



The RADIO Collaboration

- **A common architecture for radio astronomy?**
- **LTA Development Workshop**
- **Utrecht, 1/7/2026**
- **Hanno Holties**

The RADIO Collaboration

- Radio Astronomy Data-processing Inter Operability (RADIO)
 - “A series of regular workshops to drive **alignment of radio astronomy data processing systems** amongst **large radio astronomy facilities.**”
 - SKA - SKAO (UK) et al
 - ASKAP - SARAO (SA)
 - MeerKAT - CSIRO (AU)
 - ALMA - NRAO (US)
 - LOFAR - ASTRON (NL)

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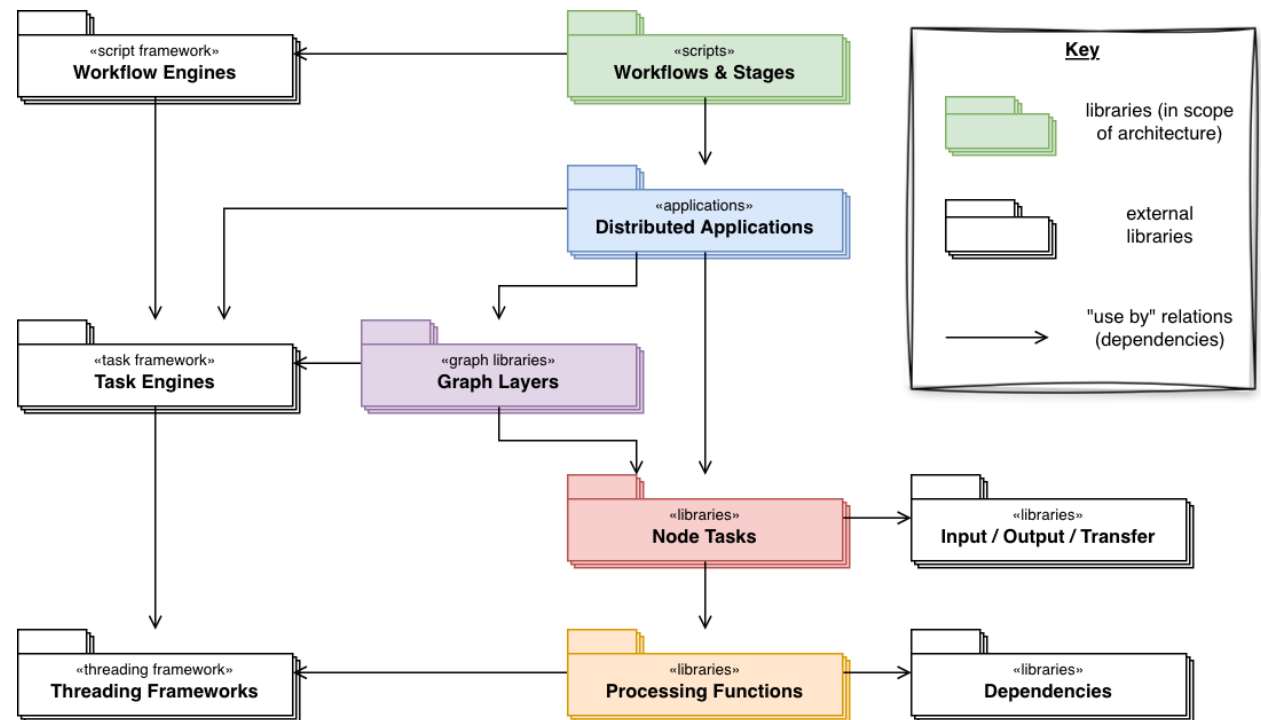
- Objectives
 - Document and adopt a **reference architecture** for future developments that allows defined **interoperability** between **re-usable components**.
 - Develop a **catalogue of** quality **software components** that we are committed to supporting in the future, on new platforms, meeting new needs.
 - **Promote development alignment** and delivery of shared solutions between members of the community through support of **workshops and other communication channels**.
 - **Define** clear **expectations that govern the quality and life-cycle** of radio astronomy processing software components.

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- **Reference Architecture for pipelines (Draft)**
 - Re-usable components for layered architecture
 - Prepared to build on
 - Task frameworks, specifically Dask
 - Python distributed multi-dimensional data objects (Xarray)
 - MSv4

Credits

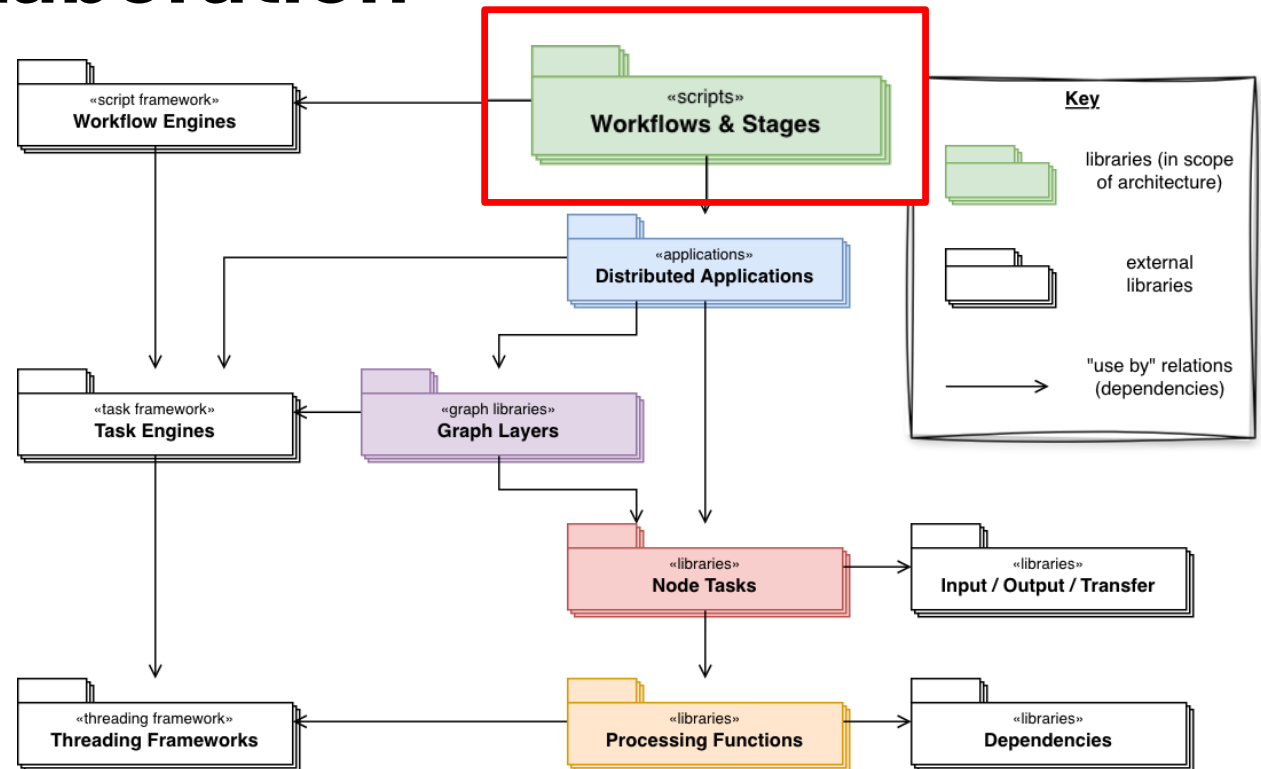
- P. Wortmann (SKAO)
- J.W. Steeb (NRAO)
- H.A. Holties (ASTRON)



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- **Workflows**

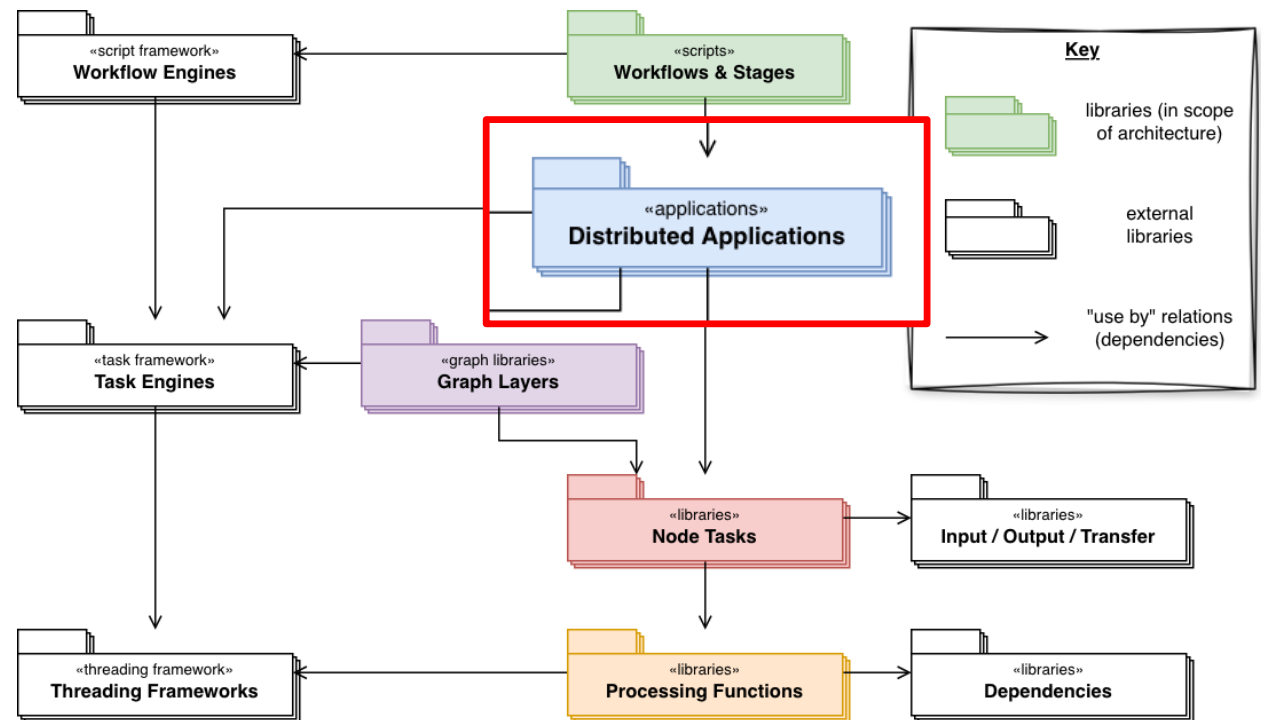
- Highest level definition of pipelines
 - Targeting a scientific data reduction
 - Well defined inputs & outputs - generation of higher level / advanced data products
 - Automation at observatory level – orchestration cross systems allowed
- E.g. Prefect, CWL



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- **Distributed Applications**

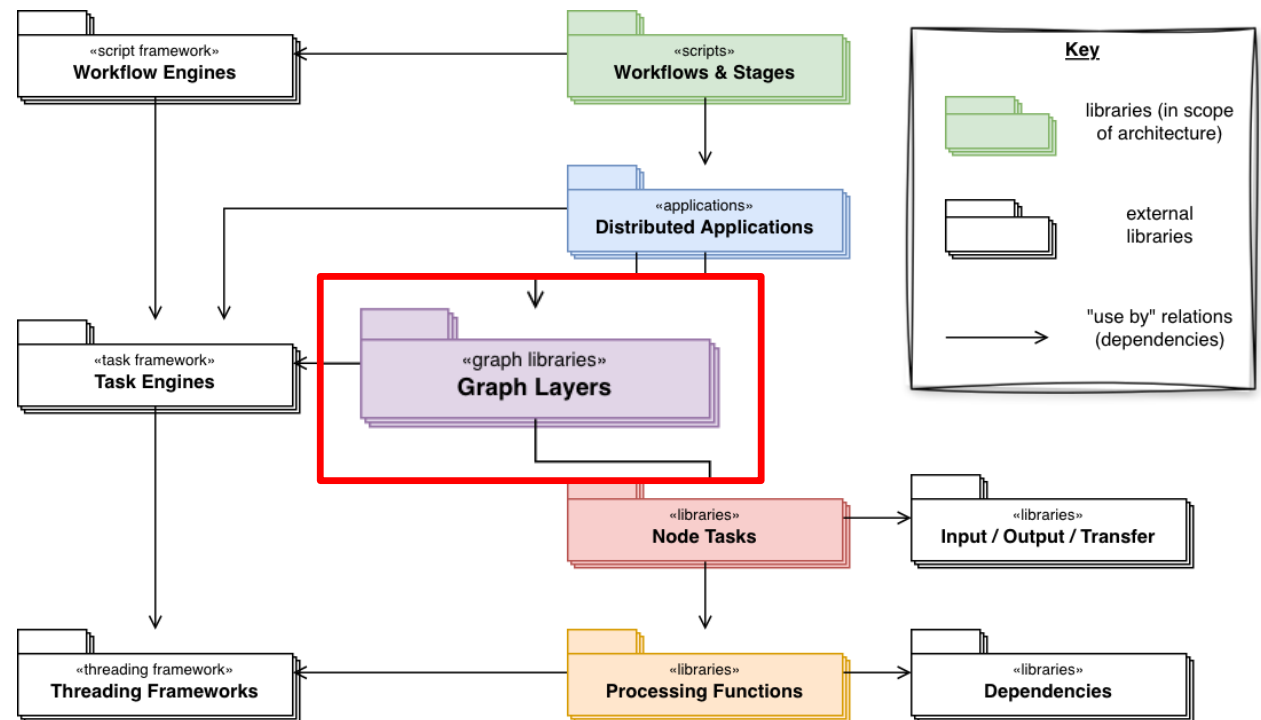
- Application level
 - Steps in workflow
 - Work on data in storage
 - May run distributed tasks across nodes of a system
 - Implement (e.g. Dask) graph of tasks
- E.g. WSClean



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- **Graph Layers**

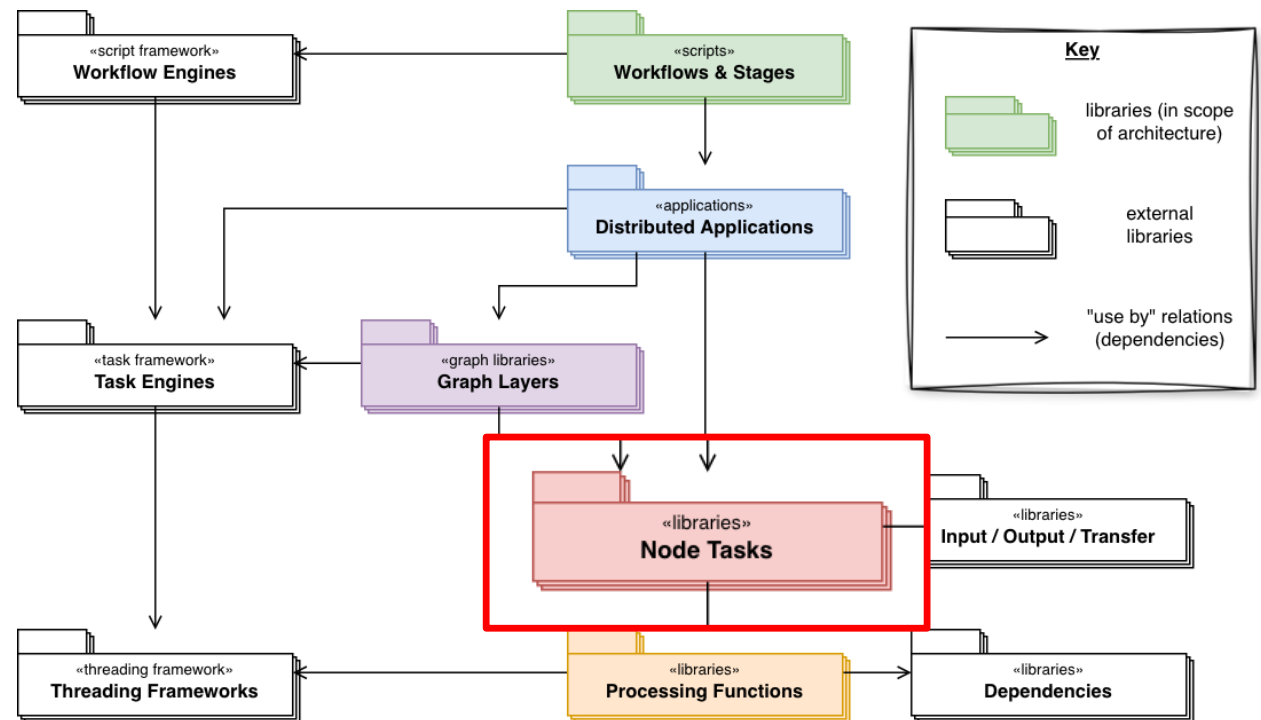
- Sub-graphs for an application
 - Typically a set of operations on an entire dataset
 - Chunks of data are distributed across nodes
 - Data objects (Spark DataFrame, Xarray) 'lazily' instantiated on nodes
 - Build heavily on capabilities of task framework (e.g. Dask)



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- **Node Tasks**

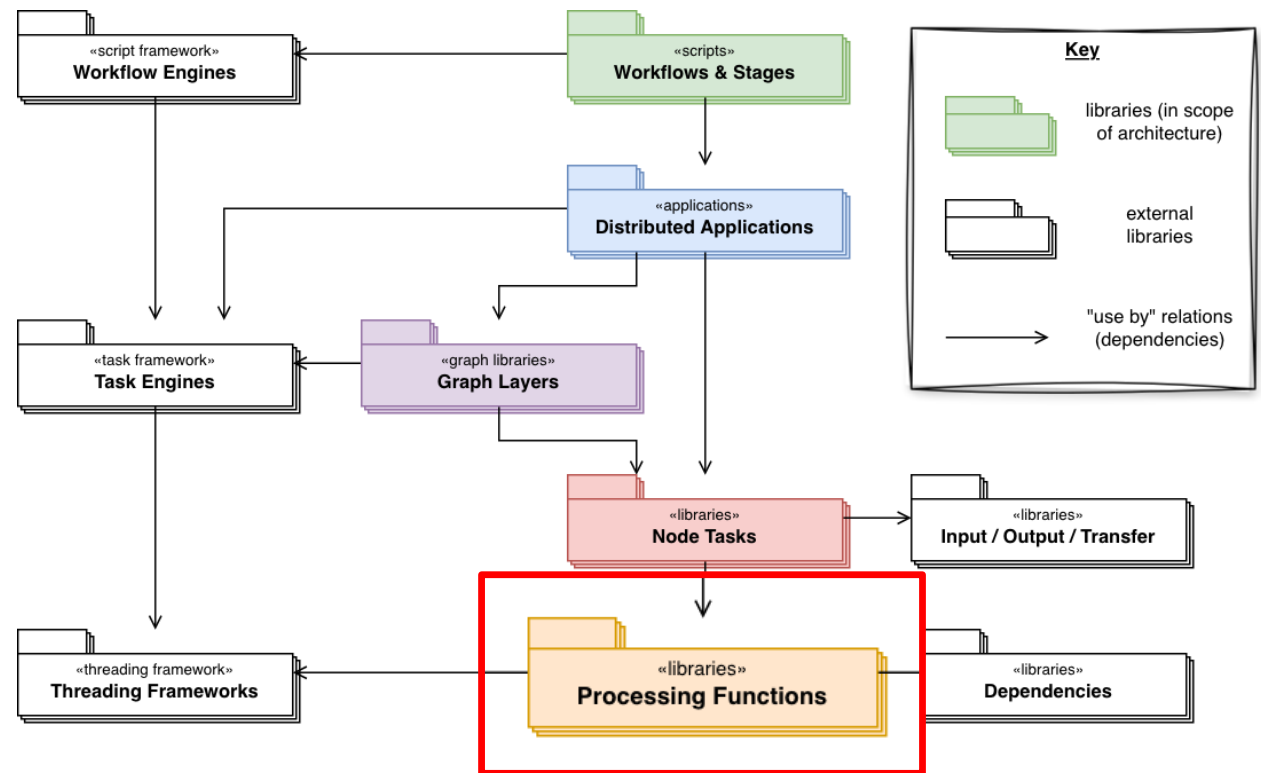
- Tasks executed on a single node
 - 'Leafs' in task graphs
 - Wrap functions & IO operations
 - Loading of data chunks/frames from storage
 - Could be application that is executed on single node
- E.g. DP3



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- **Processing Functions**

- Basic building blocks e.g. from libraries
 - Work on data in memory
 - No internal state between calls
 - Optimisations at hardware level (CPU/GPU)
 - Python interface (C++ where possible)



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- **Software component catalogue** prototype (credit John S.)

**Radio Astronomy Tools**
Reusable open source software for radio astronomy

CatalogueCategoriesAdd a toolAbout



Radio Astronomy Tools

A curated catalogue of production-ready, open source software for radio astronomy, maintained by the RADIO collaboration. Every entry is open source, aimed at **production use** rather than research code, and described in enough technical depth to judge whether it fits your pipeline.

Search 16 tools...All categoriesAny readinessAny interface

Any institute

AOFlagger

Library and programs for detecting radio-frequency interference in visibility data, combining pattern recognition with morphological operations.

ProductionRFI flaggingC++Python

ASTRON · GPL-3.0

codex africanus

"Radio Astronomy Building Blocks": RIME terms, direct Fourier transforms, gridding/degridding, deconvolution and coordinate transforms, with NumPy and Dask interfaces.

Readiness not assessedIncomplete entryProcessing functionsPython

SARAO · BSD-3-Clause

DDECal

Direction-dependent calibration task inside DP3, with multiple solver algorithms, constraints (smoothness, TEC, Faraday) and BDA support.

ProductionCalibrationPythonDP3

ASTRON · GPL-3.0 (as part of DP3)

DP3

Streaming preprocessing pipeline for radio interferometric data: flagging, averaging, demixing, calibration, prediction and beam application, reading and writing data only once.

ProductionPre-processingCalibrationRFI flaggingCommand linePythonC++

ASTRON · GPL-3.0

Dysco / Sisco / Metadata compression

Compression for radio astronomy data: lossy visibility compression (Dysco, ~4x), lossless model data compression (Sisco, 2–8x) and lossless metadata compression.

ProductionData compressionCasacore storage manager

ASTRON · LGPL-2 (as part of Casacore)

Image Domain Gridding (IDG)

Gridding that efficiently applies a-term corrections, faster than a-projection, with an access pattern well suited to GPUs.

ProductionGriddingC++

ASTRON · GPL-3.0

LINC

LOFAR Initial Calibration pipeline: corrects instrumental and ionospheric effects in HBA and LBA observations, preparing data for direction-dependent calibration.

PILOT

Pipeline for the International LOFAR Telescope: calibration and imaging at sub-arcsecond resolution using LOFAR's international stations. Under development.

Radler

Image-based deconvolution library (the "minor iterations") implementing clean, IUWT, ASP and MoreSane, with state-of-the-art multi-scale multi-frequency cleaning.