation of the elements of the FIRST/PLANCK Ground Segment and mission operations.
- establish the overall mission requirements.
- define the standards which ensure compatibility, commonality, and maximum re-use of hardware and software between all phases of the project.
- define the interface requirements for the scientific instruments on-board software design.
- establish and maintain interface control between the elements of the ground segment in collaboration with the DPCs, FSC (for FINDAS) and MOC.
- review and agree the PLANCK instrument flight operations procedures (nominal and contingency). Ensure timely delivery.
- review and agree the PLANCK-related ground segment operations procedures.
- set up the FIRST/PLANCK Ground Segment Advisory Group (GSAG).

- set up and ensure smooth operations of the ground segment Integration and Tes t Team (ITT). The ITT must be established prior to the first SVT.
- establish and maintain the overall Ground Segment schedule.
- monitor design and implementation of the scientific instruments on-board software.
- organise (jointly with D/TOS) all major ground segment and mission operation s reviews.
- assume overall responsibility for the definition and execution of the Satellit e Commissioning phase.
- provide ad-hoc specialist support during flight operations.

### 3.2 PROJECT SCIENTIST RESPONSIBILITIES

The PLANCK Project Scientist (PS) is responsible for the management of the PLANC K scientific programme, the safeguard of the scientific interests of the science community, and the maximisation of the scie ntific return of the PLANCK mission during all its phases.

The PS is ESA's interface to the scientific community, the instrument/DPC consortia, and the Telescope Provider (TP) for all PLANCK scientific matters. He organises and chairs the Science Team (ST) meetings.

The PS liaises with the FIRST/PLANCK Project Manager (PM) and the Project Team in the development phase and coordinates all scientific issues with them. In particular the P S advises the project Payload Manager on technical matters when they affect scientifi c performance.

After completion of the in-orbit operati ons the PS coordinates the creation of the scientific products, their archival (in FINDAS) and distribution to/ access by the scientific community.

The PLANCK Project Scientist does not have a dedicated team to assist him in th e execution of the tasks under his responsibility. He must rely on the assistance of th e Science Team (for advice on the formulation and implementation of the overall PLANCK science policy) and on the DPCs for the execution of the related tasks. Within thi s framework the PS is responsible for the following tasks:

- monitor instrument design and characterisation activities. Check against instrument performance requirements as specified in the IID-A.
- coordinate the definition (jointly with the ST and the PI teams) of the instrument s calibration requirements. Set up and run the PLANCK Calibration Working Group.
- monitor the instrument calibration activities (on ground).

- coordinate the definition (jointly with the ST and the PI teams) of the instruments in-orbit cross-calibration Plan. (TBC)

- define (jointly with the PI teams) the Instrument in-orbit Performance Verification Plan. Coordinate with the FIRST Project Scientist for proper allocation of the PV phase time between FIRST and PLANCK.

- detailed specification (in collaboration with the DPCs and the ST) of the data products to be generated from the mission as outlined in the SMP.

- monitor proper implementation of the data reduction activities carried out at the DPCs. In particular verify that the level of coordination between the two DPCs is sufficient to guarantee an *integrated* final set of data products.

  *Note: The PS will be assisted in this task by the ST and the GSAG.*

- review and approve the PLANCK instrument flight operations procedures (nominal and contingency)

  *Note: this task is shared with the FIRST/PLANCK Project team. The Project team ensures that the instrument flight procedures are safe and compatible with the spacecraft procedures. The PS ensures that, as defined, the instrument fligh t procedures will maximise the science return.*

- review and approve the PLANCK-related ground segment operations procedures (mainly operational procedures between DPCs, MOC and FINDAS).

  *Note: this task is shared with the FIRST/PLANCK Project team. The Project team ensures that the ground segment operations procedures are safe. The PS ensures that, as defined, the procedures will maximise the science return.*

- participate, as required, in PLANCK-related pre-launch ground segment integration, validation tests and simulations.

- define, in collaboration with the FSC and the DPCs, the facilities required from FINDAS to support the post-operational phase. e.g.
  - PLANCK archive management
  - processing tools
  - data distribution facilities.
  - PLANCK archive access facilities.

- issue the first "Call for Research Proposals"

  *Note: This call, issued about one year after completion of the AO process, is limited to the members of the PI/DPC consortia, Telescope Provider team and PS.*

- establishment of the final "Core Programme" of research topics (following initial Call)

- issue the second "Call for Research Proposals"
- support all ground segment reviews.
- attend (as permanent member) all meetings of the GSAG where PLANCK related topics are addressed.

### 3.3 PI RESPONSIBILITIES

For PLANCK each Principal Investigator (PI) will set up a Consortium which will be responsible for the provision of a scientific instrument *and* the associated Data Processing Centre (DPC).
The Consortium's ground segment-related and data processing-related contributions are provided through the DPC.

*Note: It is not required that all DPC-related activities are carried out at a single physical centre. However, for data delivery purpose a single location must be specified.*

A DPC manager, reporting to the PI, shall have full authority for the day-to-day management of the DPC.

The PI shall also set up an Instrument Development Team (IDT), under the authority of an Instrument Manager (IM), in charge of the design, implementation, calibration and testing of the corresponding PLANCK science Instrument.

The Instrument Manager, reporting to the PI, shall have full authority for the day-to-day management of the IDT.

### 3.4 FIRST SCIENCE CENTRE (FSC) RESPONSIBILITIES

The FIRST Science Centre (FSC) will be set up at a suitable location in an ESA member state to provide overall scientific coordination of the FIRST mission, as well as to carry out a number of FIRST-related functional tasks (e.g. Proposal Handling, Mission Planning, etc.).

In addition the FSC is responsible for the set up and management of the FIRST Integrated Network and Data Archive System (FINDAS). It is intended to use FINDAS for the PLANCK mission to carry out the following tasks.

- communications between the DPCs and the MOC
- storage and management of the PLANCK data products (PLANCK Archive)
- access control management under PS supervision.

- provision of the access tools necessary to allow the external PLANCK communit y access to the PLANCK Archive.
- distribution of the PLANCK data products to the scientific community.
- overall configuration control of data, products, software, documentation, etc.

These tasks are under the responsibility of the FSC Operations Manager (FSCOM) and are described in RD-7.

The PLANCK Project Scientist, the DPC managers and the FSCOM will define jointly the PLANCK specific tasks which are not covered by the general FINDAS functionality . Implementation of these tasks will be addressed in the FSC SIP.

The FSC plays **no** further role in the PLANCK mission.

### 3.5 PLANCK SCIENCE TEAM RESPONSIBILITIES

The ST overall responsibilities are described in the Science Management Plan.
The PLANCK ST will constitute the centre of the scientifi c operations support structure but will rely mainly on the technical support of the DPCs. Within the scope of this SIRD it s specific responsibilities are limited to:

- formulate and optimise PLANCK's Observation Programme.
- formulate and optimise the calibration strategy, both from the scientific an d operational viewpoints.
- specify updates or changes to the Observ ing Plan during the operational phase (for implementation by the MOC)
- monitor organisation of the PLANCK Archive (implemented via FINDAS).
- direct and monitor creation and delivery to the community of the final scientifi c products and associated documentation.
- define data rights, access, and publication policy. Monitor adherence to the rules.
- make every effort to promote public awareness and appreciation of the PLANC K mission and support ESA in its public relations efforts.
- participate (extent TBD) in major ground segment reviews

### 3.6 FIRST/PLANCK SCIENCE TEAM RESPONSIBILITIES

In addition to the separate FIRST and PLANCK Science Teams (cf. respective SMPs) a FIRST/PLANCK Science Team (FPST) will be formed, and will remain in place until the end of the post-operational phase of both FIRST and PLANCK. The FPST has the following responsibilities;

- maximise the science return of both FIRST and PLANCK within the boundary conditions of the combined mission.
- monitor and advise on any scientific issue that affect both FIRST and PLANCK during all phases of the combined mission.
- resolve any conflict in the implementation of the observing programme of FIRST and PLANCK.

### 3.7 ASTRONOMICAL COMMUNITY RESPONSIBILITIES

The community will communicate with the FSC (FINDAS), at their own cost, to access the PLANCK data products not distributed directly.

The community "responsibilities" are limited to (TBC):

- respond to the second "Call for Research Proposals"
- (for specific users) draft/supply, upon PLANCK PS's request, material for press releases, PR activities, etc.
- provide feedback to the FSC on FINDAS provided Archive access tools.

  *Note: feedback to be provided via the PS/ST (TBD)*

# 4. PI CONSORTIUM : RESPONSIBILITIES AND DELEGATED TASKS

The tasks described here are carried out either by the Instrument Development Tea m (IDT) led by the Instrumen t Manager (IM); or by the DPC Team led by the DPC Manager. The allocation of tasks between the IDT and the DPC Team is decided by the PI. It i s expected that many tasks are carried out in collaboration between the two teams.

## 4.1 FUNCTIONAL REQUIREMENTS

### 4.1.1 Instrument Development Team (IDT)

The IDT, under the Instrument Manager, are responsible for t he execution of the following tasks:

IDTF-005 definition of the various TM and TC packets required to operate th e instrument.

IDTF-010 definition of the various instrument modes (this include s diagnostic/engineering modes, compressed/uncompressed data modes, standard default mode, etc.)

IDTF-015 definition of the set of Instrument Command Sequences (ICSs) and/o r macro-commands and/or on-board command procedures necessary t o operate the instrument.

*Note: Various schemes could be used to command the instruments: (i ) sequences of elementary instrument commands (ICSs), (ii) macro - commands, and/or (iii) on-board command procedures. As far as possible a common commanding scheme will be implemented for all the FIR ST and PLANCK instruments. A selected ICS set will be available to th e SPACONs. It will contain the commands required to perform, unde r manual control, specific activities e.g. activation/de-activation, entry int o "safe" mode, contingency switch-off, etc.*

IDTF-020 definition of the set of Science-HK parameters to be monitored by th e MOC in order to ensure instrument health and safety.
For each of the parameter to be monitored:
- define the parameter limits (hard and soft -TBC-)
- define the validity conditions
- specify monitoring frequency

IDTF-025 provision of the instrument TM/TC data base.
(format to be agreed with the FIRST/PLANCK Project)

*Note: The TM data base exact ly defines (e.g. name, location, size, limits,*

*etc.) each Telemetry Parameter generated by the instrument. T he TC data base exactly defines (e.g. name, mnemonics, parameters, bit pattern , criticality, etc.) each Telecommand which can be sent to the instrument.*

IDTF-030 provision of the Instrument User's Manual including "nominal" an d "contingency" Instrument Operations Procedures.
(format and contents to be agreed with the FIRST/PLANCK Project)

IDTF-035 generation and validation of the "nominal" Instrument Operation s Procedures. This would typically include:
- start up procedure
- instrument commissioning procedures
- "first light" procedure
- "engineering" and "diagnostic" procedures
- shut-down procedure
- calibration procedures
- observation procedures
- instrument on-board S/W update procedure

IDTF-040 generation and validation of the "contingency" Instrument Operation s Procedures. This would typically include:
- reset procedures (i.e. procedures to set the instrument into an y predefined standard "default" mode)
- "safing" procedures.
- back-up procedures (e.g. activatio n of a redundant sub-system in case of failure of the prime system)
- procedures for safety parameters out of limits
- procedures for recovery from instrument command verification failure.
- procedures for other instrument anomaly recovery.

*Note: The procedures listed in IDTF-035 and IDTF-040 must take into account th e requirements for **instrument autonomy**, i.e. the instruments shall be able to operate for extended periods without ground control.*

*Note: The Instrument Procedures will be incorporated into the Flight Operations Plan by the MOC together with any related spacecraft procedures.*

IDTF-045 provision of an Instrument Command Translator (ICT) according to MOC requirements. (TBC)

*Note: It is assumed that the elementary commands defined for th e instrument are coded in a "symbolic" language (i.e. mnemonics + parameters) The ICT translates the "symbolic" instrument comman d language into the binary command patterns to be uplinked by the MOC.*

IDTF-050 definition (jointly with the Project Scientist) of the Instrument Calibration Plan.

*Note: This Plan should cover pre- and post-launch instrument calibration activities.*

IDTF-055 design, implementation, test and validation of the S/W Instrumen t Simulator. The following requirements must be fulfilled (TBC):
- "integration" with the MOC-provided simulator shall be possible.
- the simulator shall be adequate for validation of instrument fligh t operations procedures and scientific processing S/W.
- the simulator shall be adequate for the functional validation of post - launch instrument on-board S/W updates.

*Note: The level of "fidelity" required from the Simulator must be defined between the DPC and the instrument developers and agreed by th e Project Scientist.*

IDTF-060 set up and maintain an instrument on-board S/W maintenance an d validation facility. (pre- and post-launch) -TBC-

*Note: The PI may decide that this should be a DPC responsibility.*

IDTF-065 deliver (to the MOC) the instrument on-board software uplink image s according to an agreed format.
- format to be defined in an ICD produced by the MOC.
- format will be the same for the two instruments.

*Note: The PI may decide that this should be a DPC responsibility.*

### 4.1.2 Data Processing Centre (DPC) Team

Under the authority of the PI, the DPC Team is responsible for the execution of th e following tasks:

DPCF-005 establishment, jointly with the Project Scien tist, of the detailed list of DPC tasks and deliveries.

DPCF-010 generation and maintenance of the DPC Implementation Plan (DPC SIP).

DPCF-015 overall DPC organisation. DPC Team set up and management

DPCF-020 establishment and maintenance of the DPC schedule.

DPCF-025 management of the DPC interfaces w ith the FSC (for FINDAS), the MOC, and the other DPC.

DPCF-030 support to the ground segment reviews.

DPCF-035 DPC Manager attendance (as a permanent member) to the meetings o f the GSAG.

DPCF-040 establishment, jointly with ESA, of the set of documents and products to be delivered by the DPC.

DPCF-045 Provide the infrastructure (building, hardware, office space , communication equipment, etc.) as well as the support facilitie s (secretariat, clerical support, etc.) required, pre- and post-launch, t o support the development, and later, mission operations and dat a processing work allocated to the DPC .

DPCF-050 support the Science Team in its tasks

DPCF-055 definition, as required, (TBC) jointly with the Project Scientist of th e ground based calibration programme which might be necess ary to support instrument calibration pre- and post-launch.

DPCF-060 set-up and management of the instrument ground calibration data base.

*Note: This data base could be set up usi ng the basic FINDAS capabilities. It is assumed that "local" "work ing" copies will be kept at the DPC. (TBC). The "final" ground calibration data base will be available on FINDA S (TBC).*

DPCF-065 define jointly with the FSC Operations Manager the data and operational interface between the DPC and the FSC for FINDAS.
- The interface will be defined in an ICD produced by the FS C Operations Manager.
- The interface will be the same for the two DPCs.

DPCF-070 define jointly with the MOC the data and operational interface betwee n the DPC and the MOC.
- The interface will be defined in an ICD produced by the MOC.
- The interface will be the same for the two DPCs.

DPCF-075 coordinate, throughout the lifetime of the DPC, its data processin g activities with the other D PC (through its DPC Manager) in order to avoid unnecessary duplication of work, and to ensure production of a n *homogenous, integrated* final set of data products

DPCF-080 provide the tools and the computing facilities required to make th e comparison of internediate-level scientific products with those from th e other DPC.

DPCF-085 design, implementation, test and validation of the S/W required for th e Scientific Processing of the instrument data. This includes:

- Real Time Assessment/Quick-look Analysis (RTA/QLA) S/W
- Trend Analysis for long term behaviour of instrument and detectors
- Calibration Analysis (TBD/TBC)
- Scientific Pipeline Processing S/W.
- Any ad-hoc tool (e.g. uplink-downlink "cor relators", telemetry "viewers", *non*-standard data processing packages, etc.)

*Note: Some of the S/W packages listed here may be implemented (e.g . RTA/QLA) by the Instrument Development Team or in collaboration with him.*

*Note: The RTA/QLA software will be used during Instrument Level Tests (ILTs), Integrated Module Tests (IMTs), Integrated System Tests (ISTs), Simulations and during all phases of the mission. It shall be designed and implemented in such a way that it can be used on-line for real-tim e monitoring and control of the instrument and off-line for instrumen t troubleshooting.*
*The Project will guarantee that the hardware and software interfaces will be identical in checkout and during operations.*

DPCF-090 generation and validation of the ground segment-related DPC Operations Procedures (nominal and contingency).

*Note: The ground segment procedures are the operational procedure s carried out by the various groups in the ground segme nt to ensure smooth overall operations. As an example, In the case of PLANCK, a procedure would be carried out daily to acq uire at the DPCs, from the MOC, through FINDAS, the pointing information relative to the previous 24-hours o f operations. Other procedures (contingency) would deal with abnorma l conditions.*

DPCF-095 define (in collaboration with the FSC Operations Manager and th e PLANCK ST) the facilities required from FINDAS to support the post - operational phase e.g.
- PLANCK Archive Management
- processing tools
- data distribution facilities
- PLANCK Archive access facilities

DPCF-100 ensure that the commo nality standards defined jointly with ESA, the FSC (for FINDAS) and the other DPC are adhered to in the S/W design and implementation.

DPCF-105 set up and operation (pre- and post-launch) of the DPC hardware an d software Configuration Control System.

DPCF-110 provision, to the agreed standards, of all DPC-related documen tation. This

includes:
- S/W users manuals
- DPC H/W and S/W Integration and Test Plans
- S/W test procedures and test results.
- DPC Operations Procedures.

DPCF-115 provide the necessary input, as required, to the Integration and Test Team (ITT) for the generation of ground segment Integration and Validation Plans, as well as Simulation Plans.

DPCF-120 participation in pre-launch ground segment integration tests, validation tests (e.g. listen-in tests, End-to-End tests, etc.) and simulations.

DPCF-125 deliver to the MOC the necessary hardware (Instrument Station) and software (RTA/QLA, etc.) required to support the Commissioning and Performance Verification phases. Support installation as required.

DPCF-130 support ESA in its public relations efforts.

## 4.2 OPERATIONAL REQUIREMENTS

This chapter lists the activities which must be carried out by the Consortium in support of PLANCK operations.
As for the tasks described in chapter 4.1 the PI will decide the allocation of operational tasks between the Instrument Development Team and the DPC Team. All tasks listed below are necessary. The allocation given here between IDT and DPC is only ***indicative*** and may freely be changed by the PI, according to the organisation he has selected for his Consortium.

### 4.2.1 Instrument Development Team (IDT)

The IDT is responsible for the execution of the tasks listed below:

IDTO-005 set up and train the operations team required to support the instrument operations during all in-orbit phases of the mission.

*Note: The operations staff will be located at the DPC during the routine phase. The necessary accommodations and logistical support shall be provided by the DPC*

IDTO-010 provide instrument training, as required, to selected MOC (SPACONs) staff.

*Note: Training shall take place in accordance with a training plan approved by ESA. The plan shall identify duration of each training activity and*

*number of staff involved -trainers and trainees-.*

IDTO-015 provide to the MOC the operations staff required to support th e Commissioning and Performance Verification phases.

*Note: These specialists will be located at the MOC for the duration o f these two phases. The necessary accommodatio ns and logistical support will be provided by the MOC*
*At any time in the co urse of the mission, operations staff may have to be recalled at the MOC to provide payload contingency support in case o f serious malfunction of the instrument.*

IDTO-020 perform daily instrument health and performance monitoring (RTA). This includes;
- get relevant TM data from the MOC (via FINDAS)
- display and monitor instrument status.
- derive and display additional parameters. check limits.
- identify possible changes in instrument parameter settings for futur e sky scans (TBD)

*Note: This function is carried out on the Instrument Station (IS) runnin g RTA. During Commissioning and PV phase the IS is located at the MOC. Instrument "safety" is ensured by the MOC.*

IDTO-025 perform daily instrument quick-look analysis (QLA). This includes;
- select and display science data.
- derive and display additional parameters.
- perform assessment of detector behaviour (sensitivity, linearity , saturation, spiking, dark current, etc.)
- perform pointing verification (TBD)
- identify possible changes in instrument parameter settings for futur e sky scans (TBD)
- produce a QLA report (TBC) and file on FINDAS.
- provide instrument mode/parameter change requests or spacecraf t attitude trim requests to the MOC (TBD)

*Note: This function is carried out on the Instrument Station (IS) runnin g QLA. During Commis sioning and PV phase the IS is located at the MOC.*

IDTO-030 propose changes, if required, to instrument operations scenario . Coordinate with MOC.

*Note: Changes may be required in case of instrument malfunction, or as the result of improvements identified during the commissionning and/o r Performance Verification phases. Changes must be coordinated with the MOC and can only be implemen ted after Project Scientist's authorisation.*

IDTO-035 support "specific" instrument modes (TBD). This could include;
- instrument diagnostic mode.
- instrument in uncompressed data mode.

IDTO-040 maintain optimal scientific instrument performance. This includes;
- regular generation of instrument calibration parameters.
- maintenance of the initial set of ICSs
- maintenance/update of the on-board S/W.
- issue, as required, Instrument Anomaly Reports. follow up.
- determination of the optimal instrument operating limits
- adaptation to orbital environment.

IDTO-045 provide support to the ST, the DPC and the MOC in all areas regarding payload hardware and software, and interpretation of the data generated.

#### 4.2.1 Data Processing Centre (DPC) Team

The DPC Team is responsible for the execution of the tasks listed beloe:

DPCO-005 acquire, on a daily basis, the (time-ordered) payload scientific an d housekeeping data and the past (reconstruct ed) pointing information from the MOC.

DPCO-010 provide instrument teams (on their request) with off-line raw data to allow study and analysis of their instrument performance.

DPCO-015 perform continuous data processi ng during the operations. This includes;
- quality checks of the scientific data products
- calibration
- cleaning
- continuous improvement of the data processing algorithms
- continuous refinement of the scientific data products

*Note: The various scientific data products are described in the SMP.*

DPCO-020 compare, at regular intervals (TBD), intermediate pr oducts with equivalent products from the other DPC (if applicable)

DPCO-025 report (on a regular basis) to the PLANCK ST on the data processin g activities, and in particular on any anomaly detected.

DPCO-030 provide weekly activity reports to the Project Scientist. File on FINDAS.

DPCO-035 elaborate (i.e. g enerate in a format agreed with the MOC) the PLANCK's Observation Programme formulated by the ST.
Transfer to the MOC (via FINDAS).

DPCO-040 transmit to the MOC (via FINDAS), in the proper format, updates/changes to the Observing Plan formulated by the ST.

*Note: These "updates" are corrections to the sequence of manoeuvres required to progressively complete the sky survey.*

DPCO-045 maintain the DPC. This includes the following tasks:
- maintain and update as required the general DPC infrastructure.
- maintain and update as required the DPC software.
- maintain and update as required the DPC hardware. Carry out regular preventive H/W maintenance (including installation, if necessary, o f new versions of operating systems)
- perform routine S/W and data backups.
- maintain the DPC documentation.
- train (re-train) DPC staff as required.
- operate the DPC hardware and software C onfiguration Control system. (maintain a central list of all DPC Software Problems Reports)

DPCO-050 produce monthly (TBC) DPC operations reports.

### 4.3 POST-OPERATIONS REQUIREMENTS

These activities concern the tasks carried out by the Consortium at the end of the orbital operations, to produce an archive of PLANCK data products, processed with the bes t calibration possible and make them available to the community. Support of the FSC (for FINDAS) is required.

It is expected (TBC) that the IDT plays no role in this phase.

The DPC Team is responsible for the execution of the tasks listed below.

DPCA-005 carry out final reduction of the dat a to generate the final science products of the mission.

*Note: this requires availability of the full set of mission data.*

DPCA-010 organise (with FSC suppor t) the storage and management of the science products into the PLANCK Archive (FINDAS).

DPCA-015 transfer the final data products into FINDAS.

DPCA-020 produce and store into FINDAS the documentation required to allow the scientific community to access and process science data to full depth.

DPCA-025 organise (with FSC support) the distribution of the science products to the community.

*Note: The distribution itself is carried out by the FSC (TBC)*

DPCA-030 define (in collaboration with the FSC ) the access tools necessary to allow the external PLANCK community access to the PLANCK scienc e products.

*Note: The tools will be provided by the FSC.*

DPCA-035 provide support (jointly with the FSC) to the PLANCK community fo r accessing the PLANCK Archive (products and associated docum entation).

DPCA-040 extract and publish scientific results.

DPCA-045 Maintain the necessary faci lities and staff throughout the post-operations phase.

# 5. PERFORMANCE AND AVAILABILITY REQUIREMENTS

## 5.1 GENERAL

PERF-001 The Data Processing Centres (DPCs) shall be staffed on the basis of 8 hours/day, 5 days/week minimum.

*Note: Extended hours (TBC) may be required during specific missio n phases e.g. commissioning and PV.*

PERF-002 The DPCs shall be organised and staffed in such a way that th e processing of the results of the first full sky survey can proceed in parallel with the preparation of the second survey.

PERF-003 Both DPCs shall be operational 1 year prior to launch.

PERF-004 The overall availability figure for the DPC operational systems shall be 95 % minimum (TBC)

## 5.2 OBSERVATION PLANNING

PERF-010 The final Observation Programme g enerated by the ST shall be available at least 6 months prior to launch.

PERF-011 It shall be possible to update, when required, the Observing Plan within 24 hours of the availability of the data which made the update necessary. *Note: The MOC must be able to accep t updates to the Observing Plan at least up to three days before the actual operations.*

## 5.3 FIRST INTEGRATED NETWORK AND DATA ARCHIVE SYSTEM (FINDAS)

The following requirements on FINDAS availability are extracted from RD-7. If an y PLANCK specific performance/availability requirements in excess of the requirement s listed below are necessary, they will be added in future versions of this document.

PERF-010 FINDAS shall be available 24 hours a day.

PERF-011 FINDAS maximum downtime: TBD

PERF-012 FINDAS Archive Server shall guarantee near real-time access (delay of not more than 60 secs. -TBC-) to the down-linked telemetry during al l mission phases.

PERF-013 FINDAS shall be able to support up to 30 (TBC) interactive users logged on simultaneously.

PERF-014 FINDAS shall allow several (authorised) users to read a data item in parallel.

*WRITE and UPDATE rights to a particular item shall only be granted to one user at a time.*

PERF-015 FINDAS shall allow data deleted accidentally to be recovered up to 5 days (TBC) after the deletion.

PERF-016 FINDAS shall be able to support up to 1 Terabyte (TBC) of on-line storage for PLANCK

PERF-017 FINDAS basic functionality (TBD) shall be in place at least 6 months (TBC) prior to the start of the first Instrument Level Test (ILT).
The facilities required to handle documentation shall be in place earlier (goal: early-1999 TBC)

PERF-018 FINDAS shall provide the facilities required to allow, if necessary, migration of PLANCK Document Management System, Software Development Environment and existing PLANCK Archive into the FINDAS system at a (to be agreed) convenient date or version.

*Note: The PLANCK group needs basic document management facilities, software development environment, and archiving facilities before the first operational FINDAS version can be available.*
*FINDAS implementation will, to the maximum extent possible, take into account PLANCK requirements in order to ease the migration process.*

## 5.4 SCIENTIFIC DATA PROCESSING

PERF-020 MOC-provided data (command history, attitude and orbit-related data, etc.) shall be available on FINDAS 48 hours (TBC) after the execution of the corresponding scan.

PERF-021 The Real-Time-Assessment/Quick-Look Analysis (RTA/QLA) systems - generally used off-line in the DPCs- shall be capable of processing telemetry at least at the real time speed. Goal is several times the real time speed (e.g. 4 to 10 times).

*Note: This requirement covers Satellite Commissioning Phase and PV phase when RTA/QLA runs in "near real-time" in the MOC.*

PERF-022 The DPC hardware and software capability shall be able to *fully* process (from raw data to final products) the *complete* PLANCK data in less than 1 year.

## 6. PHASING AND ORGANISATION

The organisation of the project changes according to the various phases of implementation and operations. The various mission phases and responsibilities for the main sectors of the project are given as an overview in the table below:

| Mission Phase | Highest authority/responsibility for Project Sector | | | |
|---|---|---|---|---|
| | Project/ Mission | Spacecraft Operations | Instrument Operations | Science |
| Development | PM | GSM | PM | PS |
| Launch and Early Orbit Phase (LEOP) | MD (=PM) | FOD | N/A | PS |
| Commissioning | PM | MOM | MOM | PS |
| Performance Verification | H/SSD/SA | MOM | MOM | PS |
| Routine Operations | H/SSD/SA | SOM | SOM | PS |
| Post-operations | H/SSD/SA | N/A | N/A | PS |

PM = FIRST/PLANCK Project Manager (D/SCI)
MD = Mission Director (= PM in LEOP phase)
FOD = Flight Operations Director (D/TOS))
GSM = Ground Segment Manager (D/TOS)
SOM = Spacecraft Operations Manager (D/TOS)
H/SSD/SA= Head of Astrophysics Div., Space Science Dept. (D/SCI)
PS = Project Scientist (reports to H/SSD/SA)
MOM = Mission Operations Manager (D/TOS)
normally the GSM (TBC)

The table does not show the Science Demonstration Phase (duration max 0.5 - 1 month) which takes place at the end of the PV phase. This phase (ref. FIRST and PLANC K Science Management Plans ' "cover letter" ) is not defined. It is assumed that the overall organisation will be identical as in the PV phase.
"PS" in the column "Science" refers to both the PLANCK and the FI RST Project Scientists who are ,each, responsible for the corresponding activities of their respective missions.

Overall responsibility for the FIRST/PLANCK Project is transferred from th e FIRST/PLANCK PM to H/SSD/SA at the end of the Commissioning Phase.

The responsibility and authority of all participants to the FIRST/PLANCK missio n operations is defined in the Mission Operations Management Plan issued by D/OPS.

In the routine phase the SOM has full authority for the safety and integrity of the mission.

The PSs report to H/SSD/SA. Th ey are responsible for the long term scientific objectives of their respective missions.

The main activities and organisation for each phase are further described below.

## 6.1 DEVELOPMENT PHASE

### 6.1.1 Activities

This phase covers all activities up to the launch of the satellite (= spacecraft + scientific instruments). For each of the DPCs, this includes de sign, implementation, integration and validation of their respective systems as well as verification of all interfaces, in particular interfaces with the MOC and between themselves. This phase culminates at the Fligh t Readiness Review which establishes Launch readiness. It formally ends at L - 8 hour s (beginning of the LEOP phase).

### 6.1.2 Organisation

Fig 6.1 shows the top level organisati on for PLANCK during the Development phase. The FIRST organisation, which is also part of the overall set up is not shown.
Before the end of the Development phase (around L - 6 mo nths -TBC-) the build up of the FIRST/PLANCK ESOC Operations Team at the MOC will start.

This team will perform all spacecraft and inst rument operations until the end of the orbital operations

## 6.2. LAUNCH AND EARLY ORBIT (LEOP) PHASE

### 6.2.1 Activities

The LEOP is the first operational phase in the FIRST/PLANCK mission.
The LEOP phase is conducted from the Main Control Room in ESOC according to th e practices laid down in the ESTRACK Operations Manual (EOM). Mission rules an d detailed LEOP activities are defined in th e FIRST/PLANCK Flight Operations Plan (FOP).

During LEOP, checkout of essential spacecraft function s will be carried out. The scientific instruments are switched off.
Nominally, LEOP dura tion will be less than 10 days. At the end of the LEOP, the satellite shall be in a condition where payload and instrument-related operations can begin.

During LEOP telemetry will be acquired and archived on FINDAS. If required the ICC and DPC Instrument Stations running RTA/QLA -or equivalent- will be on-line in "listen-in " mode in the MOC's Inst rument Support Area although no scientific data will be available.

### 6.2.2 Organisation

LEOP is a D/TOS responsibility. It is conducted by the FIRST/PLANCK Flight Contro l Team (FCT) under the authority of the Flight Operations Director, appointed by D/TOS . Overall supervision is ensured by the FIRST/PLANCK Project Manager acting as Mission Director.

The FCT is made up of several different groups, FIRST/PLANCK dedicated groups and groups who are not specif ic to FIRST/PLANCK, manning the various Operations Control Centre (OCC) support area(s)/rooms.

The FCT will be run on a twenty four hour shift basis for at least the first 10 days of LEOP.

## 6.3. COMMISSIONING PHASE

### 6.3.1 Activities

At the end of the LEOP phase, spacecraft an d instrument control will be transferred to the FIRST/PLANCK Dedicated Control Room (DCR).

In addition, ICC and PLANCK consortia operations staff, l ocated in the Instrument Support Area in the MOC, will monitor execution of their instrument activities using the hardware and software (Instrument Stations and RTA/QLA software) which they have used during instrument level tests and AIV operations.
During this phase the checkout of the spacecraft subsystems will be completed (a s necessary) if completion was not achieved at the end of the LEOP phase. The scientific

instruments will then be turned on and checked out. Check out will be carried out b y repeating a subset of the Integrated System Test (IST).
The next activities will be dedicated to satellite commissioning.

The purpose is to assess in-orbit performance of the satellite since this will determine to a large extent how the routine operations will be carried out.

The following major activities are foreseen:

- assessment of FIRST pointing pe rformances: This implies determination of Attitude Pointing Error (APE), Attitude Pointing Drift (APD), Relativ e Pointing Error (RPE) and Absolute Measurement Accuracy (AMA);

- assessment of straylight and telescope performances: This includes measurement of Self Emission, Off-Axis Rejection, Straylight induced by a bright source in the field of view, as well as determination of the Point Spread Function and Focal Plan e Geometry Calibration. [1]

- PLANCK- related activities (TBD)

The sequence of operations, their durations and the corresponding detailed activities will be defined in the FIRST/PLANCK Flight O perations Plan (FOP) issued by D/TOS and the Satellite Commissioning Plan (SCP) issued by the FIRST/PLANCK Project.

Telemetry will be acquired and archived on FINDAS.

### 6.3.2 Organisation

Overall responsibility for this phase lies with the Project sup ported as required by Industry, ESOC and the ICC and DPC operations staff.

Operations will be under the responsibility of the MOM.

The FCT will have the responsibility to carry out the satellite commissioning activities as described in the FOP and SCP. Processing of the relevant data will provide the necessary performance information. Project, Industry, ESOC, ICC and PLANCK consortia staff will assess this information and determine pointing and telescope performances as well a s initial instrument operability.

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[1] Some of these activities might have to be delayed to later phases.

The PLANCK consorti a operations staff at the MOC will report to the MOM. As required, they will liaise with and obtain support from the DPC personnel which has remained at the DPC.

At the end of the commissioning phase the FIRST/PLANCK Project Manage r responsibilities are formally transferred to H/SSD/SA.

## 6.4. PERFORMANCE VERIFICATION PHASE (PV PHASE)

### 6.4.1 Activities

During this phase, calibrations of the scientific instruments will be made and scientifi c measurements (a s opposed to engineering measurements in the previous phase) will be started. The "Commissioning" of the overall ground segment that started in the previous phases will be completed.

The following major activities are planned:

- instrument "core" calibration;
- verification of the instrument modes: functional and scientific aspects;
- Full ground segment verification i.e. verifying that facilities and teams are ready to support the routine scientific observations.

*Note: In this phase, as well as in the commissionning phase, the FIRST and PLANC K activities are interleave d. The phasing, detailed scenario, and amount of time allocated to each mission is TBD.*

The sequence of operations, their durations and the corresponding detailed activities will be defined in the FIRST/PLANCK Flight Operations Plan (FOP) and in the Performance Verification Plans. (one for FIRST and one for PLANCK)

As in the previous phase the ICC and PLANCK consortia operations staff, located in the Instrument Support Area, will monitor the activities of their instrument. The FSC will b e fully involved in this phase. Co-location of FSC personnel at the MOC is however no t foreseen.

Starting with this phase, all operations should be pre-planned.

At the end of the Performance Verification phase the S/C, payload and Ground Segment will be considered operational.

### 6.4.2 Organisation

The organisation during the PV phase will be similar to the organisation during th e commissioning phase. The FIRST/PLANCK Project is no longer involved. The PM' s responsibility is taken over by H/SSD/SA.

Fig. 6.4 shows the PLANCK organisation in this phase. The FIRST organisation is no t shown.

Operations are under the responsibility of the MOM.

The FSC functional tasks (essentially management of FINDAS for PLANCK) are carried out by the FIRST Science Operations Team (FSCOT).

## 6.5. ROUTINE OPERATIONS PHASE

### 6.5.1 Activities

This phase is the main data gatherin g phase in PLANCK's lifetime. During this period two full sky surveys will be carried out.

During the Routine Operations phase all activities are pre-planned. The observatio n schedule will normally be executed autonomously from telecommands stored on-board . The command schedule will be up-linked daily from the ground station.

### 6.5.2 Organisation

Fig. 6.5 shows the PLANCK organisation in this phase. The FIRST organisation is no t shown.

All spacecraft and instrument operations are carried out by the Spacecraft Operation s Manager (SOM) and his/her team. PLA NCK consortia manpower is no longer required at the MOC.

The Instrument Support Area in the MOC is no longer in daily use but is not de - commissioned. In case of unforeseen pr oblems or contingencies PLANCK consortia staff may be re-called at the MOC on short notice (TBC).

The MOM function is terminated and day-to-day operational responsibility is transferred to the SOM.

The DPCs and the FSC enter their steady mode of operations. The PLANCK PS liaises with the FSC Science Op erations Manager (FSCOM) for the FINDAS-related activities of relevance to PLANCK and with the DPC Managers as required.

## 6.6. POST- OPERATIONAL PHASE

### 6.6.1 Activities

The activities carried out in this phase are as described in chapter 2.4.8. The post - operational phase for PLANCK will start while FIRST is still in its science operation s phase.
The bulk of the work is carried out by the PLANCK PS and the DPCs. The necessar y FINDAS support is provided by the FSC.

### 6.6.2 Organisation

The organisation is as shown in Fig. 6.5 but the PS no longer liaises with the SOM.

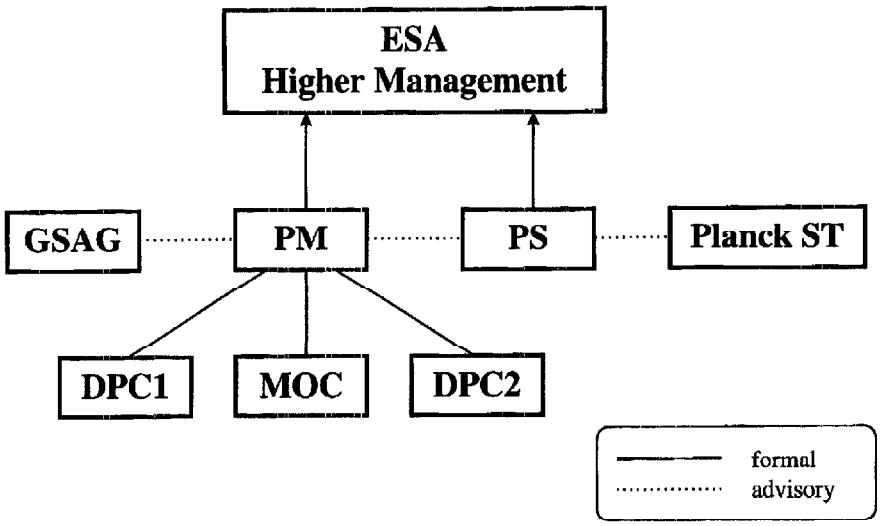


**Fig. 6.1 Planck Organisation in the Development Phase**

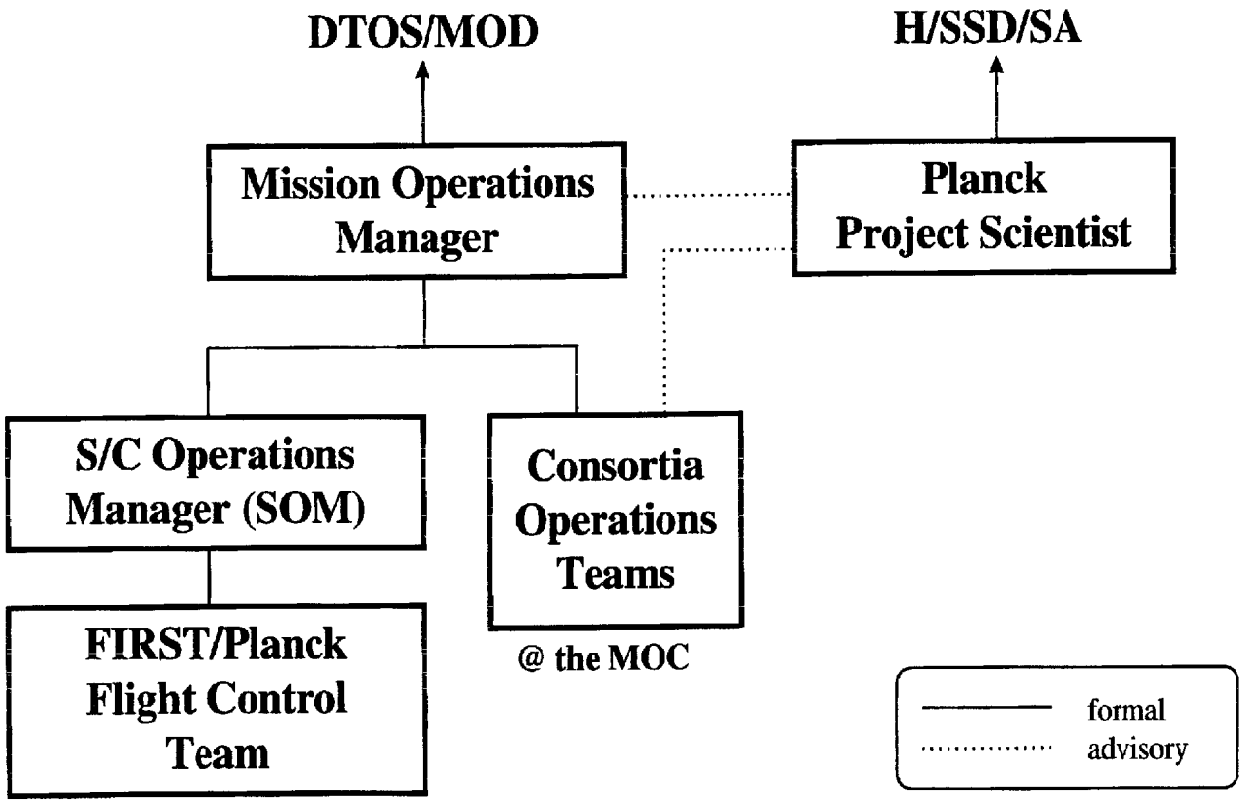


Fig. 6.4 Planck Organisation in the Performance Verification Phase

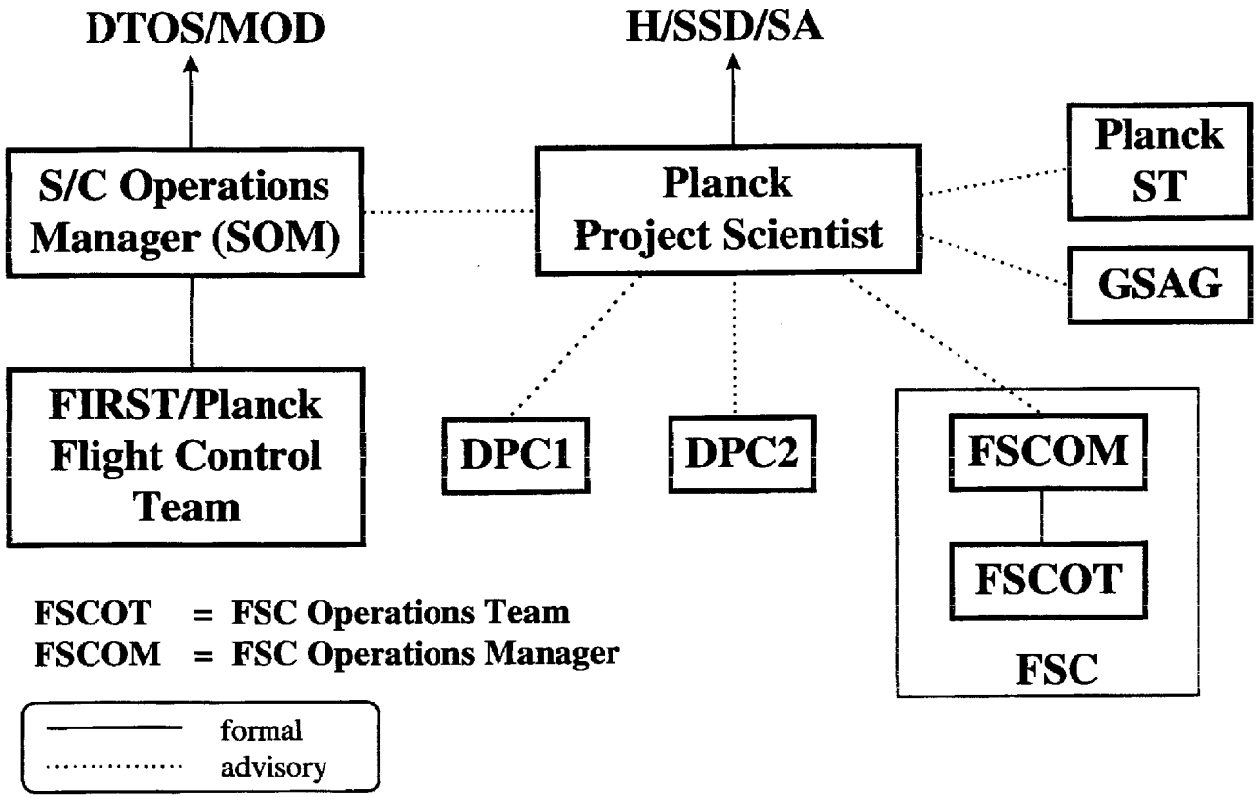


**Fig. 6.5 Planck Organisation in the Routine Operations Phase**

# 7. PRODUCT ASSURANCE and QUALITY ASSURANCE REQUIREMENT S

*Note: The requirements in this chapter are applicable to the entire FIRST/P LANCK Ground Segment, i.e. to all the facilities necessary to support both the FIRST and the PLANC K missions. A single PA/QA scheme will be used for the two missions. In the case o f PLANCK this is mainly applicable to the DPCs.*

## 7.1 GENERAL

These general requirements are applicable to all the entities which contribute to th e preparation and execution of the FIRST and PLANCK operations.

PAQA 001 During all phases of the FIRST/PLANCK mission implementation (i.e . design, development, integration and test of the total ground segmen t both hardware and software) each contributor shall carry out a Produc t Assurance/Quality Assurance (PA/QA) activity.

*The purpose of the PA/QA activity is two-fold:*

*- It ensures during each phase conformity of the outputs with th e inputs from a previous phase. It ensures traceability from requirement s to design for both hardware and software elements.*

*- it ensures adherence to the standards established for the FIRST mission. It ensures that all hardware and software elements of the ground segment implementation will comply with all mission requirements.*

PAQA-002 The PA/QA activity shall also be exercised throughout the operation s phase of the mission to ensure that all satellite operations are carried out in accordance with agreed flight procedures, and that all modification s requested by any authorised party will be controlled by a formal Change Control (CC) procedure.

PAQA-003 The ground segment shall provide for appropriate redundancy in it s elements commensurate with the availabili ty objectives defined in chapter 5.

PAQA-004 It is the responsibility of the FIRST/PLANCK PA Manager (TBC) t o ensure that the overall PA/QA requirements established for th e FIRST/PLANCK ground segment are met by the various contributors.

## 7.2 DOCUMENTATION

PAQA-010 Documentation shall be structured in a specification tree and a corresponding plan tree. The documents shall be referenced in accordance with an identification procedure consistent with the trees.

PAQA-010a The trees shall be structured in such a way that the scope and applicability of each document as well as the documents' inter-relationships are easily seen. Each top level tree shall hold on a single A4 page.

PAQA-010b Requirement specifications, design specifications, test specifications, interface control documents and user manuals shall belong to the specification tree.

PAQA-010c Implementation plans and procedures, test plans and procedures, and operations plans and procedures shall belong to the plan tree with the corresponding execution reports.

PAQA-011 Software documentation shall conform to the ESA Software Engineering Standards.
*Note: The ESA Software Standards adopted here, are the standards applicable to small projects (see AD7). They offer the same rigorous approach to the software development process as the full standards but significantly reduce the documentation overhead.*

PAQA-012 The PLANCK documentation which will be accessible through FINDAS shall conform to the 'electronic' standards (e.g. Word/WordPerfect, TEX, etc.) defined for the FIRST/PLANCK Programme.

*Note: These standards must be defined and agreed jointly by the FSC, ICCs, DPCs, MOC and FIRST/PLANCK Project.*

## 7.3 TEST REQUIREMENTS

In the case of PLANCK the test requirements below are applicable to the DPCs. Test requirements specific to the MOC are addressed in the MIRD (AD11)

PAQA-020 All operational science functions shall be tested and validated before launch.

PAQA-021 Subsystem and system tests shall be conducted according to approved test plans and test reports shall be issued.

PAQA-022 The adequacy of the science operations procedures shall be determined

by means of realistic simulators covering at least:

- execution of all nominal procedures;
- execution of all foreseen contingency procedures.

PAQA-023 The DPCs shall be included in the End-to-End Tests (EEs) which validate proper operations of the entire space- ground segment system.

PAQA-024 The DPCs shall be included in the overall simulation programme which determines the adequacy of operations procedures and training of mission controllers, computer operators and all other operations staff

## 7.4 CONFIGURATION CONTROL

### 7.4.1 Hardware Configuration Control

PAQA-030 The DPCs H/W configurations (Computers, Work-Stations, Peripherals, LANs, communication equipment, etc.) shall be maintained under Configuration Control according to the general guidelines in RD10.

### 7.4.2 Software Configuration Control

PAQA-031 The relevant DPCs' documentation and data items shall be delivered for archiving in accordance to FINDAS Configuration Control mechanisms.

PAQA-032 The CC function shall be carried out in accordance to a (common) Software Configuration Management Plan (SCMP) to be produced jointly by the ICCs, DPCs and the FSC. The SCMP shall be concurred with by the FIRST/PLANCK PA manager (TBC).

## 7.5 SOFTWARE QUALITY ASSURANCE

PAQA-033 All DPC S/W elements shall be produced in accordance to a (common) Software Quality Assurance Plan (SQAP) to be produced jointly by the ICCs, DPCs and the FSC. The SQAP shall be concurred with by the FIRST/PLANCK PA manager (TBC).

# 8. MANAGEMENT REQUIREMENTS

## 8.1 TOP LEVEL RESPONSIBILITIES

The FIRST/PLANCK Ground Segment architecture is a decentralised architecture. The allocation of responsibilities for the monitoring, management, coordination and implementation of the tasks specified in this document reflects this decentralised structure.

MNGT-001 For each of the Data Processing Centres (DPCs) -one per PLANCK Instrument- there shall be an DPC Manager with overall responsibility for the timely execution of all DPC-related tasks specified in this document.

MNGT-002 The FIRST/PLANCK "Ground Segment Advisory Group" (GSAG) shall be responsible for the monitoring of the DPCs, FSC (PLANCK-related FINDAS tasks) and MOC activities in order to verify that the tasks specified in this document are carried out according to specification and in agreement with the overall Ground Segment development schedule.

MNGT-003 The Integration and Test Team (ITT), under the authority of an ESA ITT Manager, shall be responsible for the overall ground segment Integration and the definition and execution of the system-level tests defined in chapter 7.

## 8.2 PLANNING REQUIREMENTS

MNGT-010 In response to the requirements specified in this document each PLANCK Instrument Consortium shall issue a Science Implementation Plan (SIP) covering the tasks under his/her responsibility. After approval by the PLANCK Project Scientist, and agreement by D/TOS and D/SCI the SIPs shall serve for monitoring progress of the tasks identified therein.

MNGT-011 The SIPs shall respond to the requirements specified in this document. in particular each SIP:

MNGT-011a shall contain a Project Management Plan;

MNGT-011b shall contain a description of the related science operations concept and baseline design. It shall be as detailed as needed to allow a committing schedule, and a well-established work package breakdown structure;

MNGT-011c shall contain the definition of the work packages with the corresponding inputs, deliverable items, tasks specifically excluded. progress measurement points and start and completion criteria;

MNGT-011d shall cover for each work package, the identification of the cost drivin g parameters and the corresponding estimates of resources spread ove r time (manpower, computers and other investment and runnin g expenditure);

MNGT-011e shall define the schedule for the complete set of work pack ages supported by the corresponding schedule planning;

MNGT-011f shall contain the documentation trees and the correspondin g identification.

MNGT-012 Any change in the contents of a SIP might imply changes in cost , schedule and/or performance of the corresponding science function ; therefore any modification to the SIP, or tasks, or baseline identifie d therein shall be formally approved by the PLANCK Project Scientist.

## 8.3 REPORTING REQUIREMENTS

MNGT-020 The DPCs managers will hierarchically belong to the corresponding PI - Consortia. On PLAN CK science and data processing-related matters the DPC managers report to the PLANCK Project Sci entist. They report to the FIRST/PLANCK Project Manager or his deleg ate for all issues associated with overall ground segment schedule an d/or interface of the DPCs to the other elements of the FIRST/PLANCK ground segment.

MNGT-021 The DPC managers will, as required, attend the meetln gs of the GSAG (of which they are permanent members) in order to provide progres s reporting.

MNGT-022 The DPC managers will, as needed, attend the PLANCK meetings and reviews, management meetings and delegate body meetings.

MNGT-023 The SIPs shall define in detail the reporting mechanisms which shal l include, as a minimum, quart erly (TBC) management information reports. These reports should be brief and include the following information:

MNGT-024a brief summary of the progress achieved since the previous reportin g period.

MNGT-024b concise description of the main problem areas, their criticality an d anticipated impacts (e.g. de lays in the schedule or non conformance with the requirements)

MNGT-024c status of the technical design, of prop osed solutions to the problem areas and of engineering, product assurance and testing activities.

MNGT-024d per Work Package the manpower usage showing actual versus planned and estimation at completion

MNGT-024e overall manpower usage chart

MNGT-024f update of the overall schedule with latest prediction of the completio n dates of the identified milestones.

MNGT-024g a list of relevant action items and their status.

*Note: It is expected that the Instrument Consortia will produce financia l information reports containing actual expenditure related to work packages for manpower usage, infrastructure, investment, etc. These reports may be attached to the management information reports if deemed useful but this is* ***not*** *a SIRD requirement.*

MNGT-025 The SIPs shall identify the technical documents to be produced for th e implementation of the tasks specified in the SIRD; it shall also define the review procedure and the approval authority for the various documents.