

ESA Ground Segment

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Joint NLST/SST meeting
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Science Ground Segment (SGS)

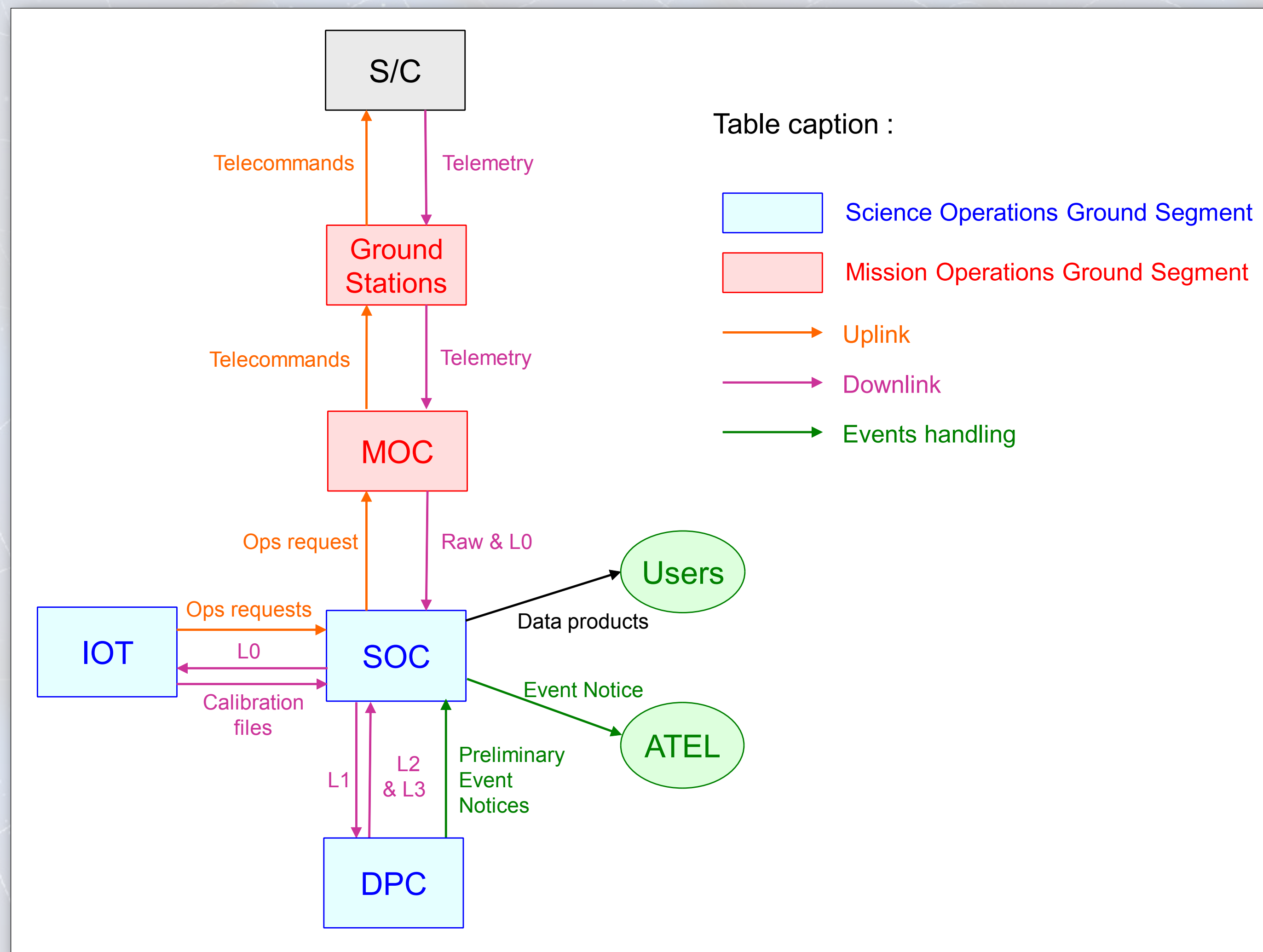


The Science Ground Segment of LISA consists of:

- Mission Operations Centre (MOC)
- Science Operations Centre (SOC)
- Consortium Data Processing Centre (DPC)
- Data Computing Centres (DCC)

Relevant Documents:

- Science Operations Assumptions Document (SOAD)
 - End April
- Science Management Plan (SMP)
 - Phase B1
- Science Implementation Requirements Document (SIRD)
- Science Implementation Plans (SIPs)



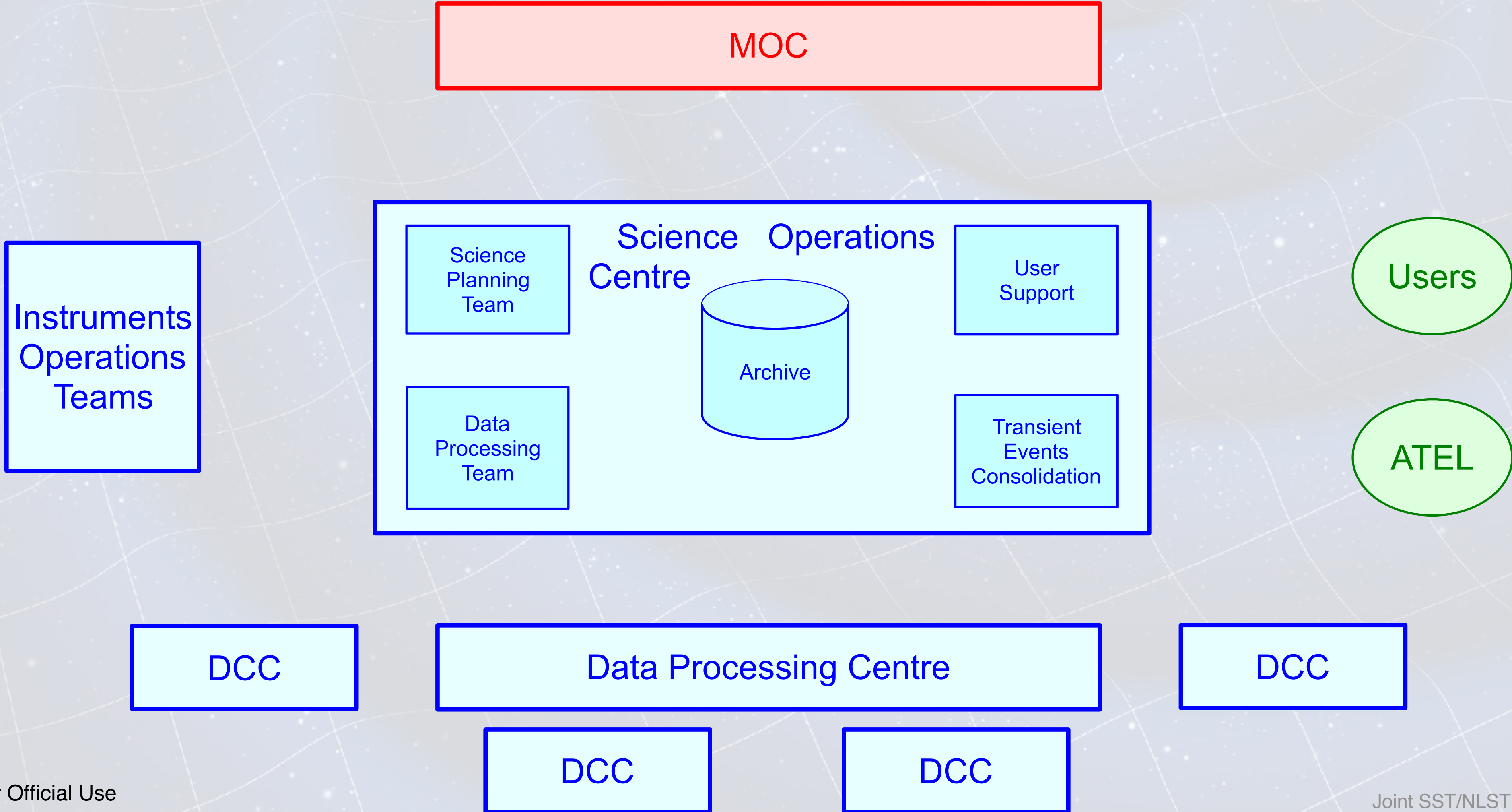
- The role of the MOC is to “fly” the satellites
 - They are responsible for all telecommands sent to the satellites, be it for spacecraft or instrument control
- MOC are also responsible for collecting and consolidating the full telemetry stream
- Consolidated telemetry is made available to the SOC ~2 hours after the end of the ground station pass
 - We will work with the MOC to try to minimise this delay
 - By 2034, the Mission Control System should be more advanced than it is today!
- During the commissioning, calibration and early operations, the SOC and Instrument Operations Teams will be located at the MOC
 - Same as was done for LPF, which proved to be essential in the success of the mission
- MOC is located at ESOC in Darmstadt, Germany



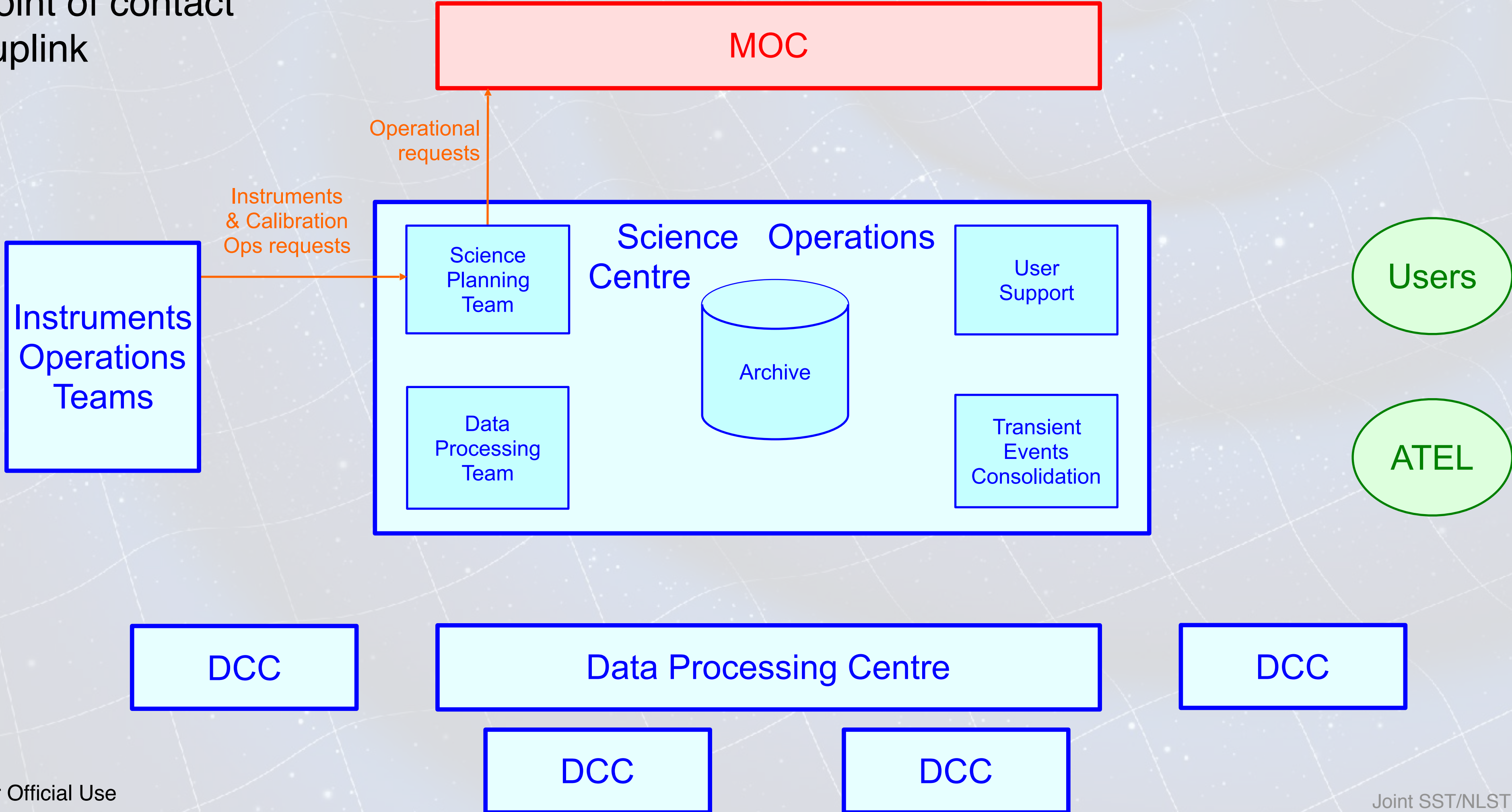
- The Science Operations Centre's role is to operate the science instrument
- During nominal and extended operations, the SOC is the single point of contact between the Consortium/science community and LISA
- The role of the SOC is to ensure the optimal operation of the instrument, including any routine calibration activities
 - e.g. LPF science operations-like activities
- The SOC is also responsible for the delivery of all data from the constellation to the DPC and eventually science community
- The SOC is located at ESAC in Madrid, Spain

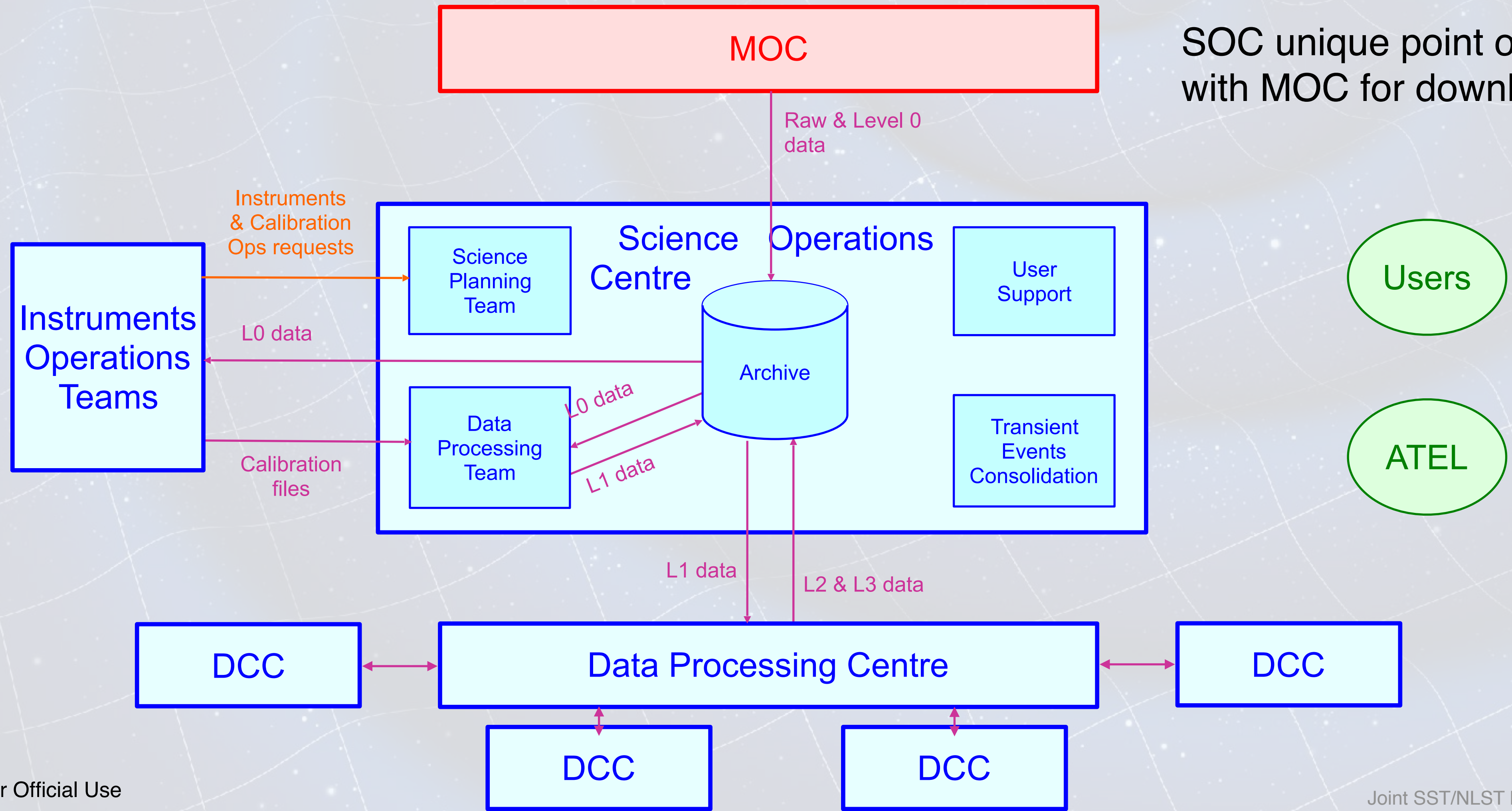


Science Operations Ground Segment elements



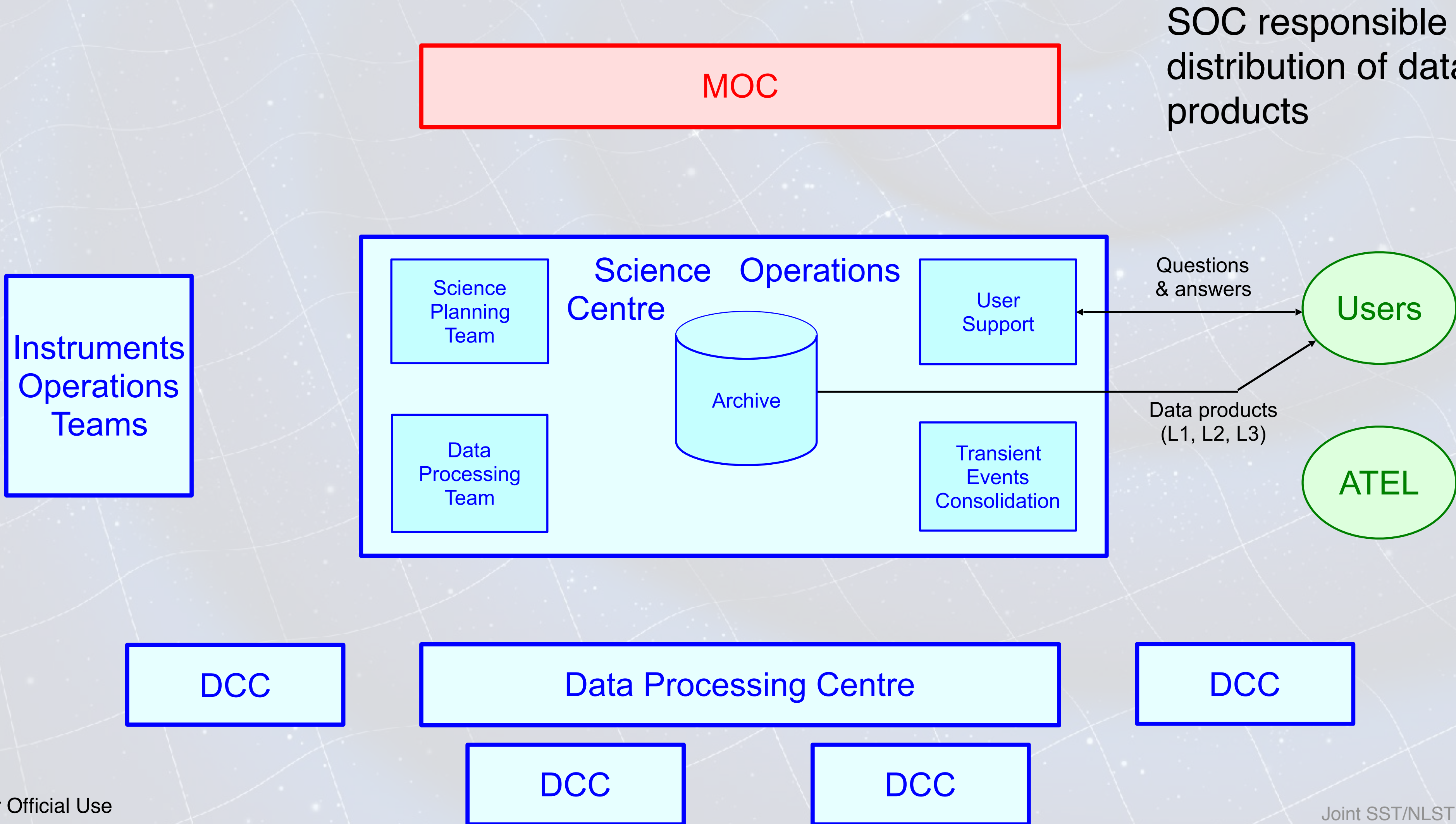
SOC unique point of contact with MOC for uplink





SOC unique point of contact with MOC for downlink

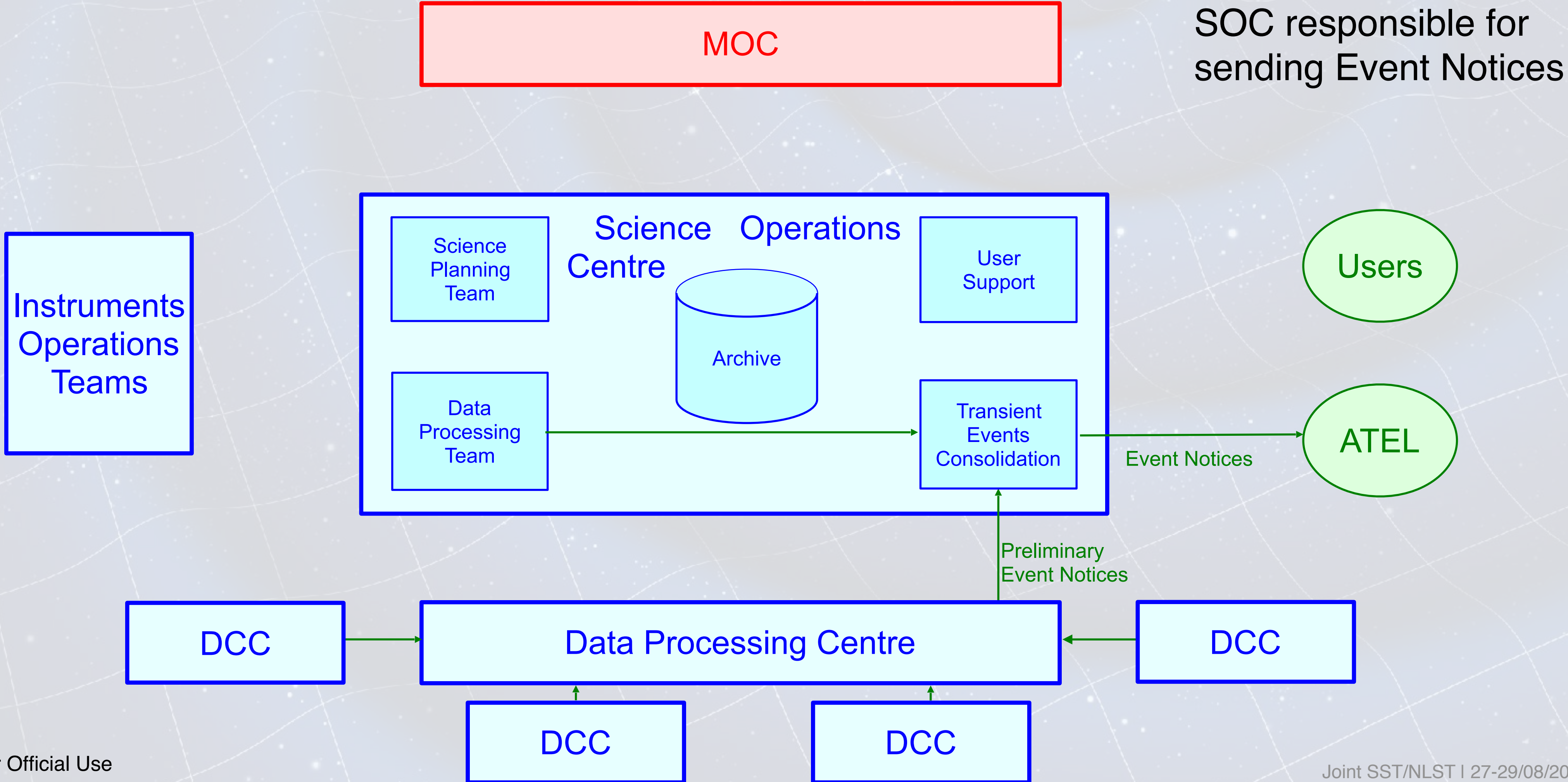
LISA SOGS : Data distribution



SOC responsible for distribution of data products

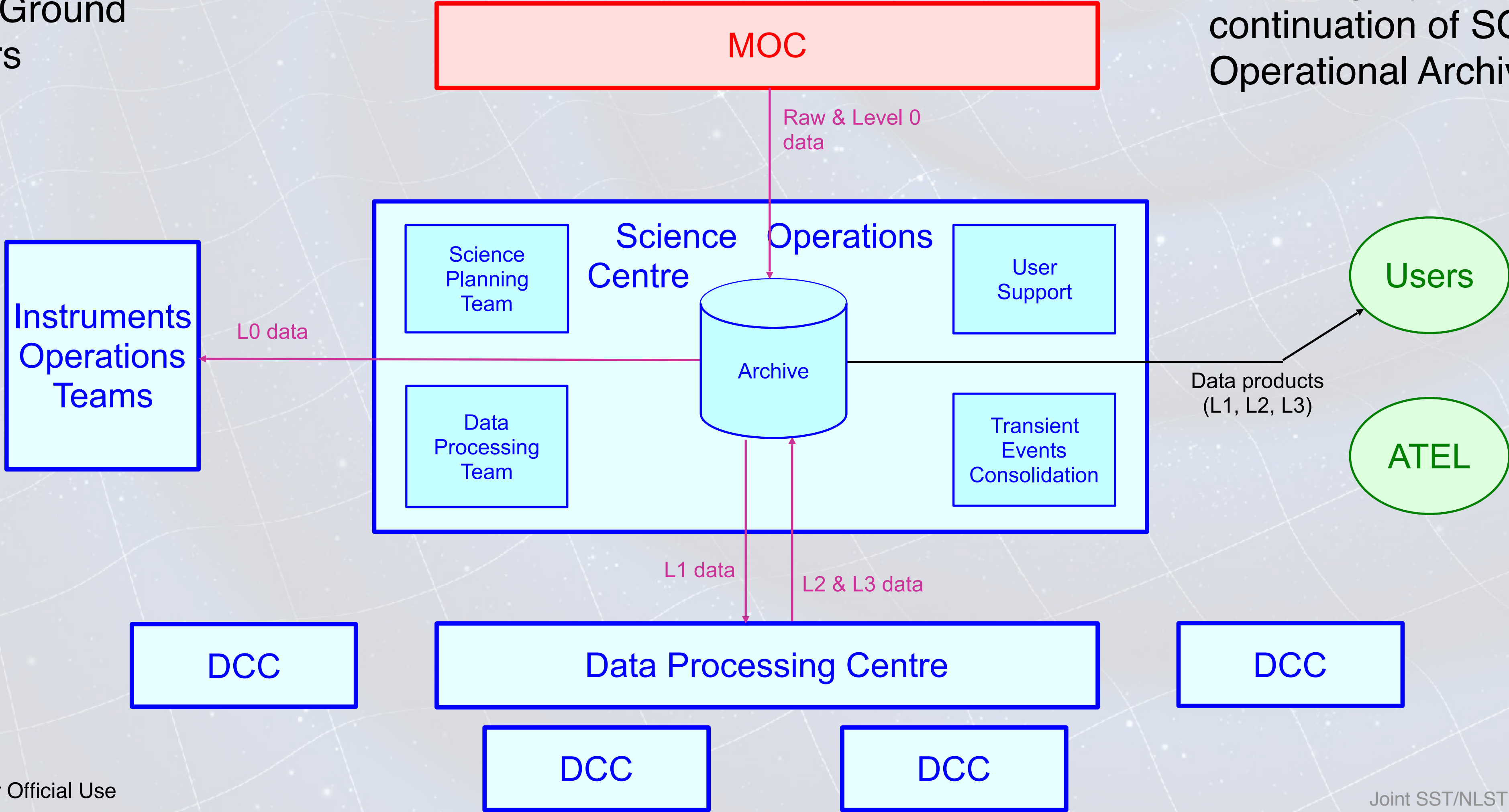


LISA SOGS : Transient Events

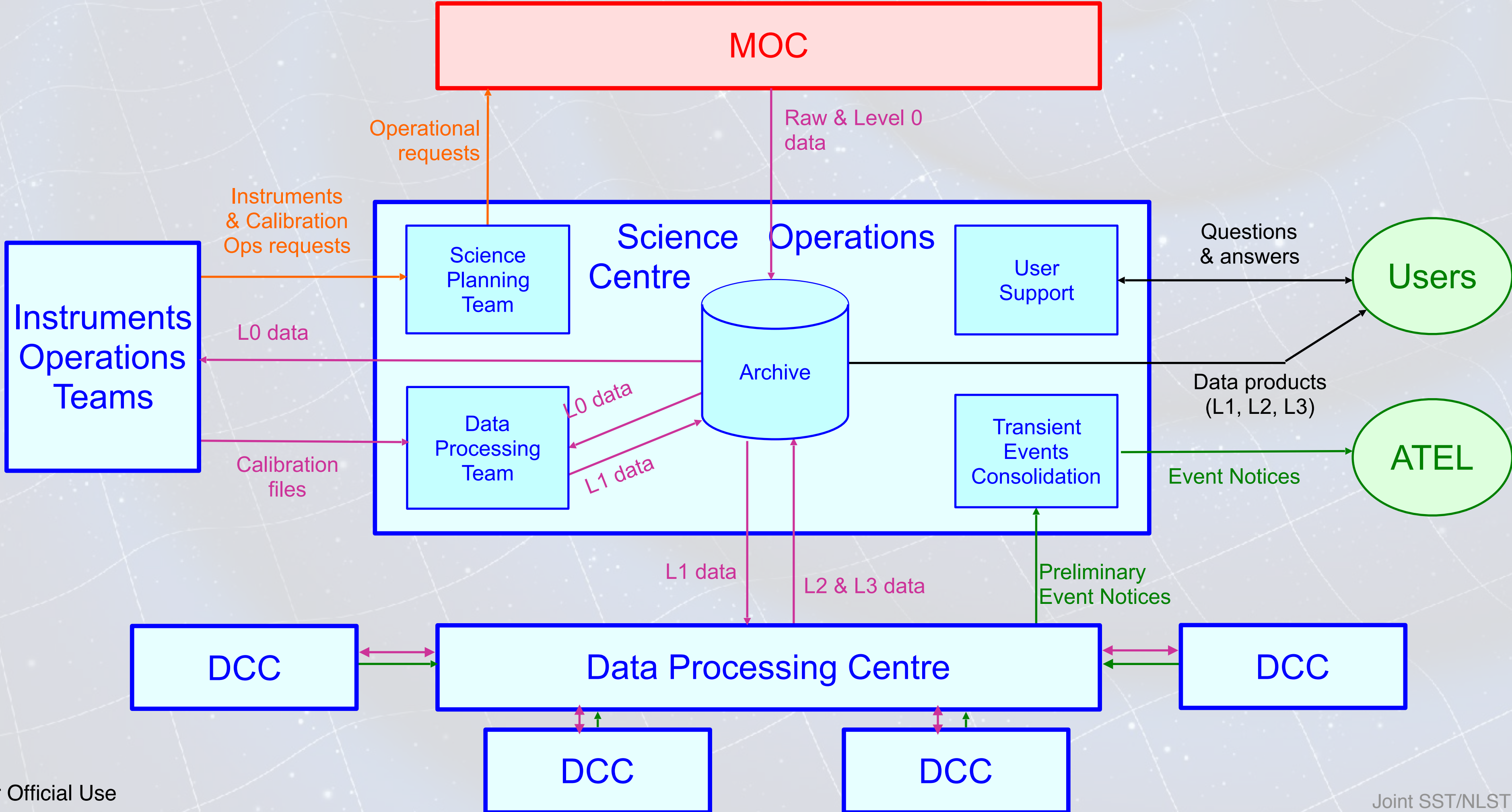


SOC Operational Archive connecting all Ground Segment actors

SOC Legacy Archive continuation of SOC Operational Archive



LISA SOGS : All interfaces



- Currently we foresee the following levels of data:
 - **Level 0:** Raw data, in engineering format, from the satellite
 - i.e. the data delivered from MOC to SOC
 - **Level 1:** Data has been “cleaned” and TDI algorithm has been implemented
 - Data cleaning and TDI will be agreed and jointly developed with the DPC
 - Level 1 data will be available to the science community from the archive after the proprietary period
 - **Level 2:** GW source parameter estimation with residuals
 - DPC produce Level 2 data
 - Level 2 data only makes sense in the case of separate source identification pipelines
 - Does not make sense if global fit is employed by DPC
 - **Level 3:** GW source catalogue
 - DPC produce Level 3 data

Responsibility in ESA

● Study Phase

→ Adoption

● Development

→ Launch

● LEOP + Cruise

● Commissioning

→ IOCR

● Calibration and Performance Verification Phase

● Science Phase (Nominal and Extended)

→ End of Operations

● Post Ops

→ End of Mission

SCI-F (ESTEC)

SCI-P (ESTEC)

SCI-O (ESAC)

- Principle of “smooth transition”
 - To use the same tools as during the operational phase (e.g. Archive, Data processing, payload monitoring tools)
- Ground Segment Tests
 - System Operations Validation Tests (SOVTs) campaign involving all actors (ESOC, SOC, IOT, DPC and Project)
 - 13 SOVTs for LPF (with increasing complexity)
- Building up of the IOT
 - The Instrument Operations Team will need to start preparing for operations before all the Payload HW is delivered (e.g. tools and procedures for payload monitoring and calibration)

During the Commissioning Phase



- Instrument Teams at ESOC
- Instrument Teams have direct interface with MOC for Uplink (via Project)
- Manual commanding to the S/C
- SOC is operational and provides Telemetry to Instrument Teams



- Interfaces identical to the Nominal Science Phase
- Instrument Teams and SOC at ESOC
- Timeline driven operations
- Calibration: to find the optimum setup for all satellite operations
- Performance Verification: to use the observatory as during the Nominal Science Phase to confirm overall system is ready

- Instrument Teams and SOC relocated at home institutes and ESAC respectively, with regular meetings
- In case of anomalies :
 - Instrument Teams support called as needed
 - Commissioning/CPV setup can be required
- Transient Events : when generation of the “Preliminary Event Notices” is stable enough, it could be run in the SOC to decrease turn-around time
- Data Re-processing
 - Regeneration of TDI'd data (L1)
 - This is expected to take place several times, requiring all data analysis to be re-run!

During the Post Operational Phase



- Generation of the ultimate payload calibration for final re-processing
- Generation of the ultimate data products for Legacy Archive

