PLATO
(PLAneetary Transits and Oscillations of stars)

Spacecraft, Payload and Mission Operation
1) PLATO Mission Overview
2) PLATO Space Segment
   - PLATO Payload
   - PLATO Spacecraft
   - PLATO Operation Concept
3) PLATO Schedule
4) Summary
PLATO Launcher

• Launcher: Soyuz ST2-1B from Kourou,

• Direct injection in transfer orbit,
  – Transfer time: 30 days

• Halo orbit around L2 Earth-Sun.

• Launch vehicle capacity:
  – 2160 kg (incl. adapter)
  – 3.86 m diameter fairing

• Launch: 2024

• Mission science operation duration: 6.0 years
PLATO Ground Segment

- **Mission operation Centre**
  - At ESOC (Darmstadt, Germany)

- **Science Operation Centre**
  - At ESAC (Villafranca, Spain)

- **Ground Stations**
  - New Norcia, Cebreros or Malargue
  - Daily science communication
    ~ 100 Gbits in X band
  - Command and control in X band
PLATO Payload

34 refractive telescopes mounted on an optical bench

- 32 telescopes in 4 groups with FoV partially overlapping,
- 2 dedicated telescopes for bright stars with colour requirements, also used as FGS.
- Total FoV: ~2232 deg^2.
Payload telescopes and baffles

- Telescopes based on dioptric system with 6 lenses (1 aspheric), 120 mm pupil,
- Individual baffles for stray-light rejection and thermal dissipation,
- Camera mass (w/o FEE): 11.7 kg
- Optics operation temperature: -80 °C
- CCD operation temperature: < -65 °C
FPA (CCDs in blue):

- 4 CCDs per FPA with 4510×4510 pixels of 18 μm each.
- Normal cameras: four 4.5x4.5 Mpixels CCDs operating in full frame mode.
- Fast cameras: four 4.5x2.25 Mpixels CCDs operating in frame transfer mode.
Payload on-board Data Processing

The ICU is composed of three main functions: a processing function, a router function and a power supply function for the whole ICU. These 3 functions are redunded (cold redundancy) and cross-strapped (the two power supplies to both processor/router chains) in order to enhance the robustness of the ICU.

Figure 5-25 gives an overview of the PLATO data processing system architecture and of the data flow rates. This chart focuses on the sharing of the main functions and the data flows. It is a simplified view of the hardware architecture. The SpaceWire routers are not shown.

5.6.2 DATA MANAGEMENT INTERFACES

5.6.2.1 Data Processing Chain

The rate from the FEEs to the MEUs is ~1320 Mb per period of 25 sec, 330 Mb will be transferred every 6.25 sec from one FEE to one DPU inside MEU at a useful rate of 128 Mbps. This rate implies that the 2 N-FEE/N-DPU SpaceWire links are configured to work at 100 Mbps. Optionally, one SpaceWire interface at 200 Mbps can be used.

The rate from the F-FEEs to the F-DPUs is ~660 Mb every 2.5 sec. The data will be transferred from the F-FEE to the F-DPU over 8 SpaceWire links with a rate of 8 x 64 Mbps through 2 channels per CCD.

The rate towards the ICU is 40 kbps per F-DPU, and 1.5 Mbps per MEU.

Figure 5-26 gives an overview of the data rates inside the Payload:
PLATO Payload Programmatics

PLATO flight model payload include:
- Serial production of 136 FM large format CCDs,
- Serial production of 34 FM telescope optical units (TOU),
- Serial production of 18 FM data processing units.

Schedule:
- Payload EM and simulator for AVM to be delivered by June 2019,
- First batch of 8 N cameras to be delivered by December 2020,
- Last batch of 8 N cameras with FM ICU by December 2021.
- Launch in January 2024.
PLATO Payload Accommodation: Candidate Spacecraft Configuration B
**AOCS:**
- Actuators: reaction wheels and N2H4 propulsion,
- Science mode attitude control with feedback from fast cameras, gyros, and star tracker.

**Power:**
- Fixed Solar Array mounted on the body and on the Sunshield,
- Ga As triple junction solar cells.

**Data handling & communications:**
- X-band for up/down link,
- Deployable steerable HGA with two DoF.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>Mass</td>
<td>2100 kg</td>
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<tr>
<td>Power</td>
<td>1.6 kW</td>
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<tr>
<td>Data rate</td>
<td>8.7 Mbit/s</td>
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<tr>
<td>Lifetime</td>
<td>6 years</td>
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<tr>
<td>Dimensions</td>
<td>5m x 3m x 3m</td>
</tr>
</tbody>
</table>
**Concept of operations**

- All observations in staring mode.
- Long-Duration Observations (2 fields)
- Step-and-Stare Observations (several sky fields 2 to 5 months each)
During the long duration observation phase, the spacecraft is rotated every 3 months around the mean boresight axis of the payload cameras.
PLATO Mission Design drivers

- low non-photonic noise level constraining the spacecraft relative pointing errors at high frequencies and the pointing drift and optical bench thermoelastic stability at low frequencies,

- large field of view and throughput leading to many short focal length cameras with constraints on mass and volume accommodation,

- long uninterrupted observation providing constraints on payload module design (sunshield), spacecraft operation and duty cycle,

- large volume of data requiring significant on-board data processing and compression.

- schedule driven by the large amount of payload elements to be produced.
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3) **PLATO Schedule**

4) Summary
- Phase B1: March 2014 – April 2016
- **PLATO System Requirement Review: Feb – March 2016**
- Payload FM delivery: Dec 2020 – Dec 2021
- PLATO launch: January 2024
Definition Phase B1 (three parallel Industrial studies):
- Phase B1 industrial studies kick-off: October 2014
- Payload Design Consolidation Review: March-April 2015
- Mission adoption & IPC approval: Q2 2016

Implementation Phase (one Prime Contractor):
- Industrial ITT for Phases B2/C/D/E1: July-Dec 2016
- Industrial Prime contractor kick-off: Jan 2017 (TBC)
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Summary:
- The PLATO payload consists of 34 telescopes each coupled to a focal plane array that includes 4 large format CCDs,
- The PLATO payload generate a huge amount of data requiring significant on-board compression,
- Two spacecraft concepts have been identified that can accommodate the PLATO payload and provide the necessary resources for its operation,
- All spacecraft and payload technology is available,
- The PLATO payload and spacecraft definition will be completed in Feb-March 2016 by a System Requirement Review,
- Following mission adoption in Q2 2016, an ITT will be issued by ESA to Industry for the PLATO spacecraft procurement.