



ISRO Science Data Archive: Chandrayaan-1

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Chandrayaan-1

- ISRO is launching its first satellite to moon called 'Chandrayaan-1' during September 2008
- Objectives of the mission
 - Chemical, mineralogical mapping of lunar surface in visible, low-energy and high-energy X-rays with high spatial resolution
 - Specifically to carry out high resolution 3D mapping of topographic features along with the simultaneous mapping of distribution of minerals such as Si, Al, Mg, Ca and elemental chemical species including radioactive nuclides
 - To create expertise in development of detectors and sensor technology for planetary remote sensing for future planetary exploration program

Chandrayaan-1 Payloads

- Indian Payloads
 - Terrain Mapping Camera (TMC)
 - 5m spatial resolution, 20 km Swath (500-850 nm band) with three observation systems viz, fore, aft and nadir
 - Hyper Spectral Imager (HySI)
 - Operating at 400-950 nm band with a spectral resolution of 15 nm, spatial resolution of 80 m with swath 20 km. It has 64 channels, with central wave length shift 8 nm
 - High Energy X-ray spectrometer (HEX)
 - 30-270 keV spectrometer employing CdZnTe solid state detectors having a foot print of approx. 40 km
 - Lunar Laser Ranging Instrument (LLRI)
 - To determine global topography of moon with a height resolution of about 5 m
 - Moon Impact Probe (MIP)
 - A technology mission

Chandrayaan-1 Payloads

- AO Payloads
 - **Moon Mineralogy Mapper (M3)**
 - JPL, NASA, to create a mineral resource map of moon
 - **MiniSAR**
 - APL, to look for presence of ice in the polar regions of moon
 - **Infrared Spectrometer (SIR-2)**
 - Max Plank Institute/ESA, to determine the chemical composition of the lunar crust
 - **Radiation Dose Monitor (RADOM)**
 - Bulgarian Academy of Sciences, to characterise the dose rate and deposited energy spectrum in terms of particle flux in near moon surface
 - **Sub-keV Atom Reflecting Analyser (SARA)**
 - Jointly by IRE, Sweden, SPL, India, ISAS/JAXA, Japan and VBE, Switzerland
 - **Low Energy X-Ray payload (CIXS)**
 - RAL, UK/ESA



Indian Space Science Data Center (ISSDC)

- Indian Space Science Data Centre (ISSDC) is set up at Bangalore, which is the custodian of all the science data from the Indian science missions; Chandrayaan-1 is the first among all such missions.
- ISSDC is responsible for the Ingest, Archive, and Dissemination of the payload and related ancillary data
- The primary users of this facility will be the PIs of the science payloads initially till the lock-in period.

Data Products at ISSDC

- Basic data product levels (all instruments) at ISSDC are
 - Level-0: Time tagged raw instrument data along with the ancillary information
 - Level-1: Instrument calibration along with seleno referencing (wherever applicable)
- Higher levels: Instrument specific (limited)
- Dissemination is initially limited to the concerned PIs. Release to the other specific users after a lock-in period.

Archive Plan



ISRO Science Data Archive (ISDA) Characteristics

- The ISDA for Chandrayaan-1 will be an archive holding the data from all science instruments.
- The underlying standard of the ISDA is the Planetary Data System (PDS) from NASA, which is defined by **the PDS Standards Reference, the Planetary Science Data Dictionary Documents and the PDS Data Preparation Workbook.**
- The ISDA aims to be fully PDS compatible

ISDA Characteristics

- Supports the ingestion of full data sets. The data in ISDA are available for scientific use by the interested, after the lock-in period.
- It will be an online archive, where the data are delivered electronically. **A data set will include the data products as well as the ancillary data, software and documentation.**
- In general, the data products from different instruments are contained in separate data sets.
- Planned to keep at least 15 years after the end of the mission.

Planetary Data Archive Process

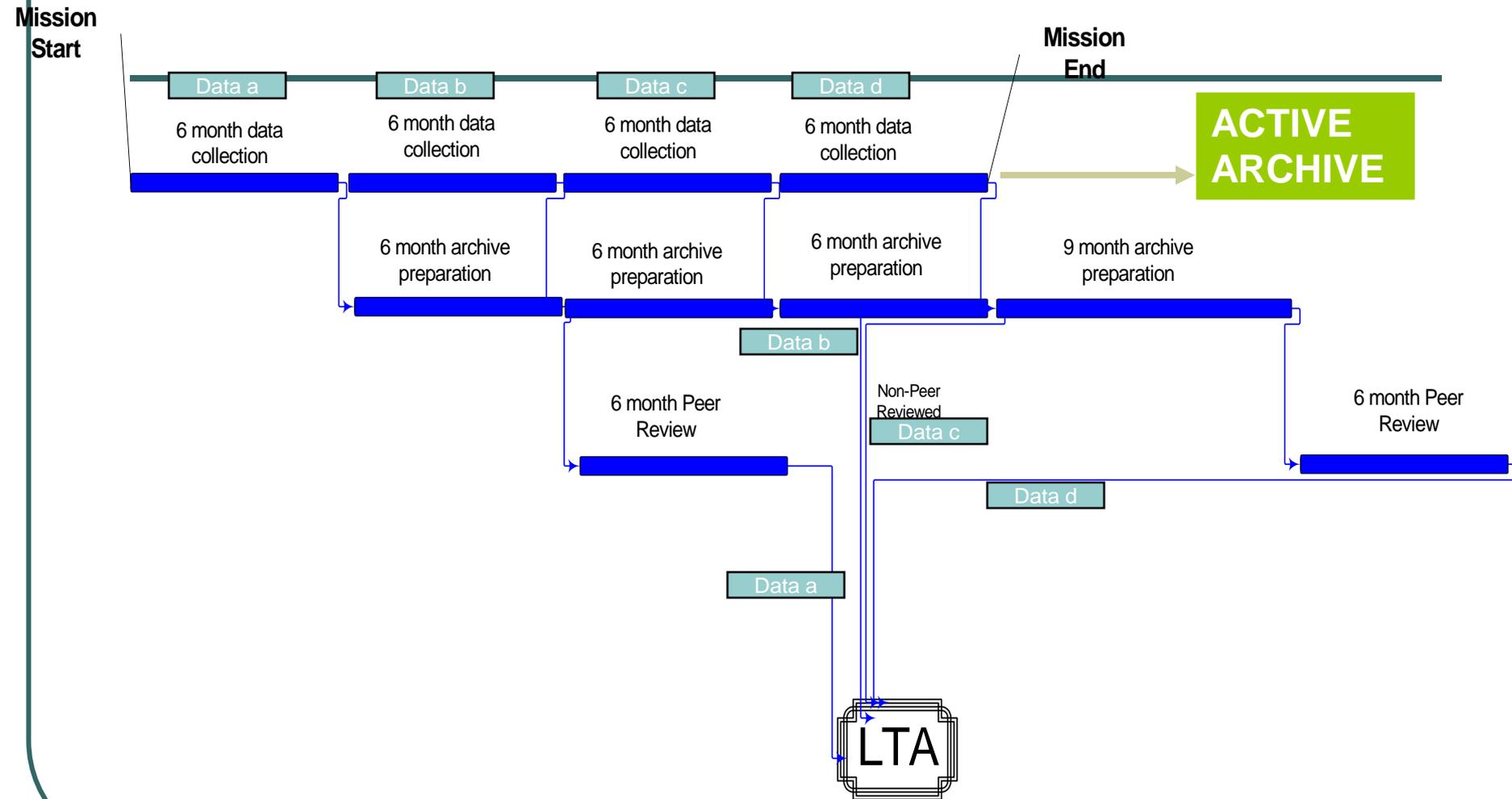
- Discussion at the Ground Segment Steering Committee (GSSC) & Scientific Advisory Board (SAB) on the requirements.
- Preparation of the Archive Generation, Validation and Transfer Plan (also called Archive Plan) & Archive Conventions.
- Preparation of EAICD (Experimenter to Archive team Interface Control Document) for each instrument by respective

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Planetary Data Archive Process

- Data Collection Period Definition in various mission phases and Archive Delivery by PI teams to ISDA
- Peer Reviews
- Teams Involved
 - PI, POC and instrument
 - ISDA
 - CSDAWG (Chandrayaan-1 Science Data Archive Working Group)
 - SCC/ISSDC
- Rolls and Responsibilities

Science Data Archive Schedule



Peer Reviews and Archive Validation

- The ISDA team arranges the **Peer Reviews**. It is proposed to appoint separate review panels for the individual instruments. The external review team members and the review chairpersons will be agreed on in the CSDAWG
- EAICD Review: Peer Review of the individual EAICDs (from the PI teams) is to be arranged 3 months before launch. The review shall be finished at launch.
- Initial Peer Review: The first data sets containing data acquired during first 6 months data collection period will be peer reviewed within 6 months after delivery. The Peer Review team verifies the data sets /documents.
- Final Peer Review: All data sets together will be reviewed within 6 months after the final delivery expected 15 months after the end of the Chandrayaan-1 mission.

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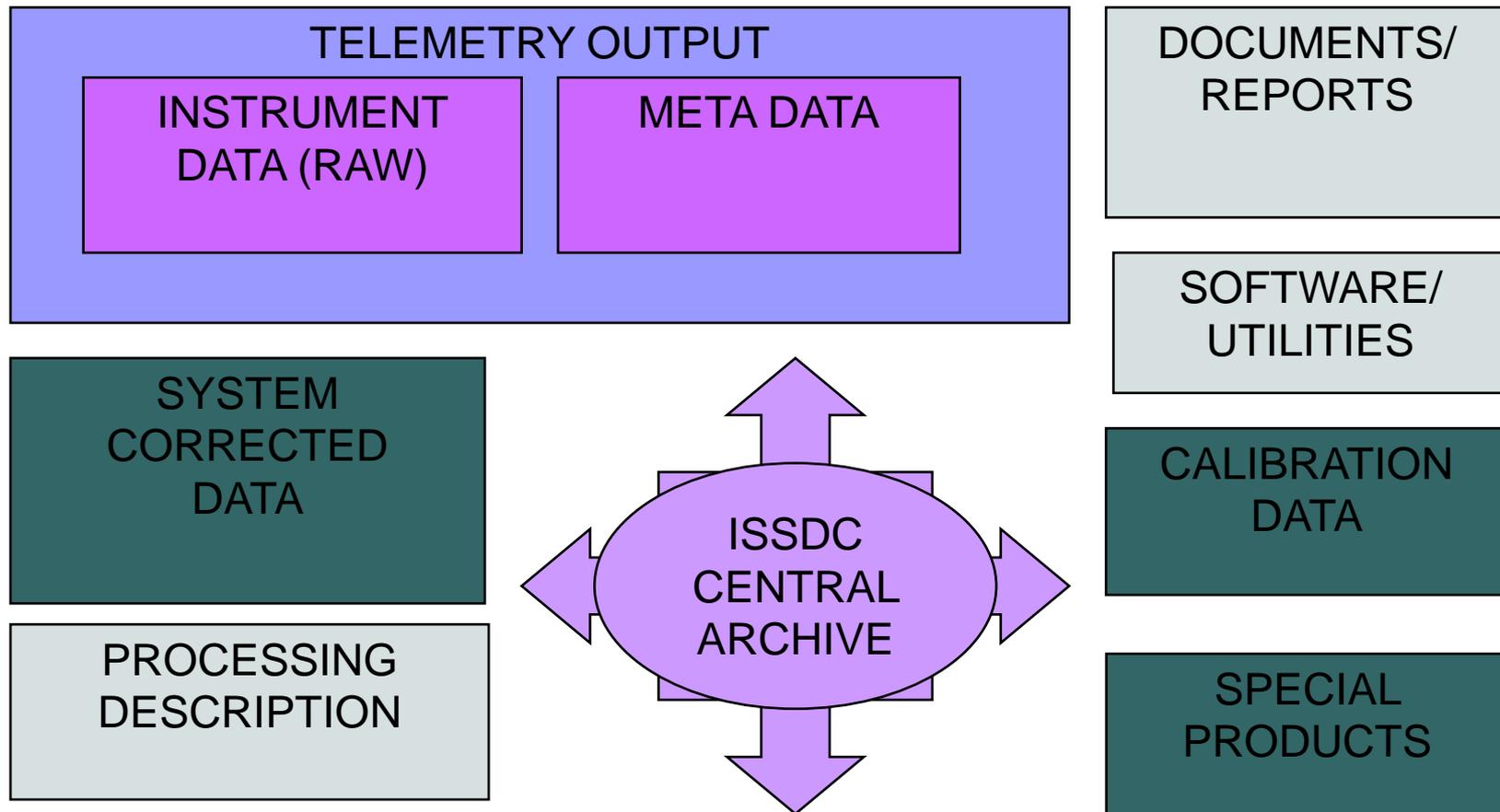
Peer Reviews and Archive Validation

- Arising problems will be resolved by the concerned experiment/PI teams, and the ISDA team through **Chandrayaan-1 Science Data Archive Working Group (CSDAWG)**.
- After a successful Peer Review the data sets are marked as "successfully peer reviewed" in the ISDA.
- Depending on the result of the Peer Review, the ISDA will indicate the status of the reviewed data set as "successfully peer reviewed", "peer review is pending" or "failed peer review"

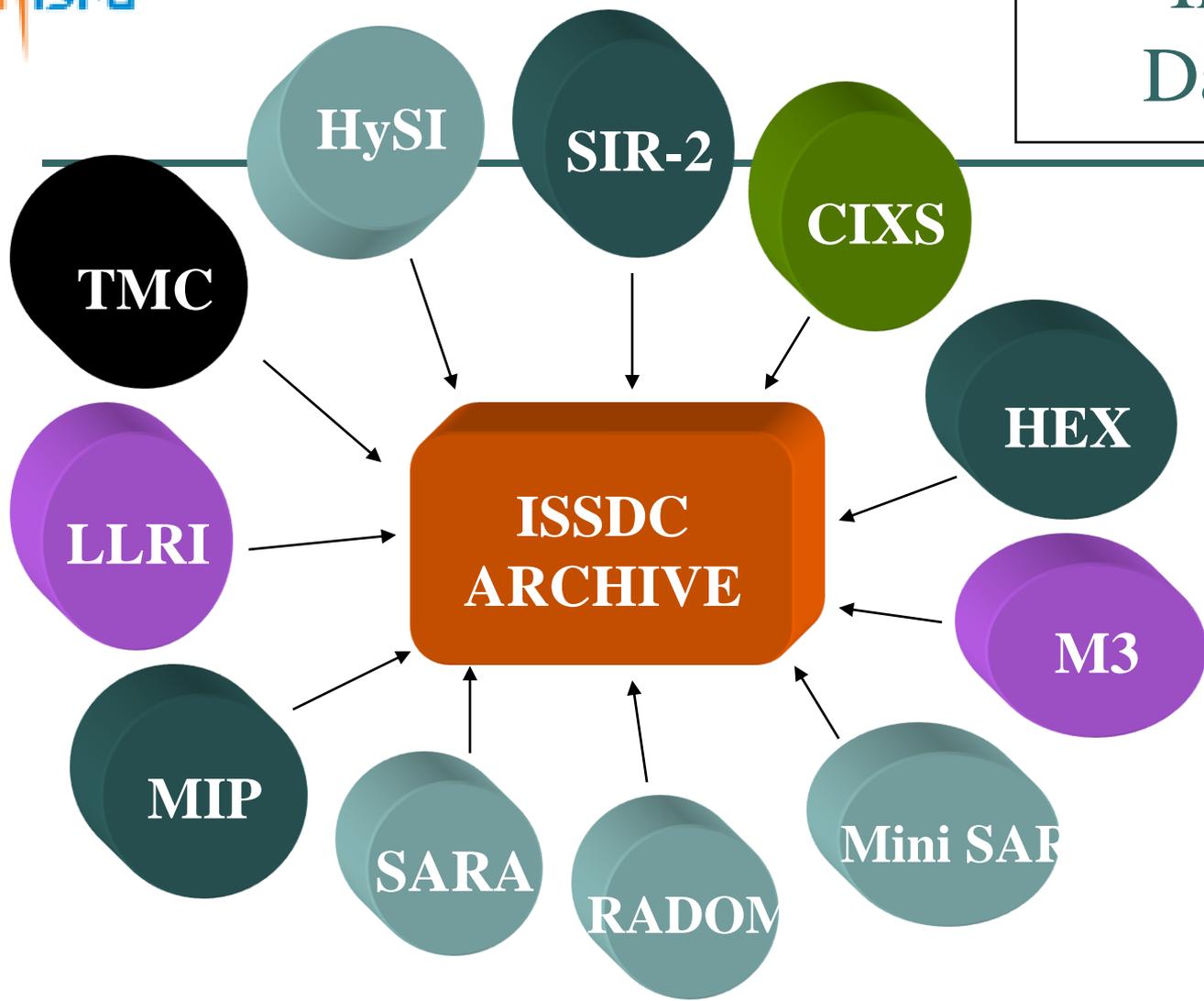
Archive Conventions

- Phases of Mission
- Data Organisation
- Mandatory Keywords and Standard Values
- Standard Values and abbreviations
- Data Directory Naming Convention
- File naming Convention

ISSDC Chandrayaan-1 Archive



Instrument Data storage



Archive Development Status

- Archive Plan and Archive Conventions are prepared and agreed by all instrument PIs/Scientists after one level of iteration
- First version of EAICDs for instrument data were submitted by the respective PIs and an initial review was done and comments were sent from ISDA team
- EAICD updations are being taken up
- Workflow with respect to (i) Active Archive and (ii) the Long Term Archive (LTA) preparation identified
- Data pipelines are being integrated at ISSDC

Points for Discussion

- Implementation of IPDA guidelines and standards, when to start??
- Availability of sample data sets from other missions who has already in compliance with IPDA standards, for the new implementation as an example
- Incorporation of some new mission modes for imaging payloads; related information and guidelines
- Availability of tools to the IPDA members, developed under projects

Thank You

Roles and Responsibilities (PIs and POCs)

- Produce the EAICD for their instrument, following the Archive Conventions.
- Format all data files to PDS standards, for describing completely the calibration and basic reduction procedures.
- Provide a data pipeline to produce Level - 0/1 for the (daily) Active Archive at the Operations Centre ISSDC.
- Provide support in installation and maintenance of this pipeline.

Roles and Responsibilities (PIs and POCs)

- Provide electronic copies of all documents needed to describe the instrument and its operation.
- Ensure that the electronic documents are in a format that is acceptable to PDS.
- Providing higher-level data products to the archive. Each PI team is responsible to ensure that higher-level data products based on data from the appropriate instrument are properly archived.

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Roles and Responsibilities (PIs and POCs)

- Provide suitable parameter tables containing important instrumental parameters that are not included as keywords in the labels.
- Provide index tables to enable searching for desired data files in a straightforward manner.
- Solve problems which have been identified in their data sets.
- Guarantee accessibility of the data from the instrument for which it is responsible to all members of the respective experiment team.



Roles and Responsibilities (SCC/ISSDC)

- Provide up-to-date information to each of the PI teams on the orbital position, velocity and attitude of the spacecraft at the time of all observations by any instrument in the form of SPICE kernels.
- Provide complete details of the orbit, velocity and attitude of the spacecraft throughout the mission to the ISDA team .
- Provide retroactive updates to the orbit, velocity and attitude data products whenever the precision is significantly improved.
- Provide any other spacecraft ancillary data, e.g. health and status information as ASCII files, and sufficient documentation to understand these data.
- Provide any other non-spacecraft ancillary data, e.g. event files, the command database, the list of executed commands, all in ASCII format.
- Provide to the ISDA team the complete instrument telemetry stream.



Roles and Responsibilities (ISDA)

- Coordinating with PI teams
- Ensuring the usability and accessibility of the archive.
- Validating the data sets delivered by the experiment
- Conducting all Peer Reviews of the data
- Ingesting the spacecraft orbit, velocity and attitude data & the other relevant data to the archive
- Providing the data access and distributing the data to the worldwide scientific research community after lock-in period.
- Ensuring preservation of a long-term copy of the raw data.

Roles and Responsibilities (Other Organisations)

- The ESA-PSA archiving team will give support and advice on any archiving matters.
- The official long term archive following the PDS standard including the complete review process is the responsibility of the ISDA team for all instruments, including those provided by all other agencies

