ICRAR

International
Centre for
Radio
Astronomy
Research

The SKA Data Flow Systems Design

Hatching out of the Egg

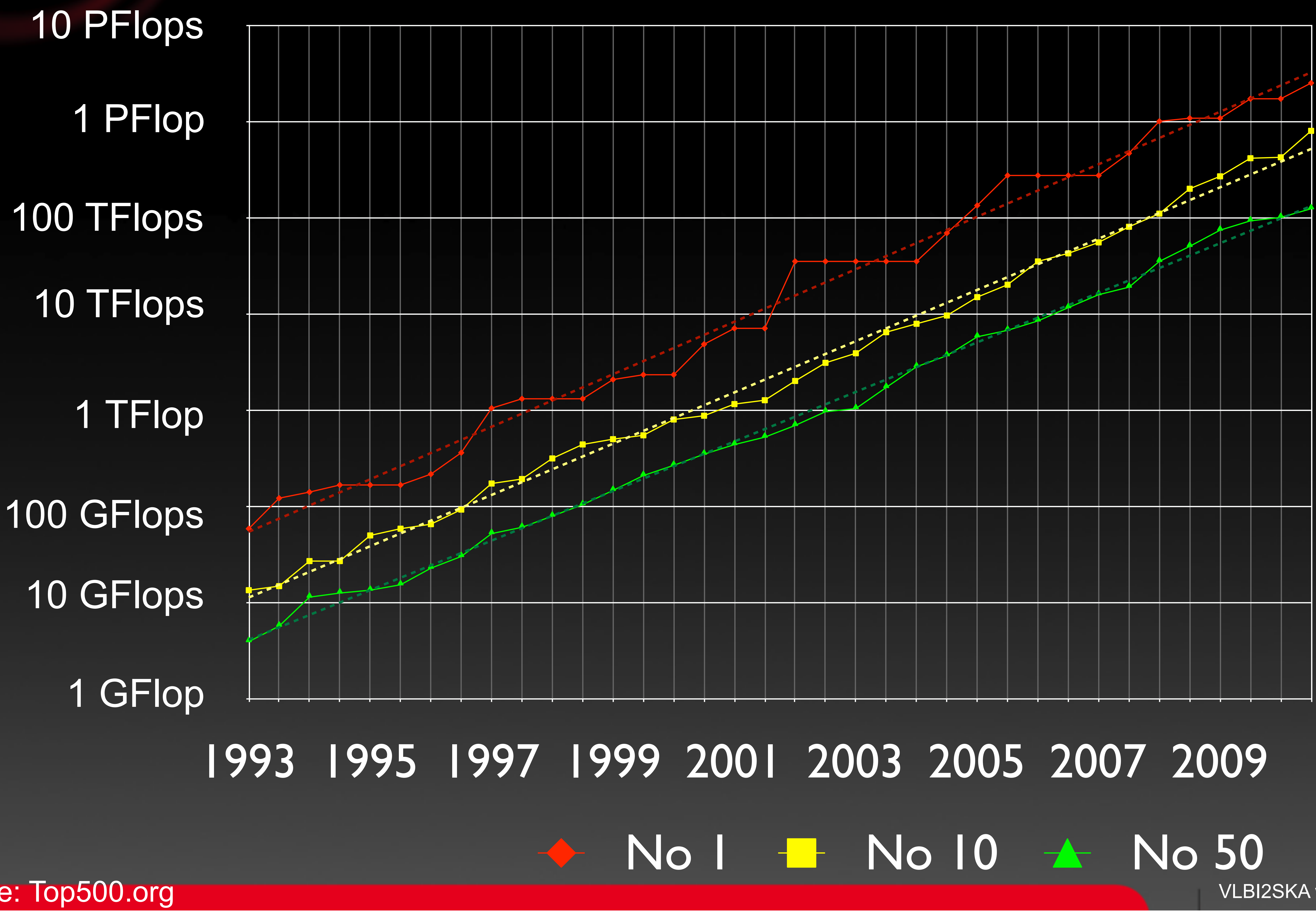
Andreas Wicenec

Curtin University

THE GOVERNMENT OF WESTERN AUSTRALIA

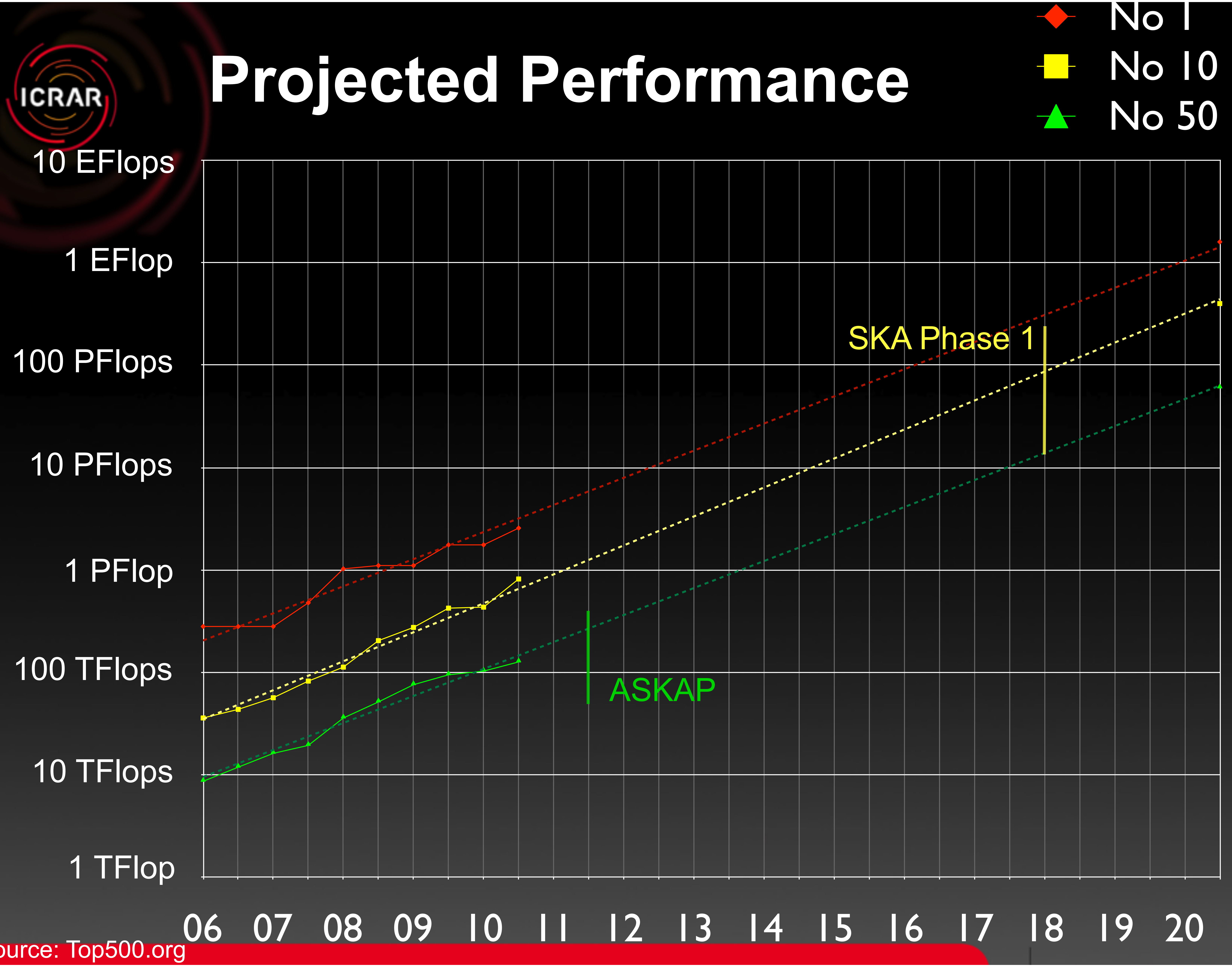
THE UNIVERSITY OF WESTERN AUSTRALIA
Achieve International Excellence

Logarithmic Growth in Flops



Source: Top500.org

Projected Performance



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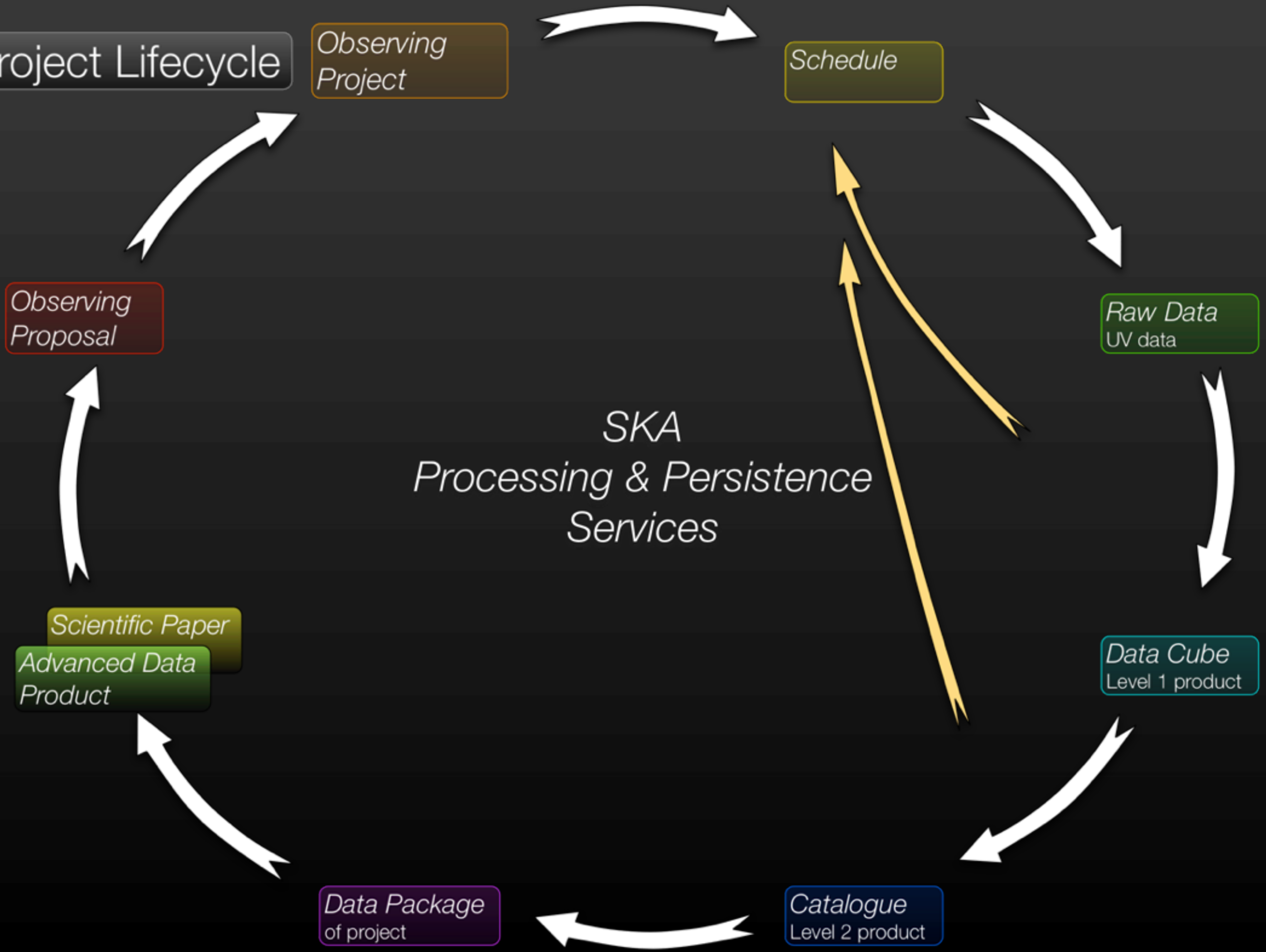
Wednesday, 25 May 2011

SKA
Processing & Persistence
Services

ObsProject Lifecycle



Observing Project

Schedule

Raw Data
UV data

Data Cube
Level 1 product

Catalogue
Level 2 product

Data Package
of project

Scientific Paper

Advanced Data Product

Observing Proposal

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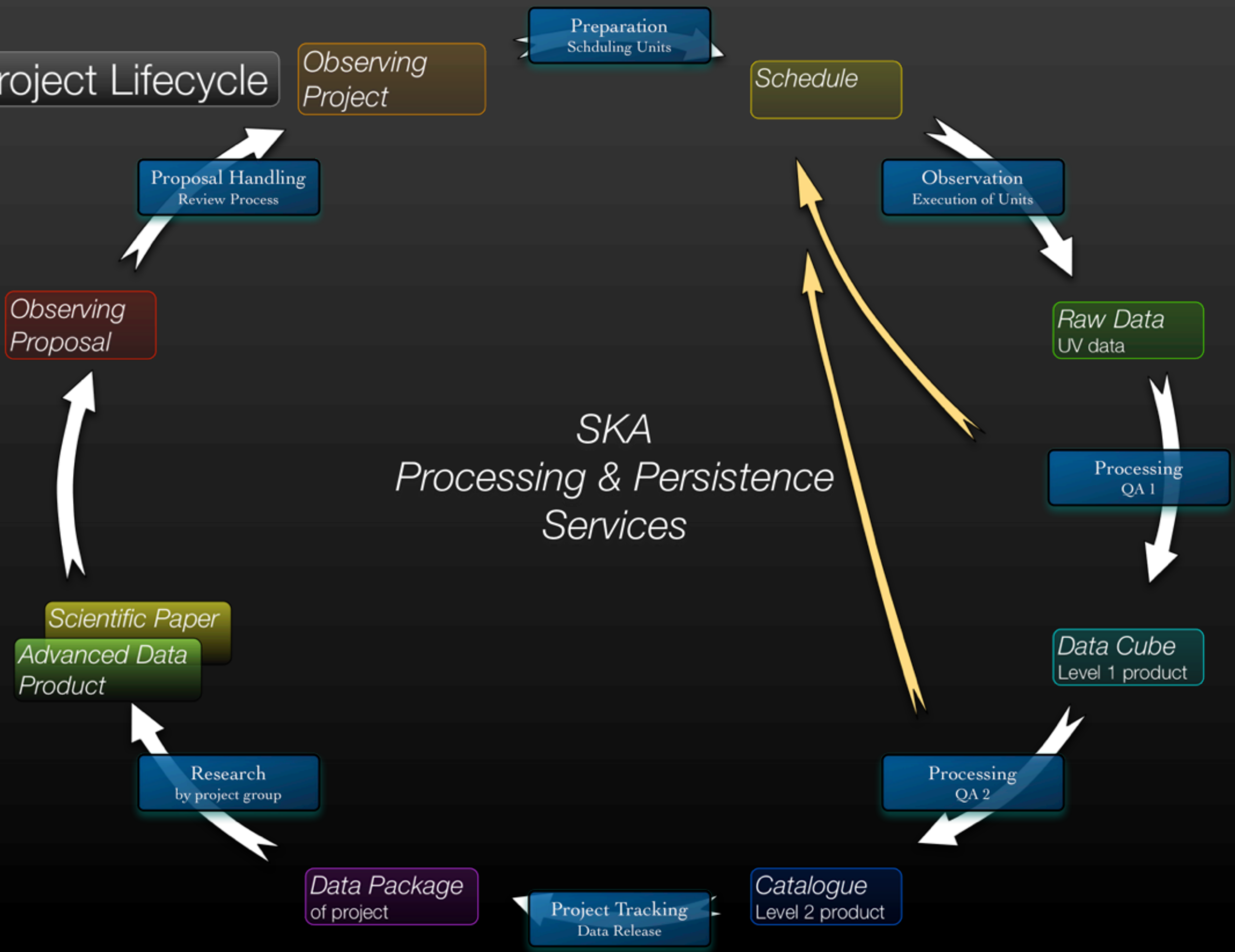

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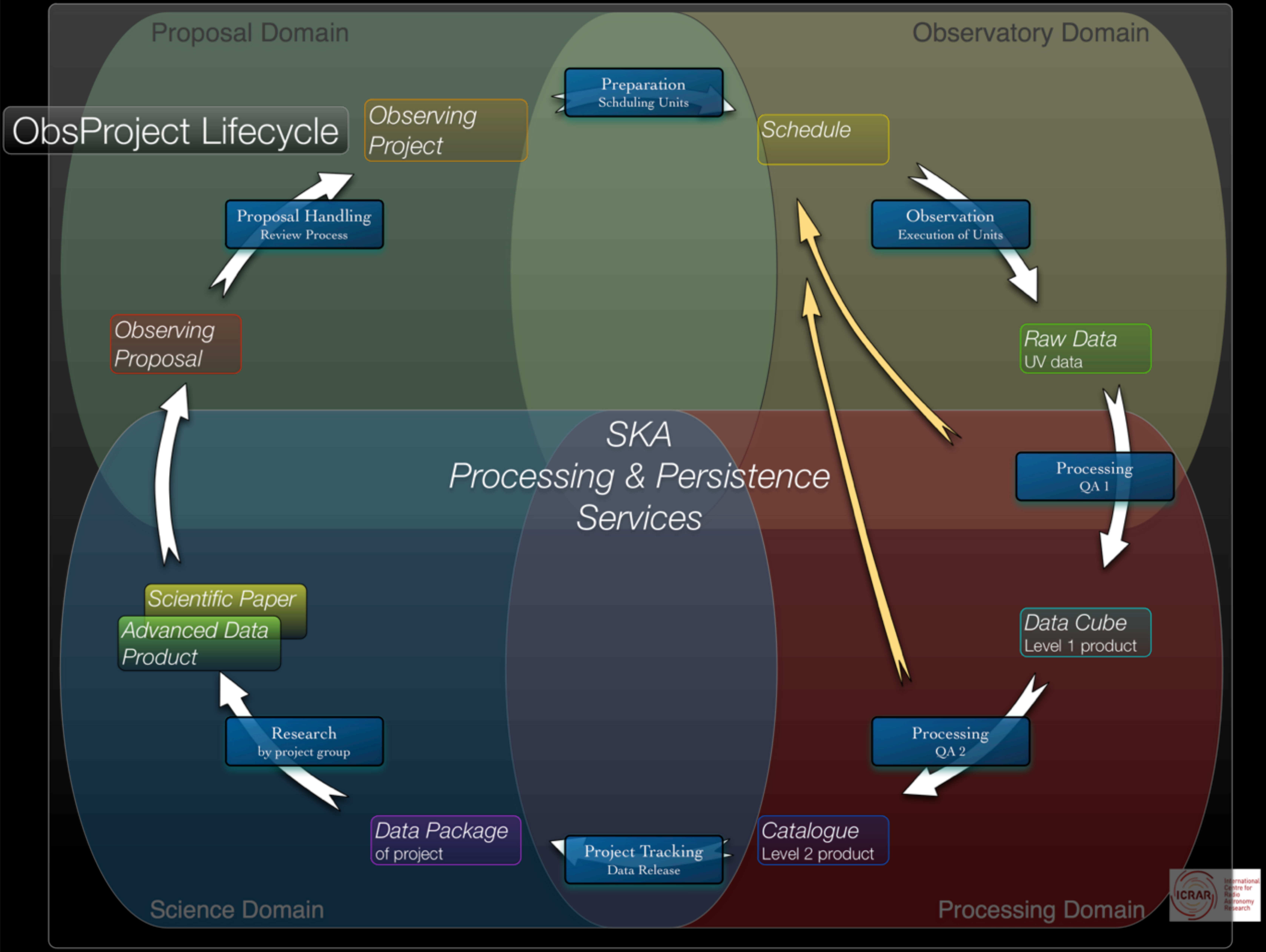

Proposal Domain

Observatory Domain

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Processing Domain

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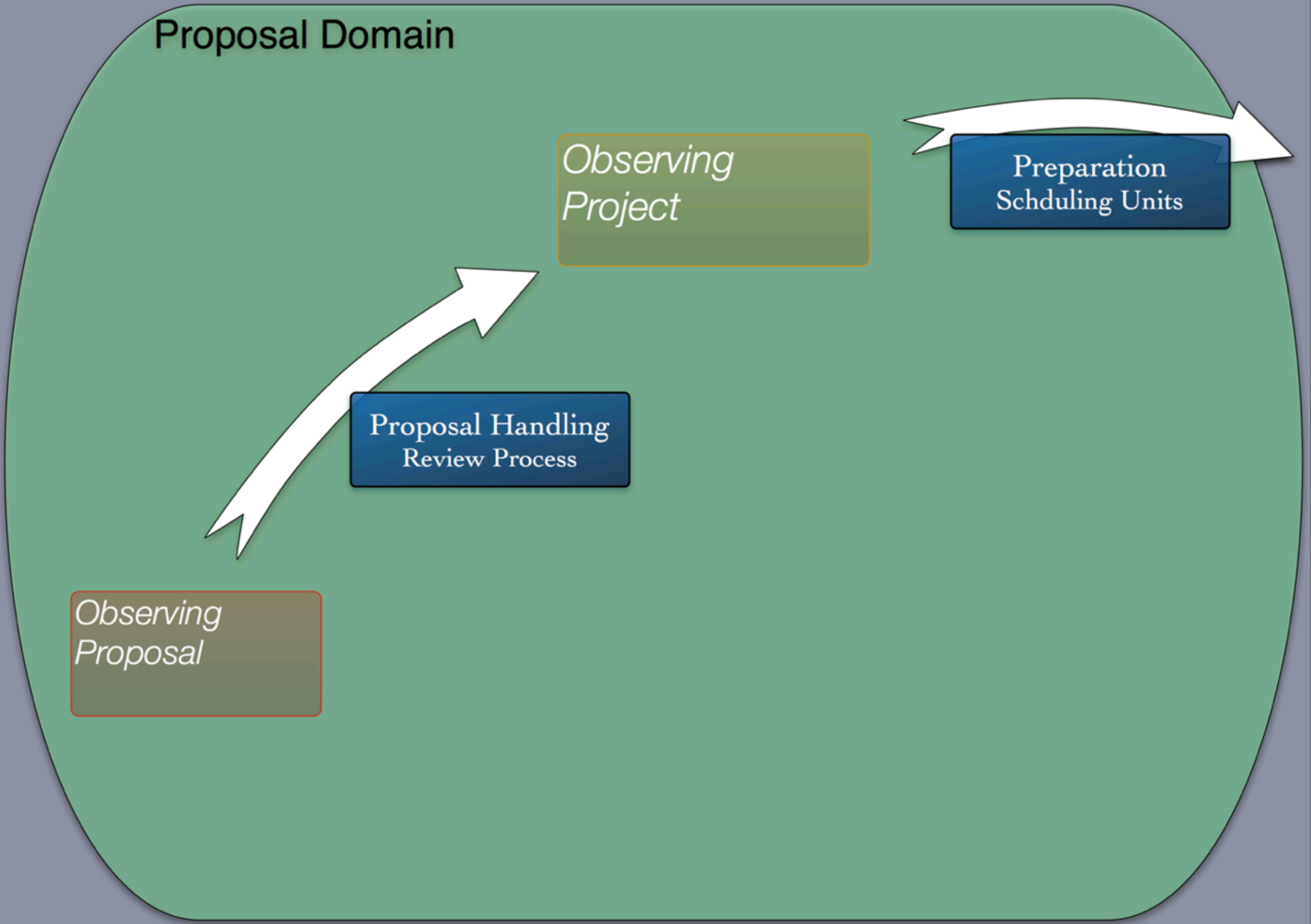

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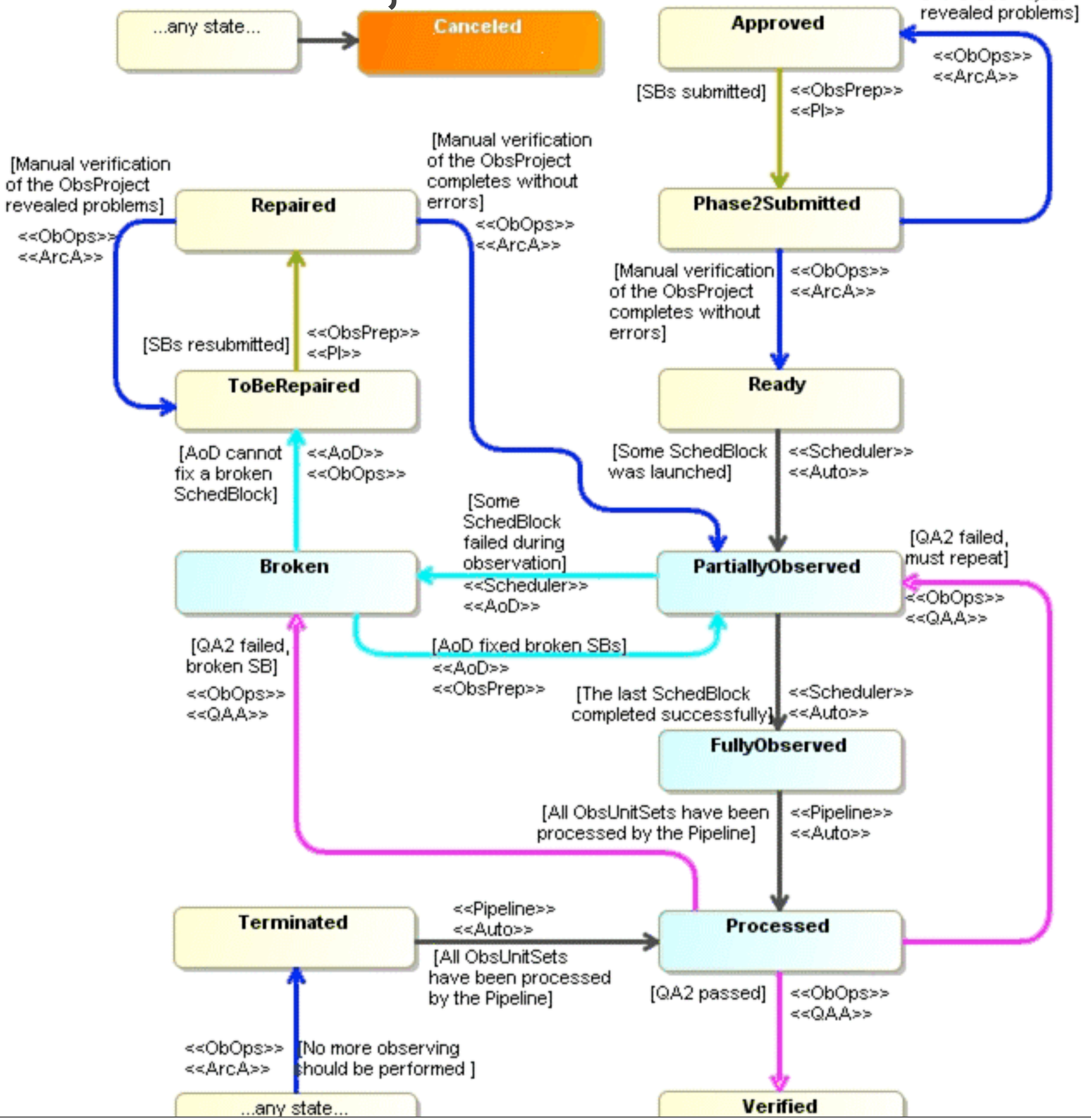
Project State Model



...any state...

Canceled

Approved

[Manual verification of the ObsProject revealed problems]

<<ObOps>>
<<ArcA>>

[SBs submitted]

<<ObsPrep>>
<<PI>>

Phase2Submitted

[Manual verification of the ObsProject completes without errors]

<<ObOps>>
<<ArcA>>

Ready

[Some SchedBlock was launched]

<<Scheduler>>
<<Auto>>

[Manual verification of the ObsProject revealed problems]

<<ObOps>>
<<ArcA>>

Repaired

[Manual verification of the ObsProject completes without errors]

<<ObOps>>
<<ArcA>>

[SBs resubmitted]

<<ObsPrep>>
<<PI>>

ToBeRepaired

[AoD cannot fix a broken SchedBlock]

<<AoD>>
<<ObOps>>

Broken

[Some SchedBlock failed during observation]

<<Scheduler>>
<<AoD>>

PartiallyObserved

[QA2 failed, must repeat]

<<ObOps>>
<<QAA>>

[AoD fixed broken SBs]

<<AoD>>
<<ObsPrep>>

[QA2 failed, broken SB]

<<ObOps>>
<<QAA>>

[The last SchedBlock completed successfully]

<<Scheduler>>
<<Auto>>

FullyObserved

[All ObsUnitSets have been processed by the Pipeline]

<<Pipeline>>
<<Auto>>

Terminated

<<Pipeline>>
<<Auto>>

[All ObsUnitSets have been processed by the Pipeline]

Processed

[QA2 passed]

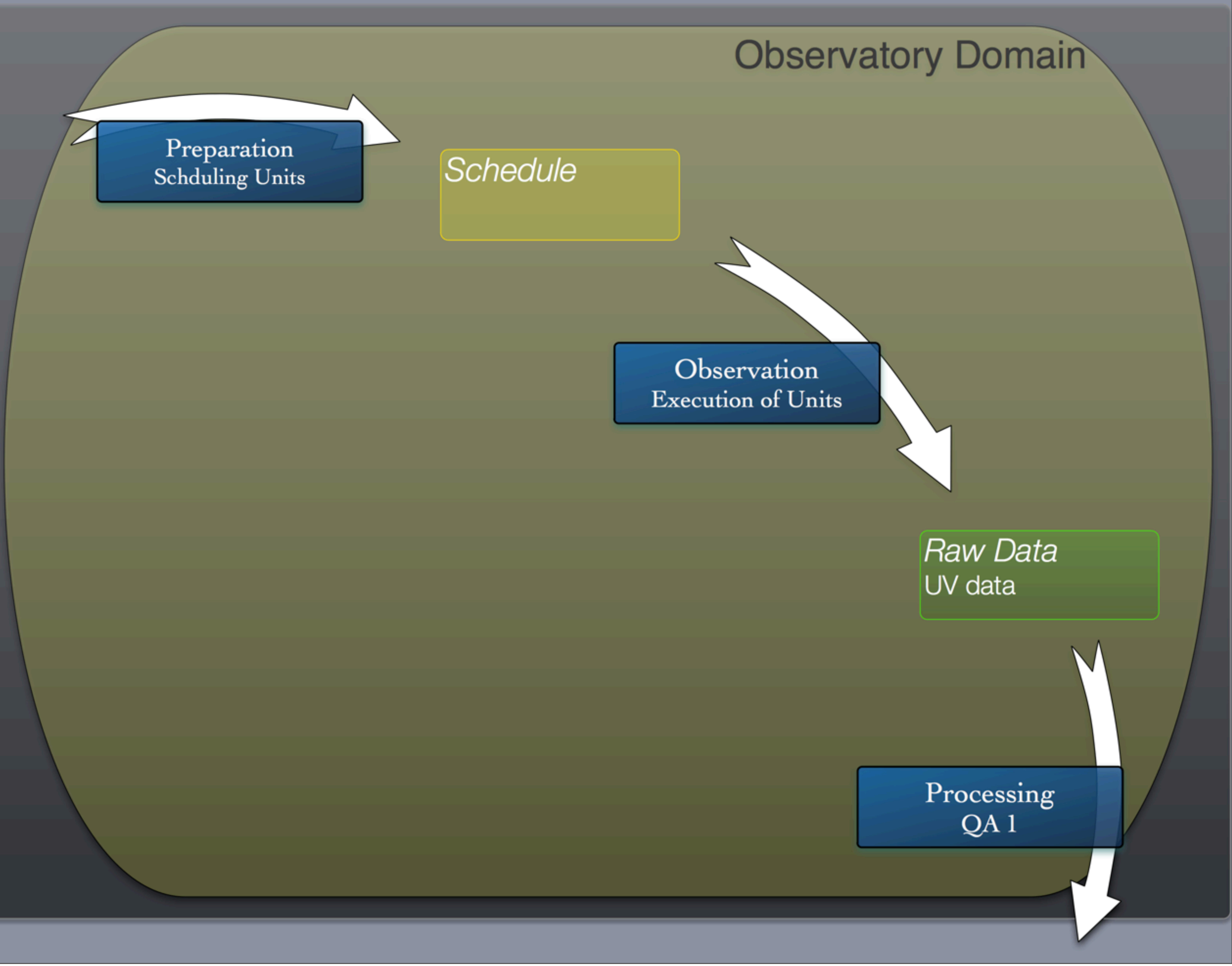
<<ObOps>>
<<QAA>>

<<ObOps>>
<<ArcA>>

[No more observing should be performed]

...any state...

Verified



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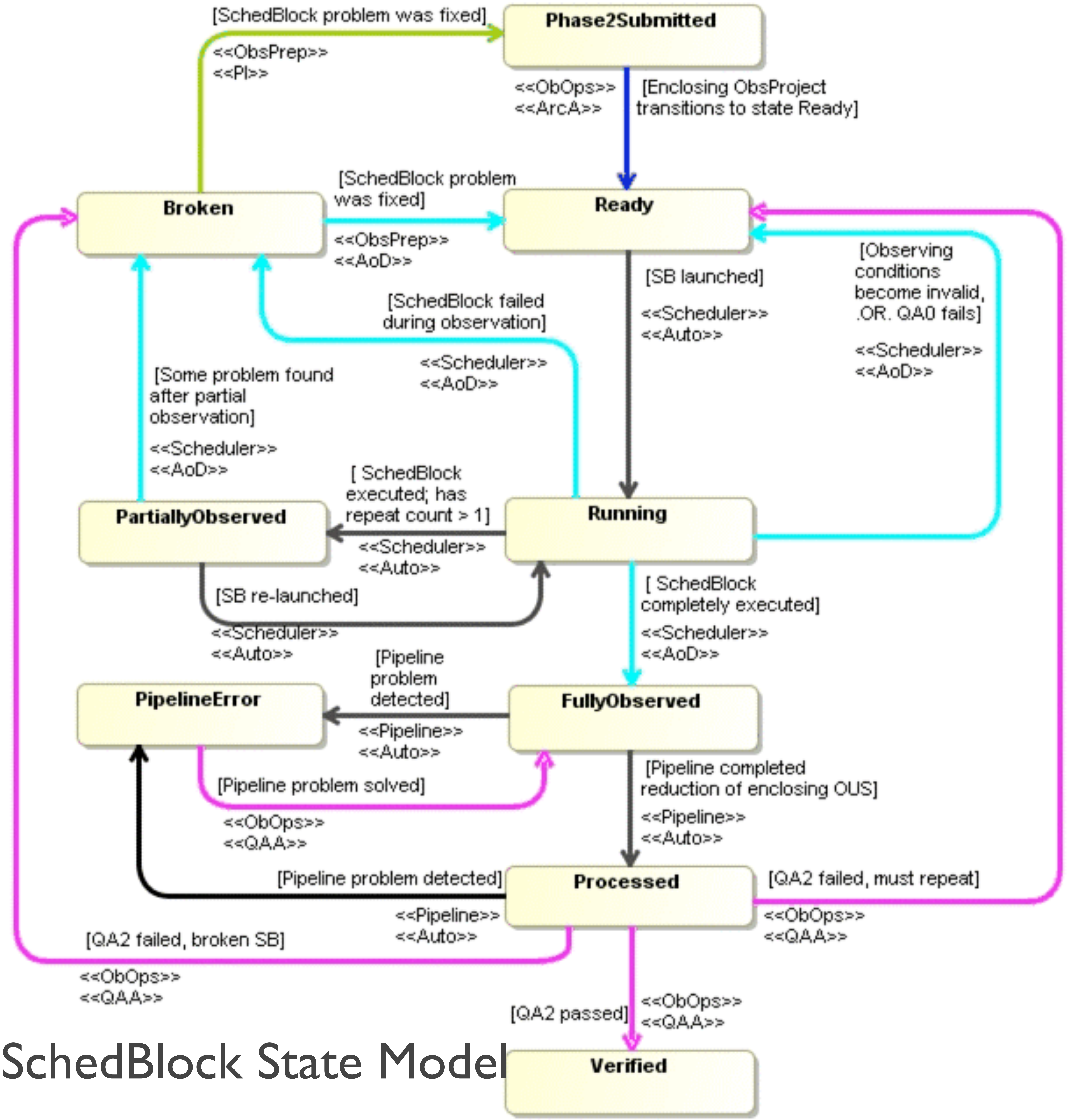
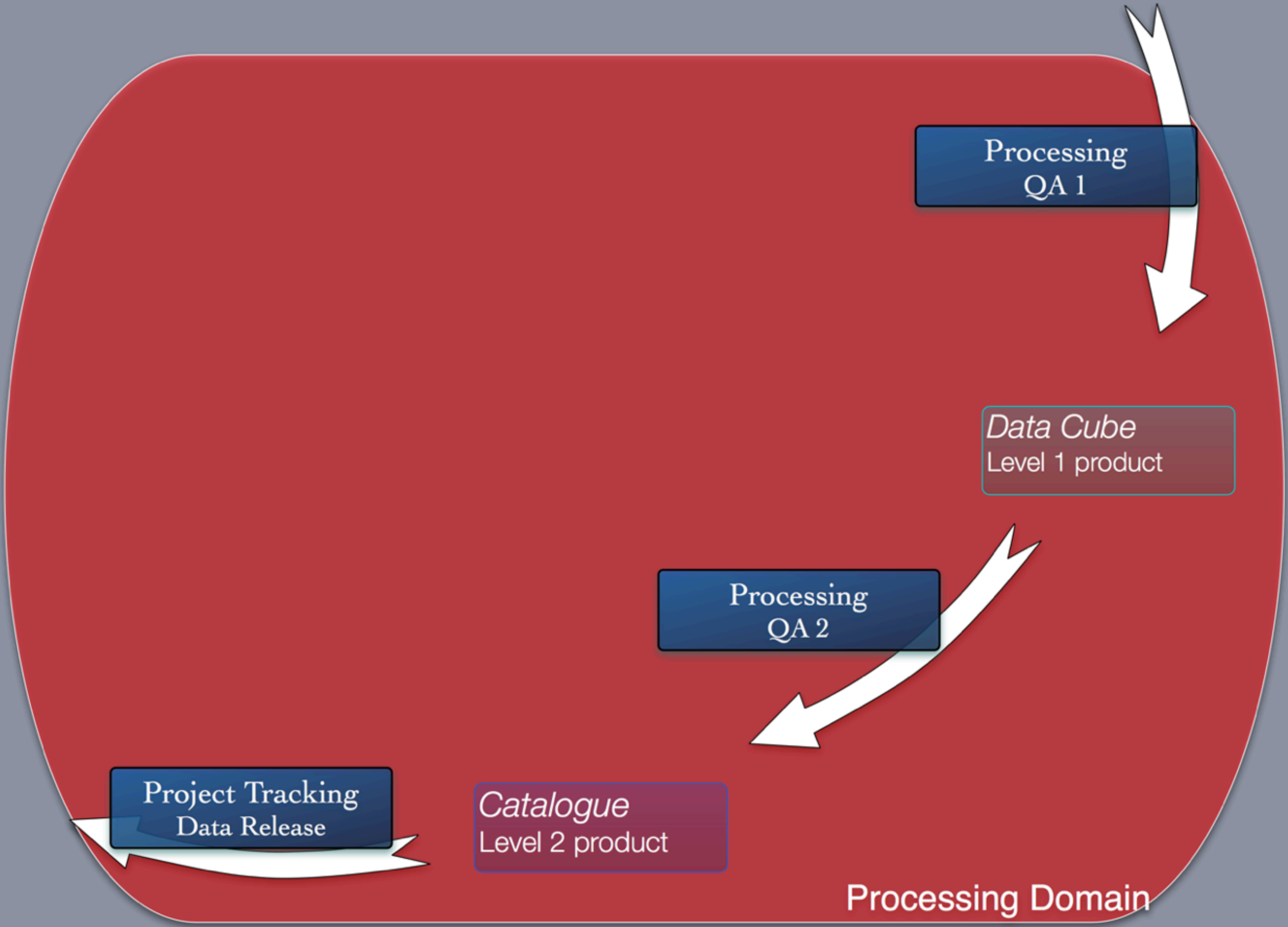
SchedBlock State Model





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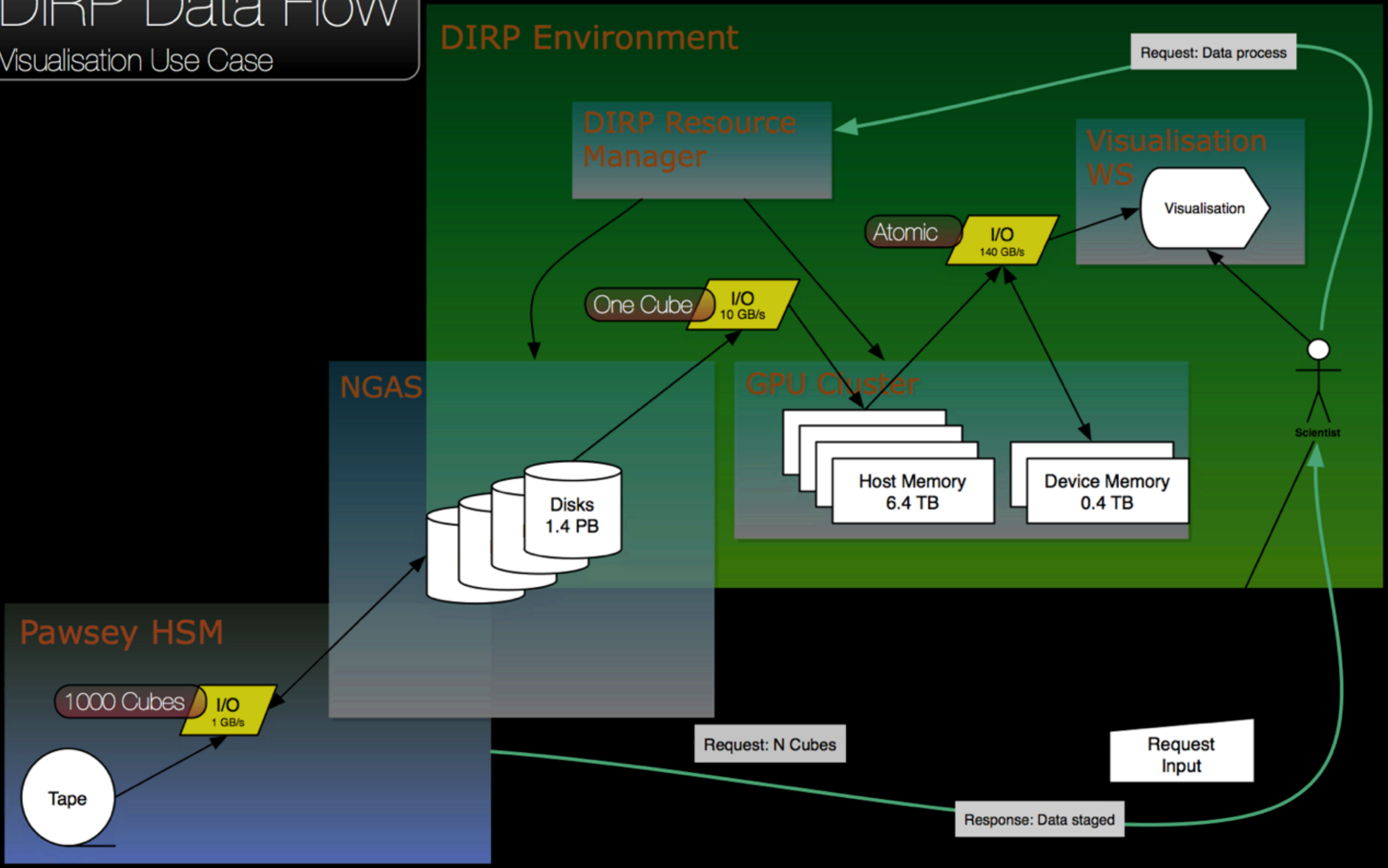
Processing Domain

DIRP Data Flow

Visualisation Use Case



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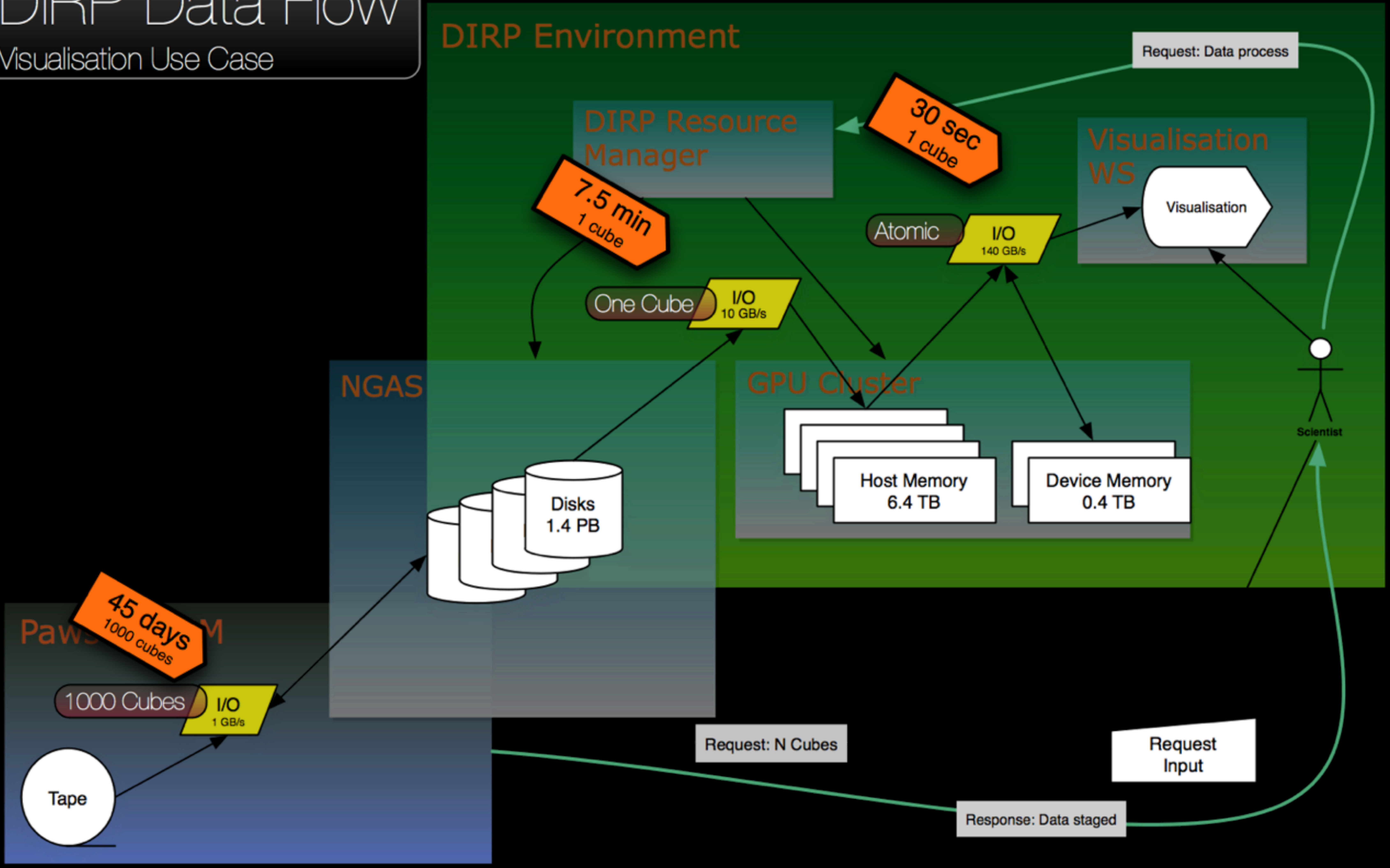
DIRP Data Flow

Visualisation Use Case



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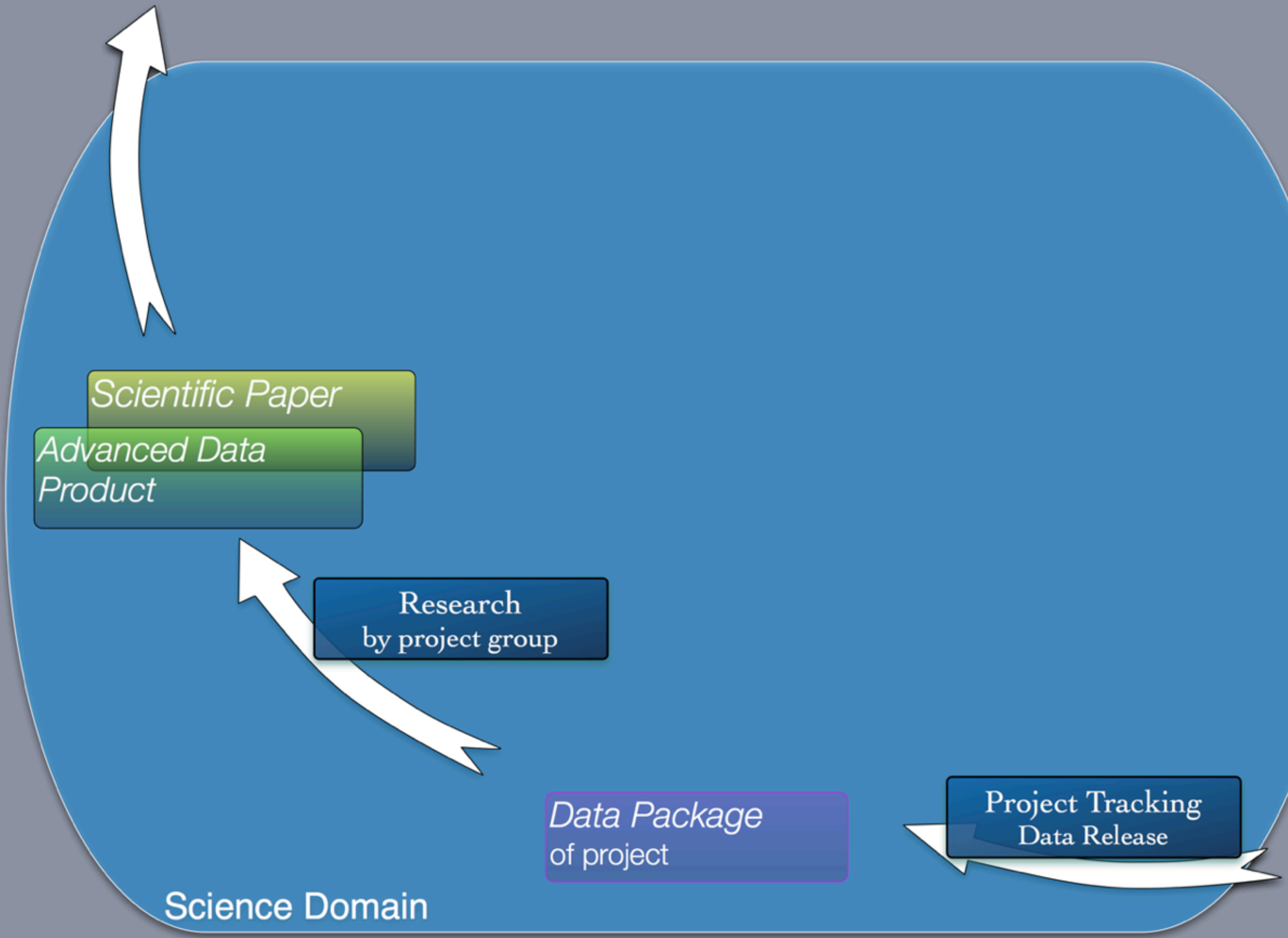

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Science Domain

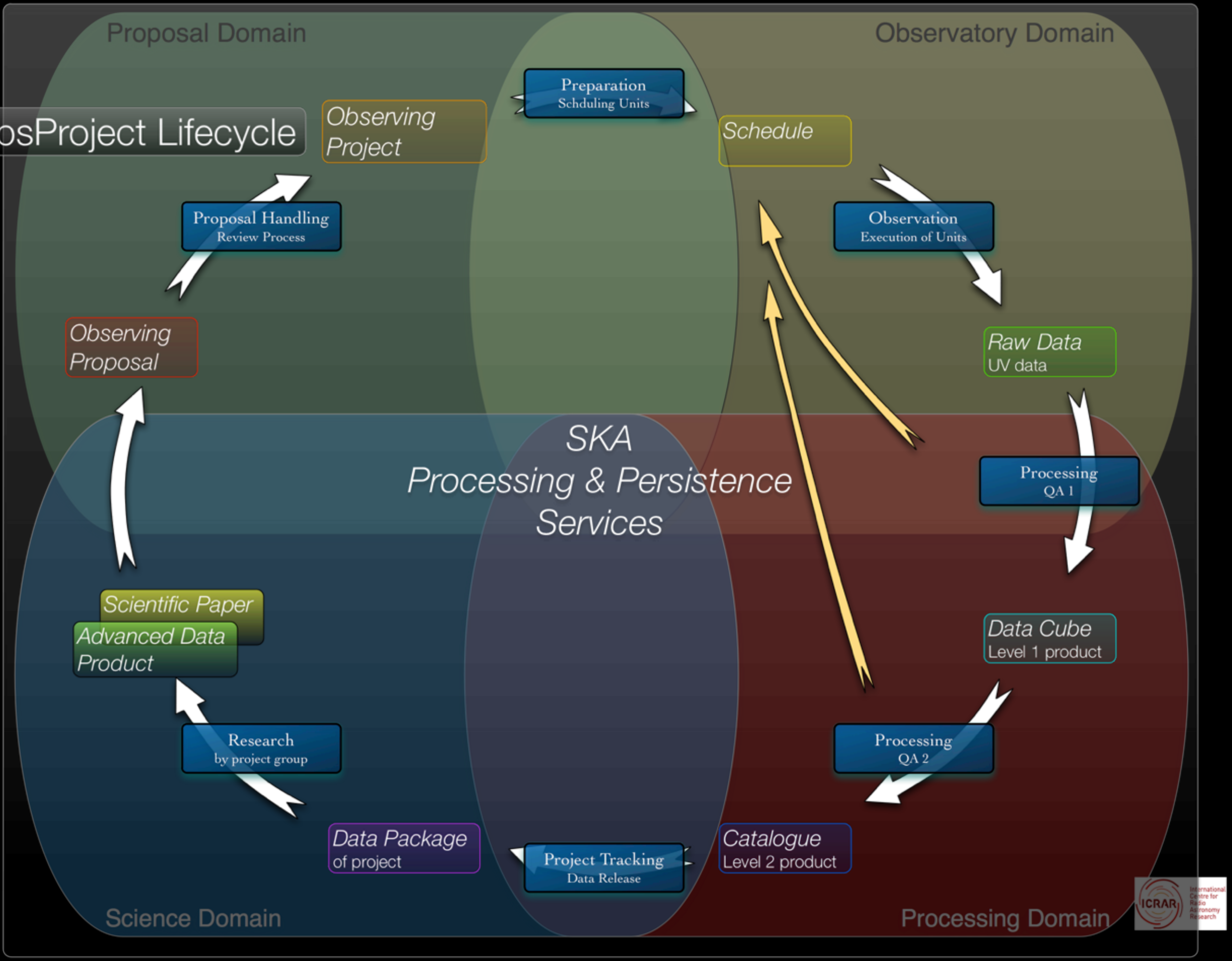
Science Projects

- Typical small science projects with SKA precursers are many TB. Surveys are many PB.
- SKA projects likely to be a few orders of magnitude more.
- Large scale data reduction and scientific analysis only possible with dedicated vast computing resources.
- No data delivery of complete projects to individuals?
- Where are the data products of the projects stored?

Connectivity of Data Centers

- Scientific exploitation of first level data products requires many FLOPs somewhere accessible to the science teams.
- In general this is not a one-shot process, but requires multiple runs to optimize the parameters used.
- Quite different usage of HPC centers, need of research in HPC scheduling
- HPC inter-connectivity and connection between HSM (tape??) storage and processing has to be balanced.
- Much higher Amdahl number required.

ObsProject Lifecycle



SKA Processing & Persistence Services

Powering the beast

- Storage power consumption 2-5 Megawatt/Exabyte

- Computing power consumption 350 MW/Exaflop with current technology

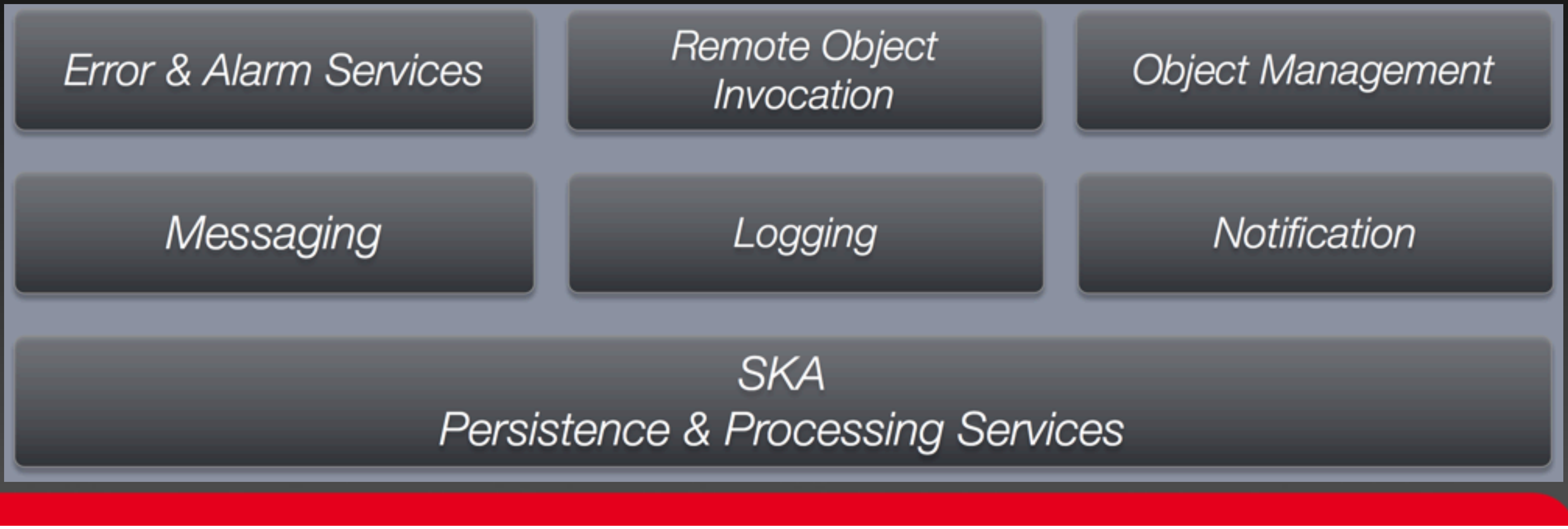
- Need GREEN solutions and better power efficiency

Persistence Layer

- Costs of persisting the operationally critical data could easily dominate the total operational costs: Need to define and implement detailed life-cycle for all data categories.
- Rigorous control of monitoring and logging activities to avoid system overload. Separate monitoring and logging from science data persistence.
- Costing, priority and operational model for long-term archiving of science data required.

Common Software

Common Software



Error & Alarm Services

Remote Object Invocation

Object Management

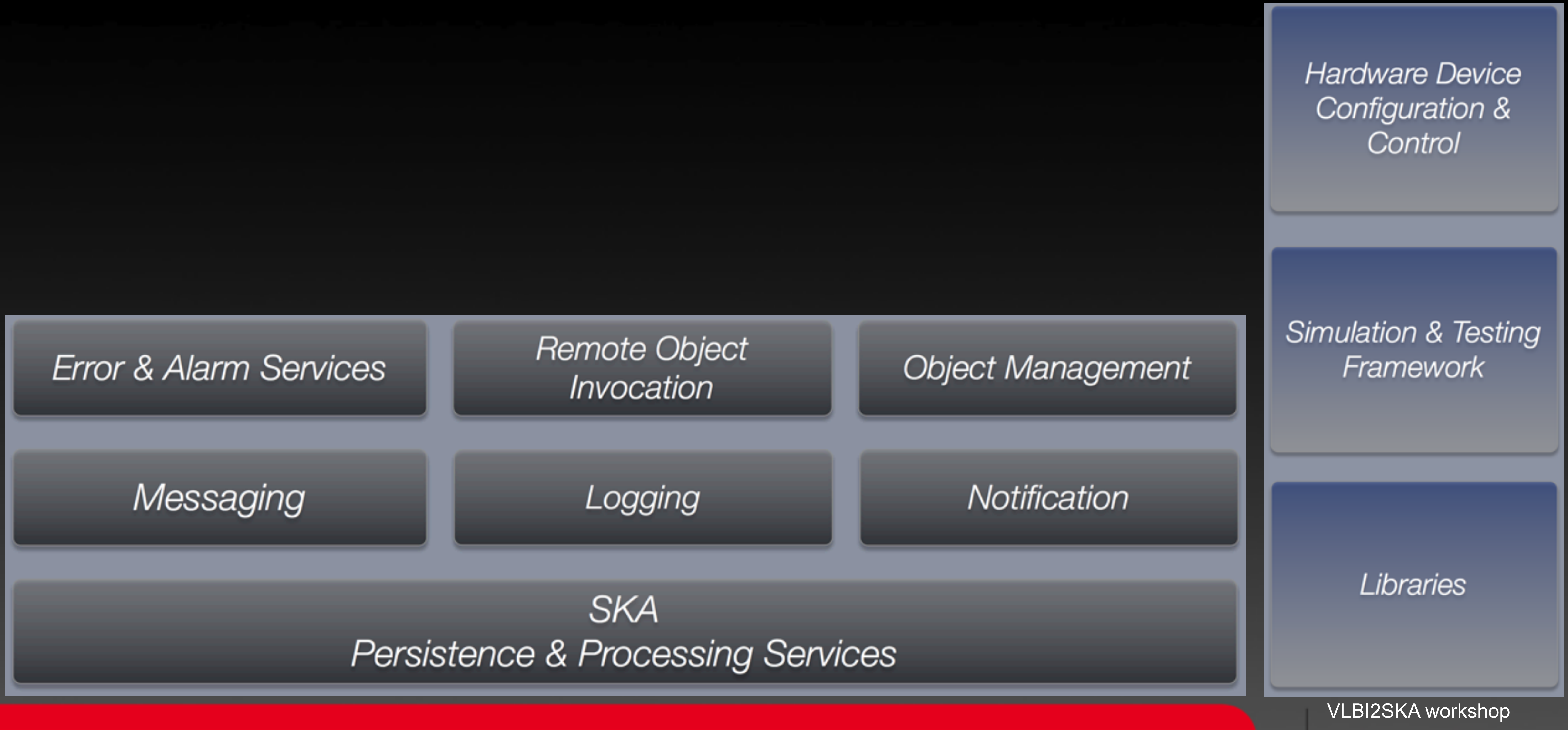
Messaging

Logging

Notification

SKA
Persistence & Processing Services

Common Software



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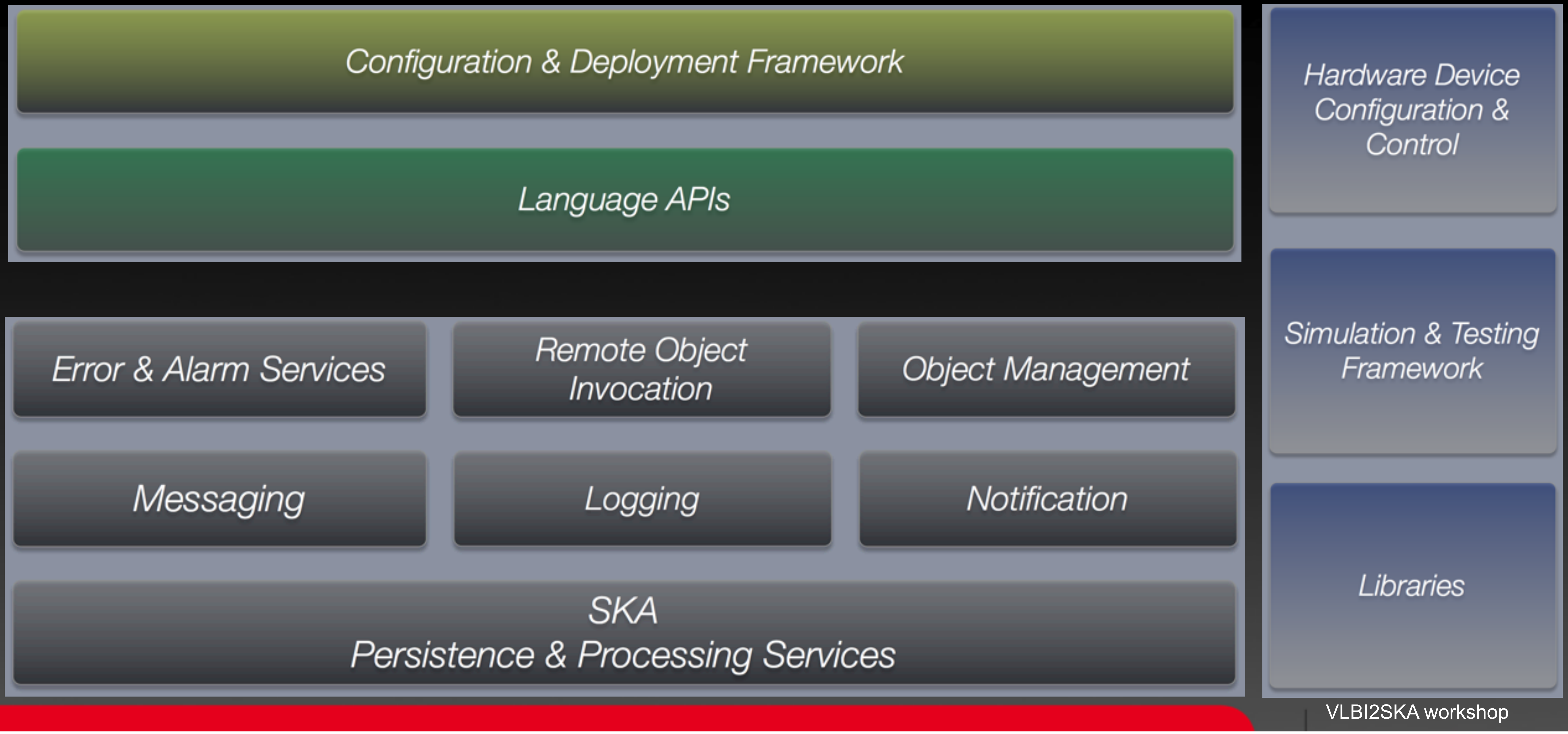
Hardware Device Configuration & Control

Simulation & Testing Framework

Libraries

Common Software



Configuration & Deployment Framework

Language APIs

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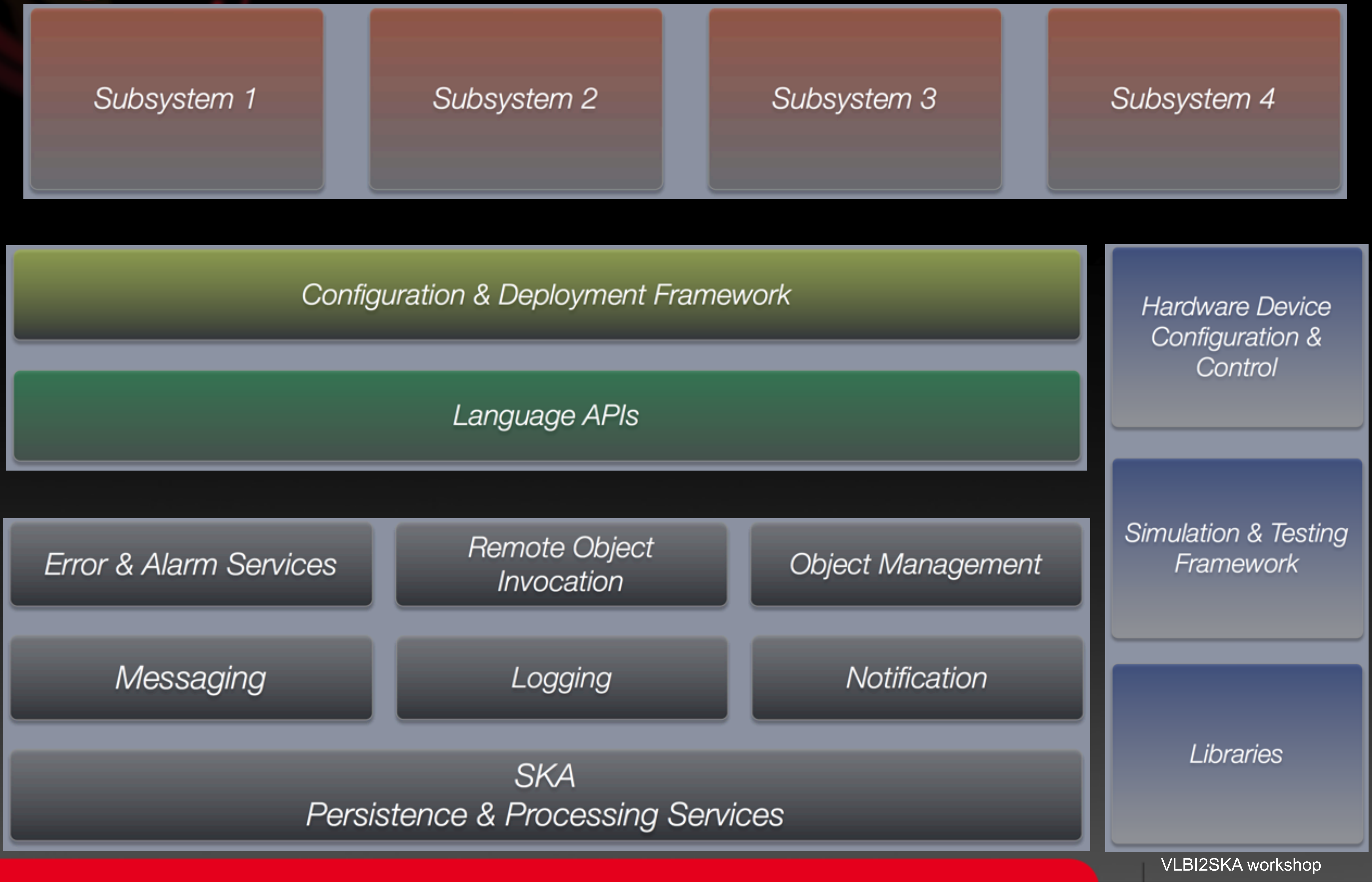

Subsystem 1

Subsystem 2

Subsystem 3

Subsystem 4

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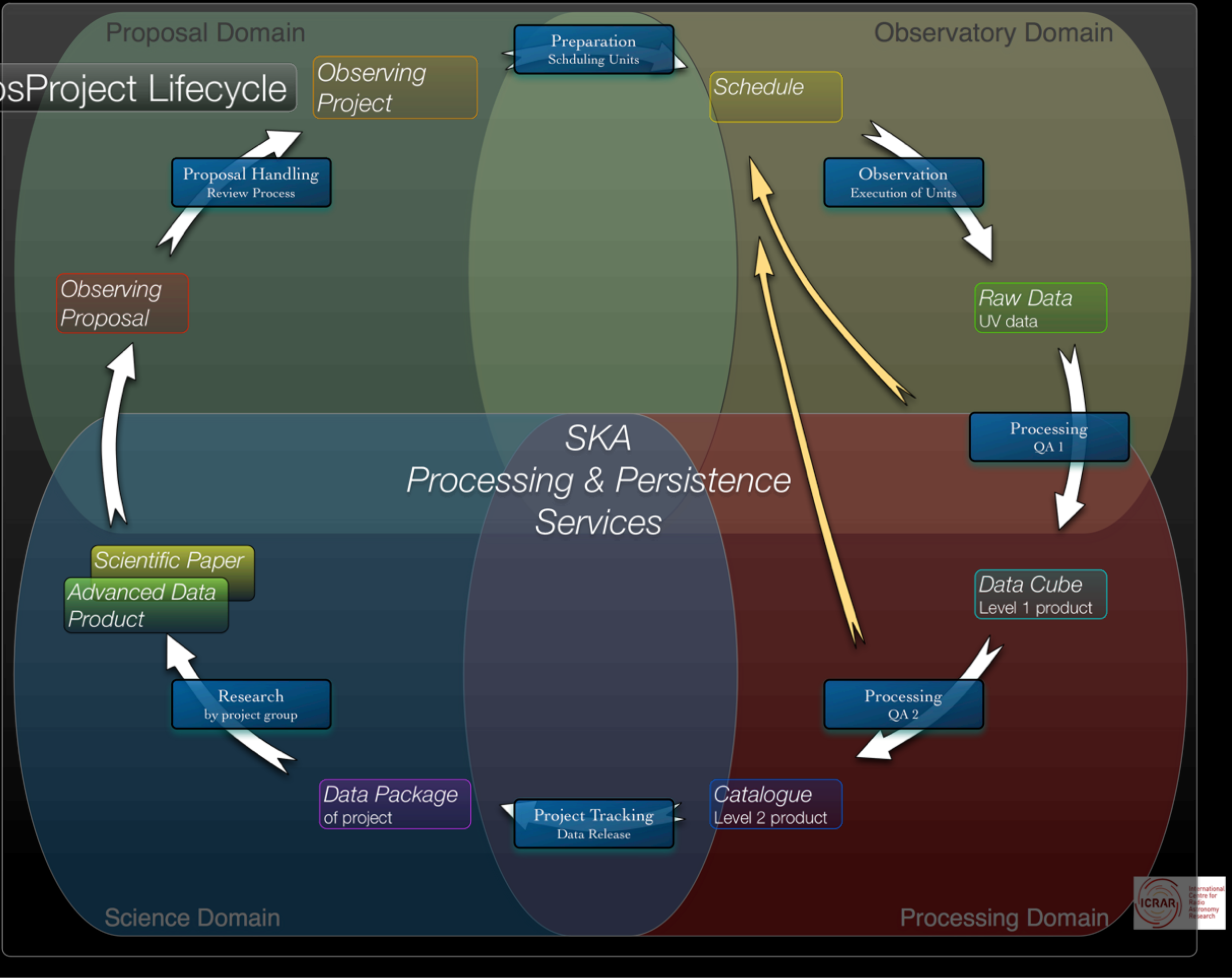

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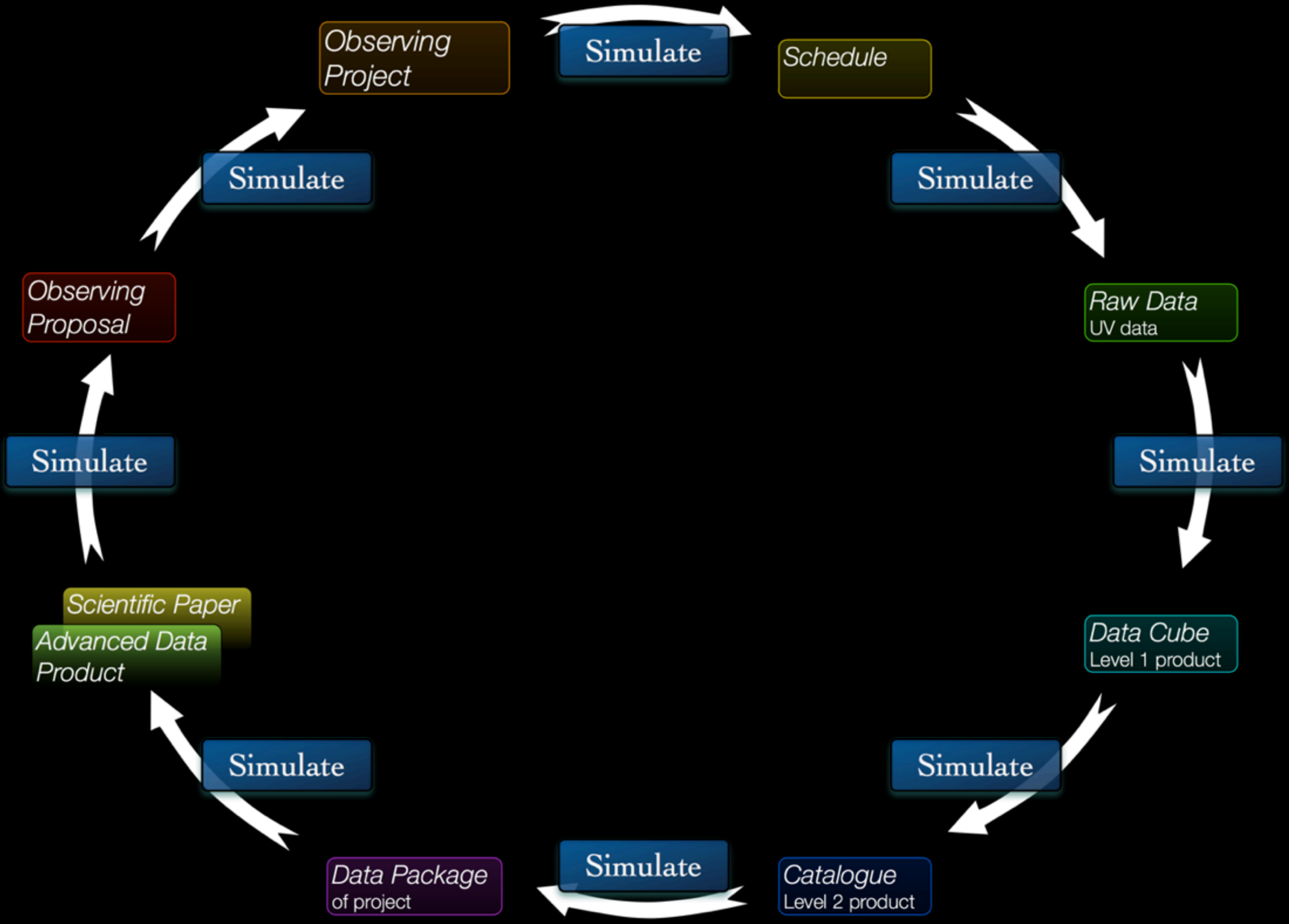

Observing Proposal

Simulate

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Simulate

Data Flow Simulation

- Tests first approach calls for complete data flow simulation.
- Starts with simulating proposals
- Simulate every step along the way.
- Every subsystem simulates its output
- Next subsystem consumes output.
- Once simulators and interfaces are in place the whole system will work already, without any functionality...
- Simulation in some cases is a BIG effort!

Thank You!

Thanks for material: Kevin Vinsen, Tim Cornwall, Peter Quinn, ALMA Project