LMC Overview

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Science Data Processor Consortium

Status

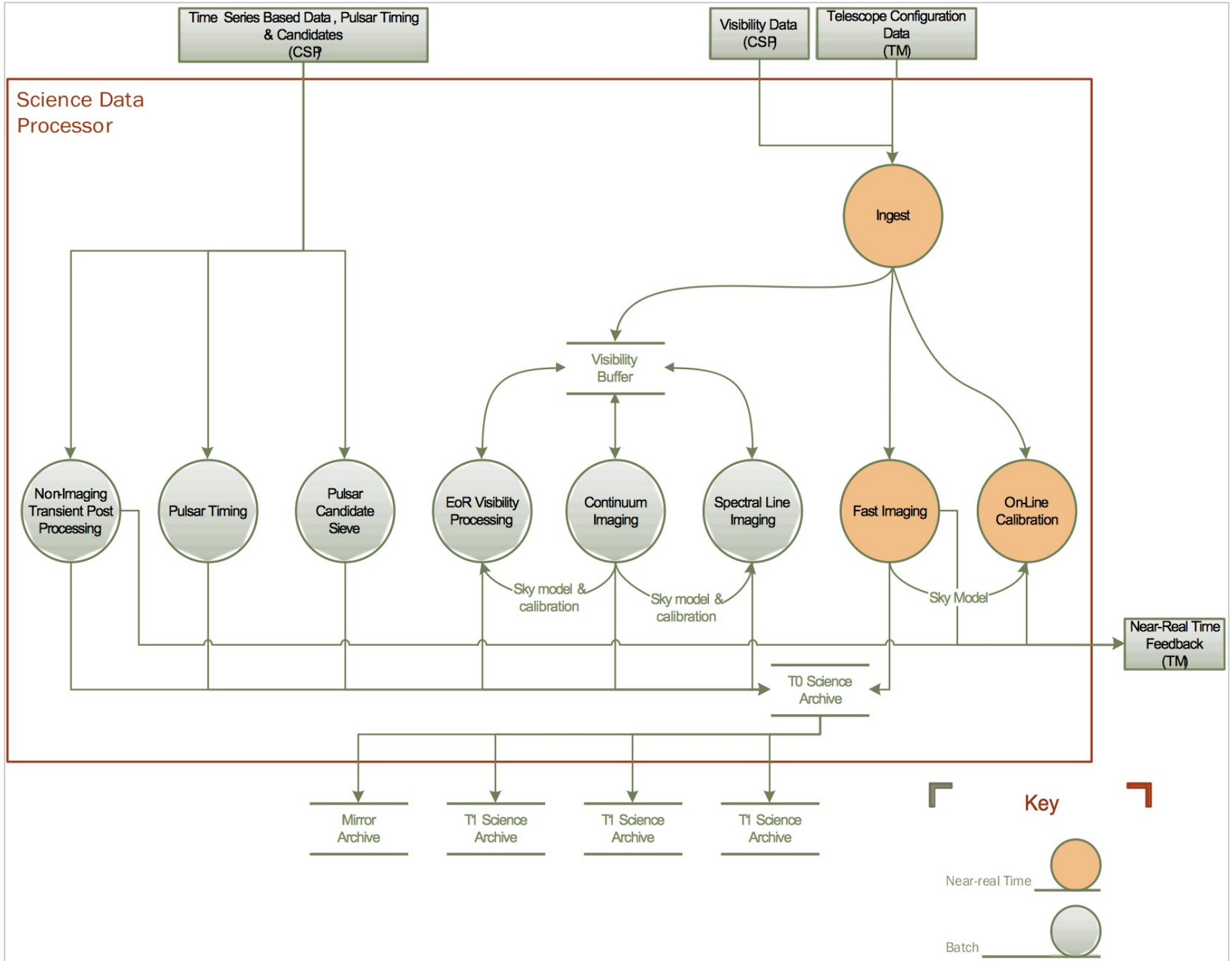
- PDR review meeting complete (15 March)
- Major focus to date has been on architecture and costing efforts.
- New baseline design likely to have significant impact on cost/schedule but not necessarily architecture.
- Need to ask the question of how much closer to the precursors the problem has become.

Status - LMC

- LMC design document reasonably well received at PDR (8 Major / 19 Minor).
- ICD related issues such as capability definition and role of Telescope Model are highest priority.
- Effort is understaffed at the moment – integrating distributed resources is proving challenging.

SDP – Capability

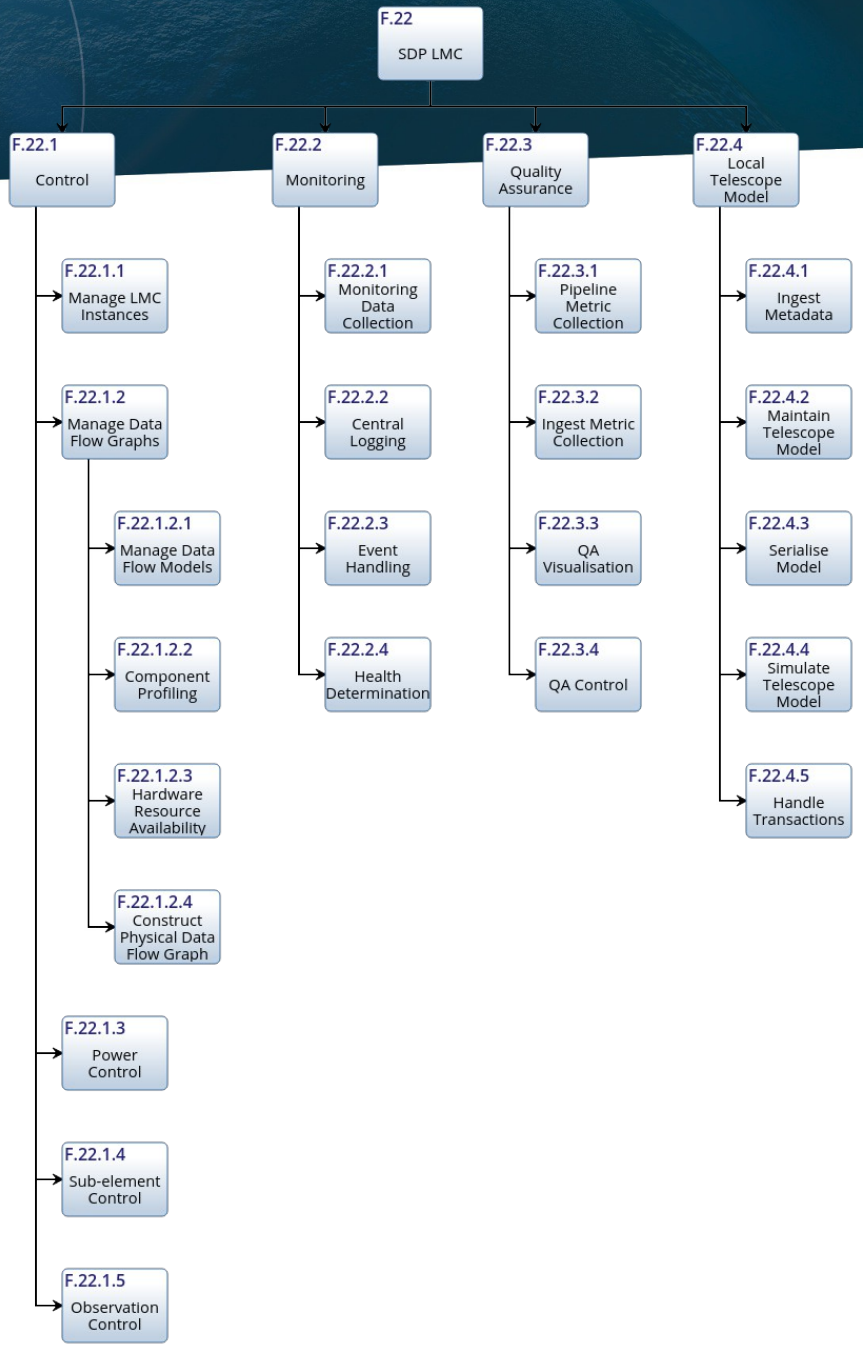
Capabilities are fundamentally high level observation modes, that when coupled with a particular set of observation parameters produce a specific data product. For example, "continuum imaging" may be the capability, with a number of observation parameters such as field of view, number of channels, major cycles etc...


Time Series Based Data , Pulsar Timing & Candidates (CSP)
Visibility Data (CSP)
Telescope Configuration Data (TM)
Science Data Processor
Ingest
Visibility Buffer
Non-Imaging Transient Post Processing
Pulsar Timing
Pulsar Candidate Sieve
EoR Visibility Processing
Continuum Imaging
Spectral Line Imaging
Fast Imaging
On-Line Calibration
Sky model & calibration
Sky model & calibration
Sky Model
Near-Real Time Feedback (TM)
T0 Science Archive
Mirror Archive
T1 Science Archive
T1 Science Archive
T1 Science Archive
Key
Near-real Time
Batch

LMC Components

- Configuration and Control
- Data Flow Management
- Health and Status Monitoring
- Error Handling
- Quality Assurance
- Telescope State Information

Functional Decomposition

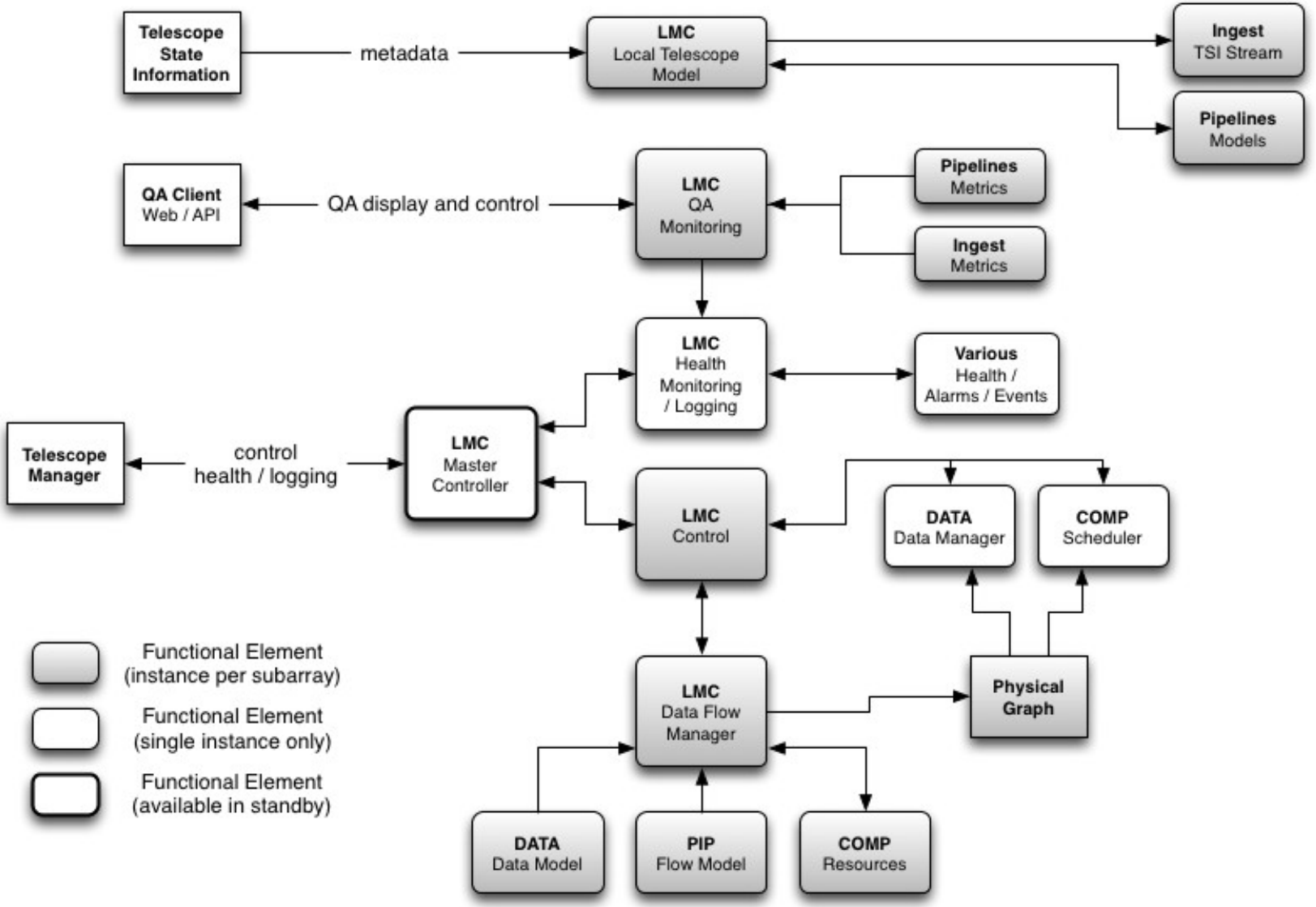


SKA SQUARE KILOMETRE ARRAY

SDP

SCIENCE DATA PROCESSOR

Architectural Overview



Configuration and Control

- Physically provided by the SDP Master Controller.
- Presents a single interface to TM allowing control and configuration of all SDP capabilities.
- Most configuration items and monitoring points are indexed by capability and could be interacted with seperately.
- Possibility of active failover – dependent on reliability analysis.

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SDP
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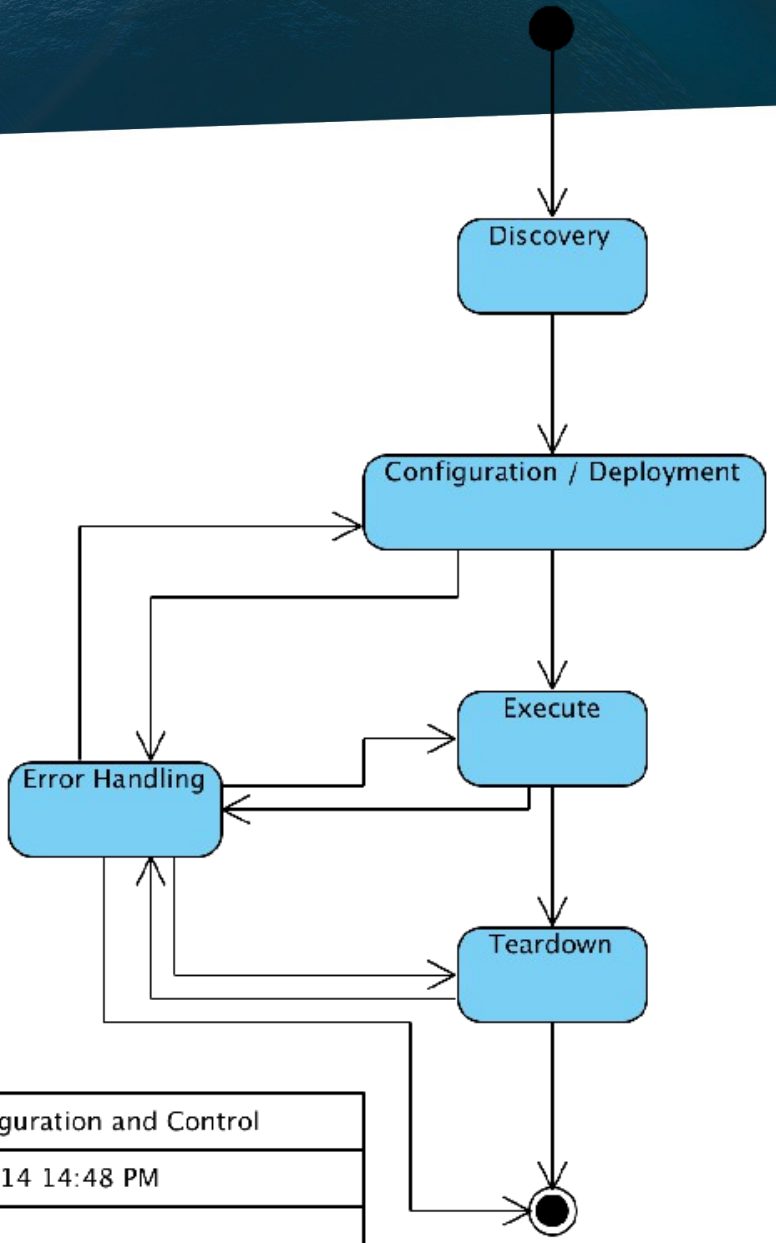
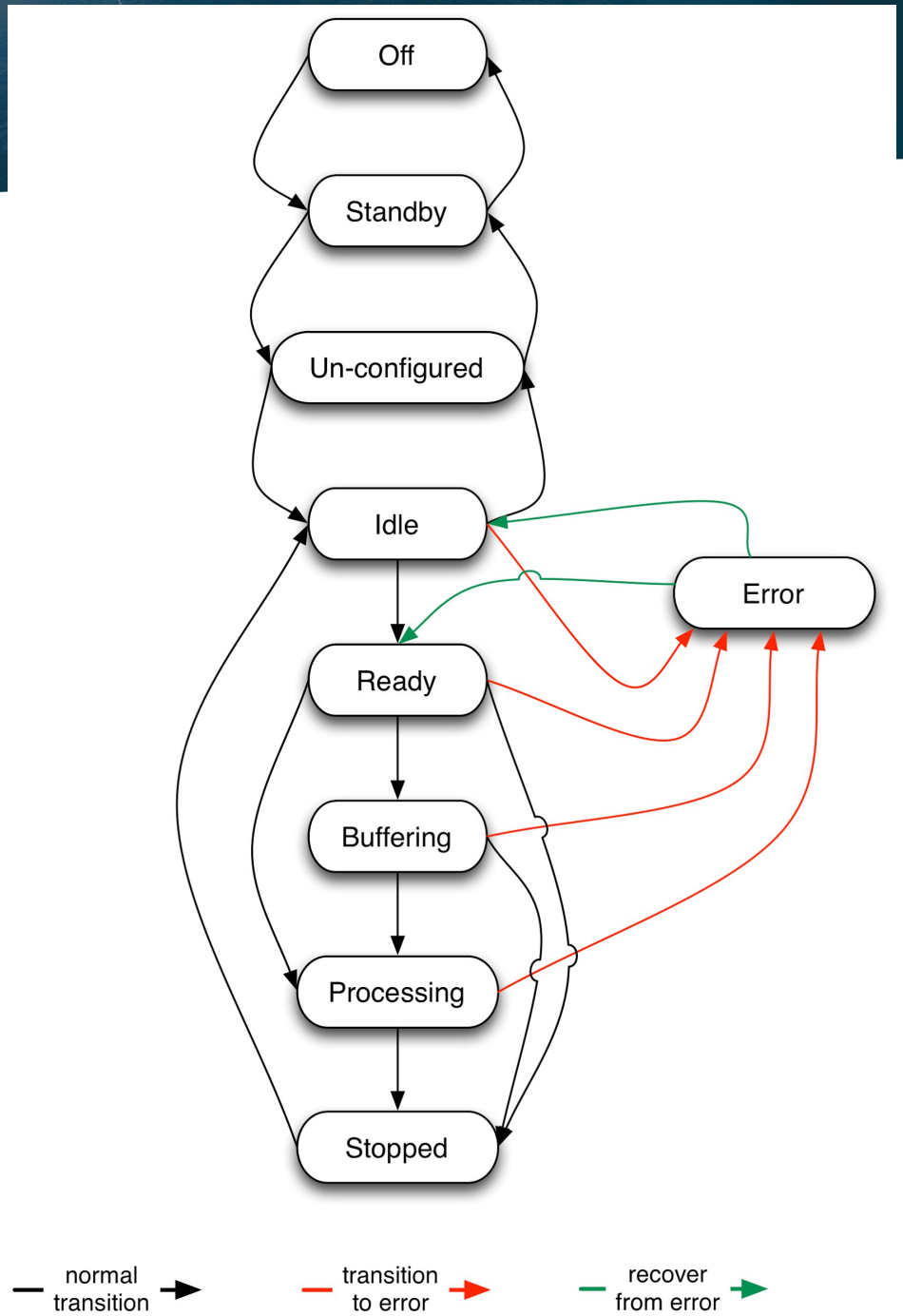


Name:	LMC Configuration and Control
Last Modified:	14 Aug 2014 14:48 PM
Documentation:	

States

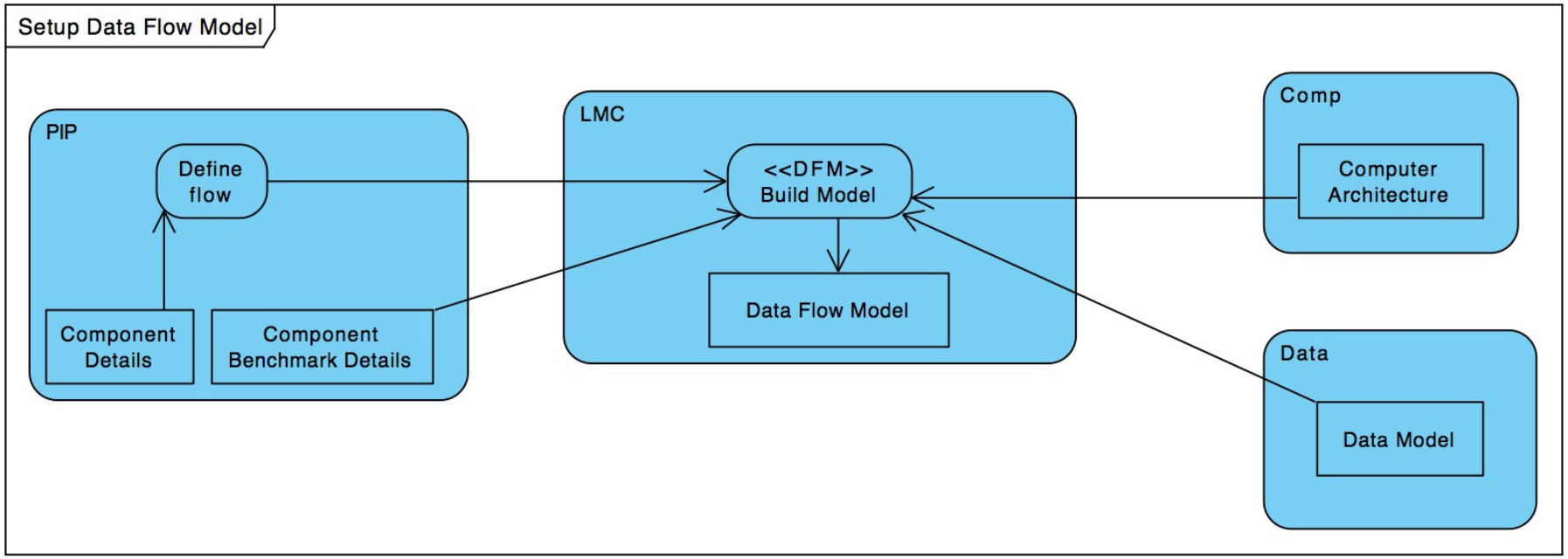

Off
Standby
Un-configured
Idle
Error
Ready
Buffering
Processing
Stopped
normal transition
transition to error
recover from error

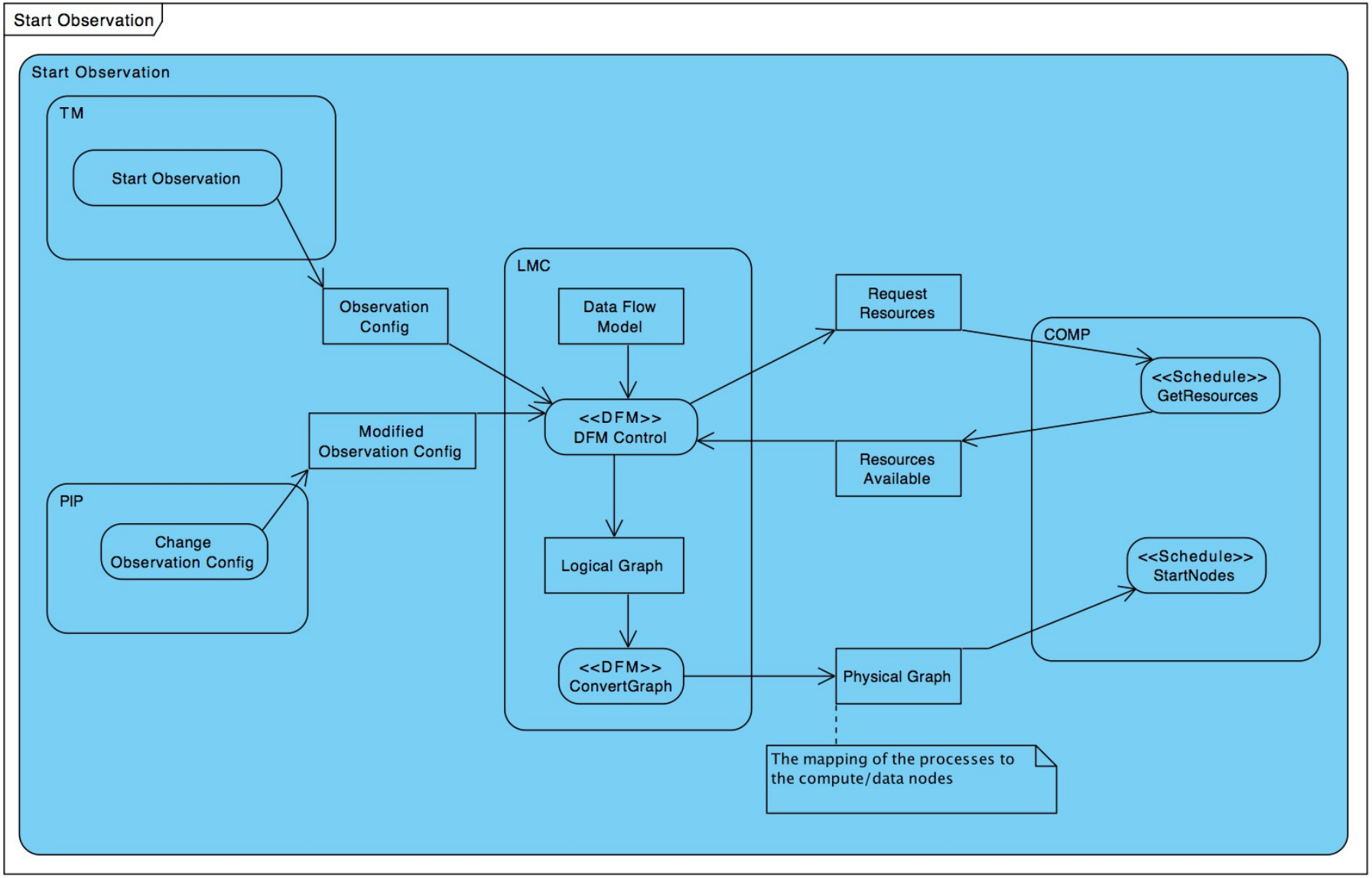
Simulation

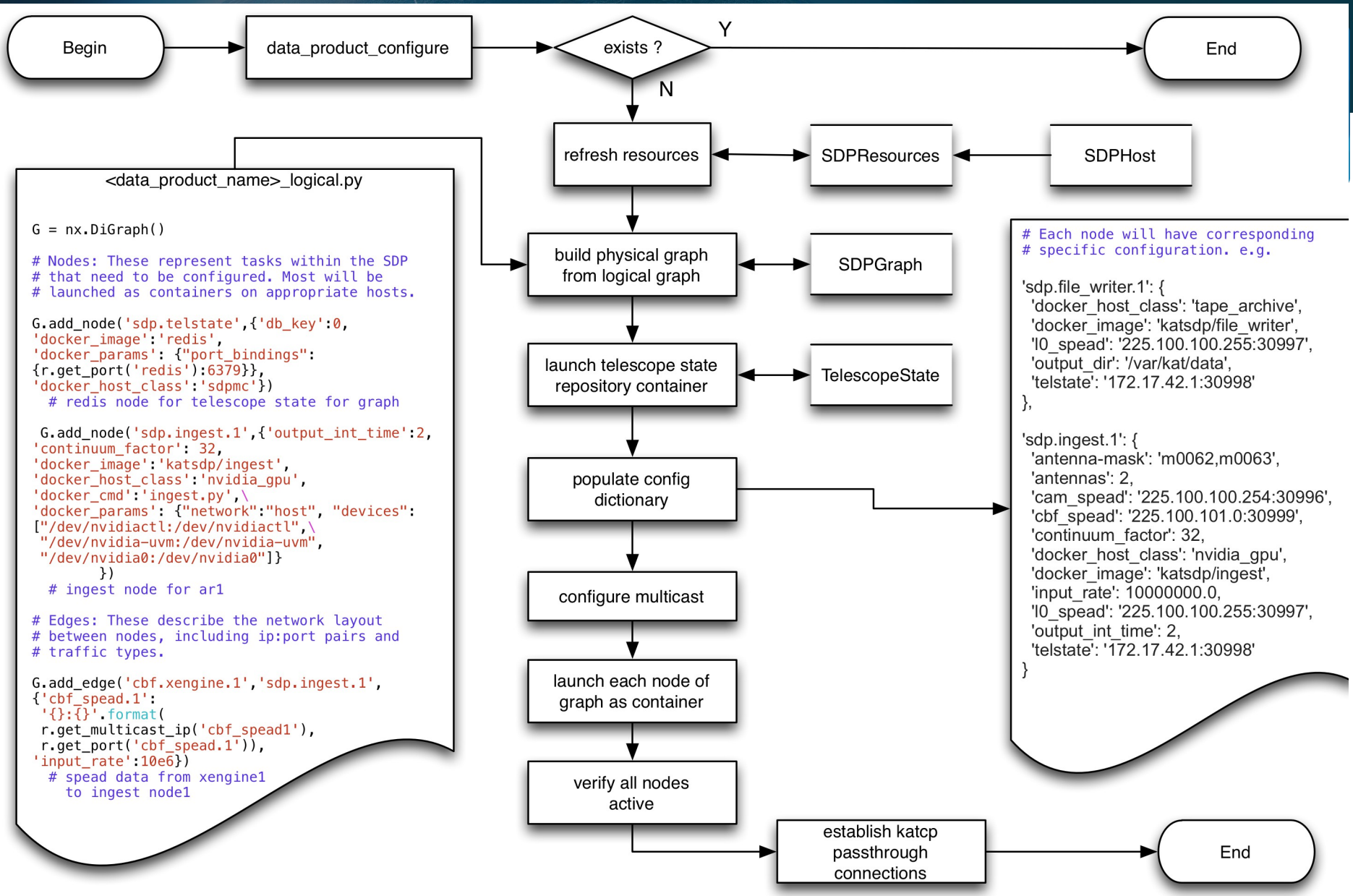
- The SDP MC is also the primary point for simulation of SDP capabilities outward to TM and the TM role inward to SDP.
- Work on the exchange of telescope state information is still needed.
- Used internally in run up to CDR to validate horizontal prototype, but not currently planned as part of CDR deliverable.

Dataflow Manager

- Prime role is construction of Physical Deployment Graph from description of logical data flow and available physical resources.
- Can also provide estimates of hardware resources required during discovery phase.
- Once complete, the graph contains a description of Data Object to be configured in the Data Layer and compute resources to be configured in the Computer Platform.
- Once configuration of underlying objects and resources is complete, the dataflow manager plays no further active role until an error or end of observation request.


Setup Data Flow Model
PIP
Define flow
Component Details
Component Benchmark Details
LMC
<<DFM>>
Build Model
Data Flow Model
Comp
Computer Architecture
Data
Data Model


Start Observation
Start Observation
TM
Start Observation
Observation Config
LMC
Data Flow Model
Request Resources
COMP
<<Schedule>> GetResources
Modified Observation Config
<<DFM>> DFM Control
Resources Available
PIP
Change Observation Config
Logical Graph
<<Schedule>> StartNodes
<<DFM>> ConvertGraph
Physical Graph
The mapping of the processes to the compute/data nodes



MeerKAT SDP Master Controller

Health and Status Monitoring

- Provides high level rolled up sensors such as element health, capability health, capability status, loading, versions and build.
- Also includes logging interface. Will allow runtime / crashed inspection of components and alterations to logging levels. This allows conservative defaults and deeper inspection on alarm or event.
- Alarms and events are handled within this framework – the master controller will provide roll-up and aggregation.

Error Handling

- Very challenging for a system of the likely scale of the SDP (20,000+ nodes).
- Detection mechanisms are key:
  - Hard
  - Soft
  - Silent
- Automatic recovery will be limited to prune and graft of existing data flow graph.
- More advanced intervention will require input from TM (either automatic or via telescope operator).
- Deciding on how to report errors and their likely impact is a topic for further research.

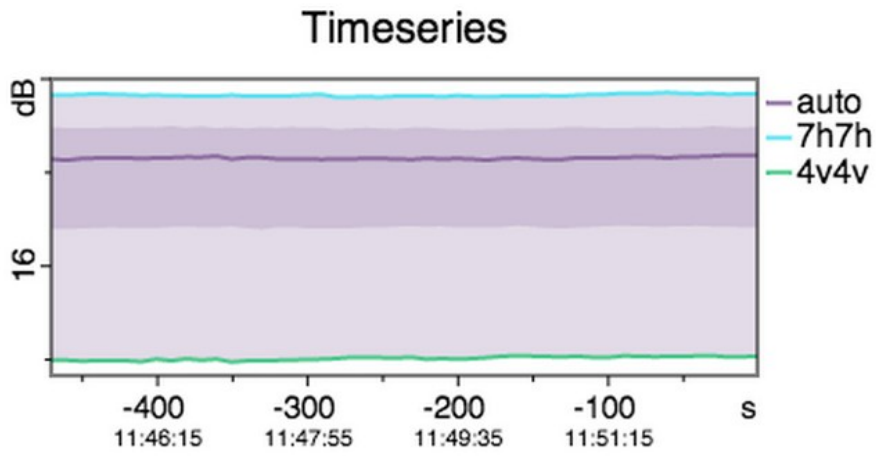
Quality Assurance

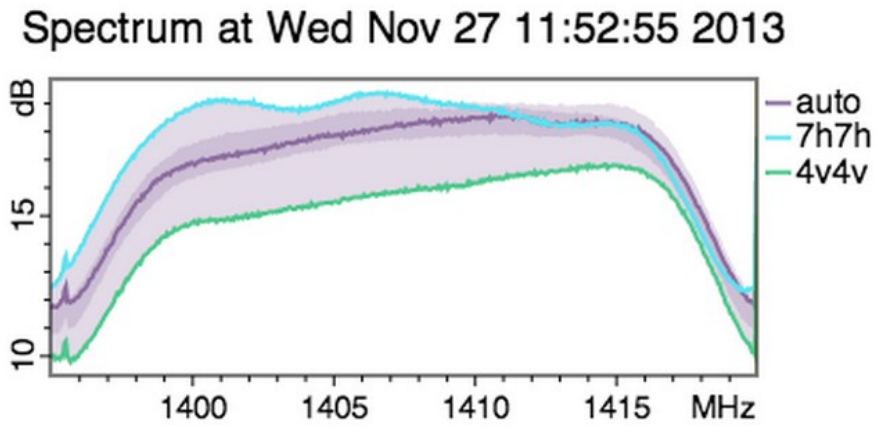
- SDP is responsible for producing three broad categories of scientific metrics:

Interferometric Measures – These represent a near real-time view on telescope performance and include metrics such as visibility phase per baseline as a function of time.
Instrumental Calibration – These show the state of dynamic calibration of the instrument and include metrics such as bandpass calibration.
Performance Metrics – These are higher level, derived metrics that show the overall current performance of the instrument in terms of quantities such as astrometry (showing deviation of source position from known standards).

Quality Assurance

- In addition to QA metrics, SDP will also produce real-time visualisation of the scientific payload.
- This will plug into the TM GUI framework and rely on the framework to provide support such as A&A.





Telescope State Information

- Meta-data required by the SDP, over and above the scientific payload, to fulfill the scientific mission of the two telescopes.
- Current plan is to host this within the SDP, and rely on streamed meta-data from other sources (CSP, TM) to populate the state repository.
- Will include model generation code alongside for calculation of just in time parameters such as UVW coordinates.
- Will exist per capability to both distribute load and reduce single points of failure.
- Some / all of the collected meta-data will also be delivered in stream alongside scientific payload.

State Information Categories

Data Identification – Information directly needed to interpret the scientific payload structure (e.g. baseline indexing).

Pointing – Information related to physical (antenna) and virtual (beam-former) positions, modes and targets.

Telescope State / Configuration – The static configuration of the telescope as it describes the environment in which a particular capability is to be executed (e.g. channel bandwidth).

Environment – Factors within the telescope environment used for further scientific analysis (e.g. wind speed).

High Level Requirements on TM

- Control and management of SDP capabilities and observations.
- Interface with sensors, logs, events and alarms.
- Error handling and propagation.
- Provision of the SDP with telescope state information and configuration.
- GUI framework for delivery of the quality assurance user interfaces.
- A&A ?
- SDP unlikely to use any framework internally. As with CSP, we mostly want a simple, well defined, communication protocol to use for internal and external component communication. (katcp for now)

Questions to address

- Timeframe for decisions regarding frameworks / protocols and closeout of ICDs.
- Requirements on SDP from the TM perspective (simulators, etc…)
- Telescope State Information and Telescope Model
- Suggest we need a cross cutting error propagation and handling group.
- How can we tighten the work across CSP-SDP-TM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