



ESCAPE

European Science Cluster of Astronomy &
Particle physics ESFRI research Infrastructures

Batch Processing with ESAP

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CTAO



- What and why we want batch computing
 - general use cases
- The plan we developed
- What we built
- What still can be done (currently)
- The future possibilities

- A gamma-ray perspective

- Thanks to:
 - Klass Kliffen
 - John Swinbank
 - Hugh Dickinson
 - Dave Morris



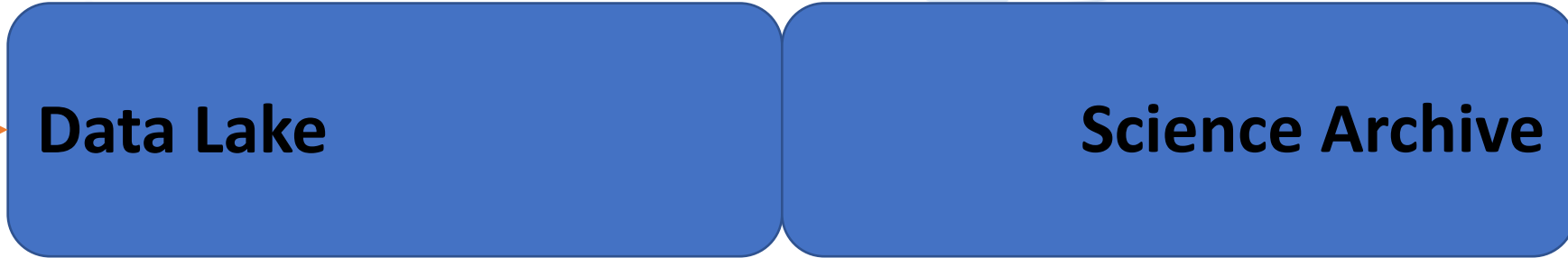
<https://www.cta-observatory.org/>



- Batch processing is when a computer processes **a number of tasks that it has collected in a group**. It is designed to be a completely **automated** process, without human intervention. It can also be called workload automation (WLA) and **job scheduling**.
- Simulations (Monte Carlo)
 - Used in counting experiments to characterize the instrument
- Data Analysis (Quality checking / Science)
 - Set of observations taken over a long period of time
 - Spread over many files
 - But the same workflow to be applied (with some caveats)



When is Workload Management useful?



CONCORDIA (WP3/OSSR Task 3.3)

- ConCORDIA (Container Corskia DIRAC)
- Provide a common simulation tool between experiments (CTA & KM3NeT)
 - Singularity containers to be deployed on the GRID
- Integrated as a DIRAC WebApp
 - Access to GRID job submissions and existing resources utilities
- EGI resources for DIRAC access
 - First developments in the EGI DIRAC-client docker
 - First tests on EGI-connected resources
- Containers can be tweaked on-demand
 - GUI for container creation
 - Tune the simulation parameters according to needs
 - CORSIKA setup and runcards
- Running the containers:
 - Scripting access and management
 - GUI access and management



PARAMETERS:

Energy Hadronic Interaction Model

Low Energy Hadronic Interaction Model

Detector Geometry

ADDITIONAL OPTIONS:

1a - Cherenkov version:

- 1 - Photons counted only in the step where emitted [DEFAULT]
- 2 - Photons counted in every step down to the observation level (compatible with old versions)
- 3 - No Cherenkov light distribution at all
- 1 - Emission angle is wavelength independent [DEFAULT]
- 2 - Emission angle depending on wavelength

1b - Cherenkov version using Bernlohr IACT routines (for telescopes):

- 1 - Particles at detector level not stored to IACT file [DEFAULT]
- 2 - Particles at detector level are stored to IACT file

1c - apply atm. absorption, mirror reflectivity & quantum eff.:

- 1c - apply atm. absorption, mirror reflectivity & quantum eff.

1d - Auger Cherenkov longitudinal distribution:

- 1d - Auger Cherenkov longitudinal distribution

INPUT:

RUNNR - RUN NUMBER:

EVTNR - NUMBER OF FIRST SHOWER EVENT:

NSHOW - NUMBER OF SHOWERS TO GENERAT:

PRMPAR - PARTICLE TYPE OF PRIM. PARTICLE:

ESLOPE - SLOPE OF PRIMARY ENERGY SPECTRUM:

ERANGE_MIN - ENERGY RANGE OF PRIMARY PARTICLE (MIN):

ERANGE_MAX - ENERGY RANGE OF PRIMARY PARTICLE (MAX):

THETAP_A - RANGE OF ZENITH ANGLE (DEGREE):

THETAP_B - RANGE OF ZENITH ANGLE (DEGREE):

PHIP_A - RANGE OF AZIMUTH ANGLE (DEGREE):

PHIP_B - RANGE OF AZIMUTH ANGLE (DEGREE):

SEED1_A - SEED FOR 1. RANDOM NUMBER SEQUENCE:

SEED1_B - SEED FOR 1. RANDOM NUMBER SEQUENCE:

SEED1_C - SEED FOR 1. RANDOM NUMBER SEQUENCE:

SEED2_A - SEED FOR 2. RANDOM NUMBER SEQUENCE:

SEED2_B - SEED FOR 2. RANDOM NUMBER SEQUENCE:

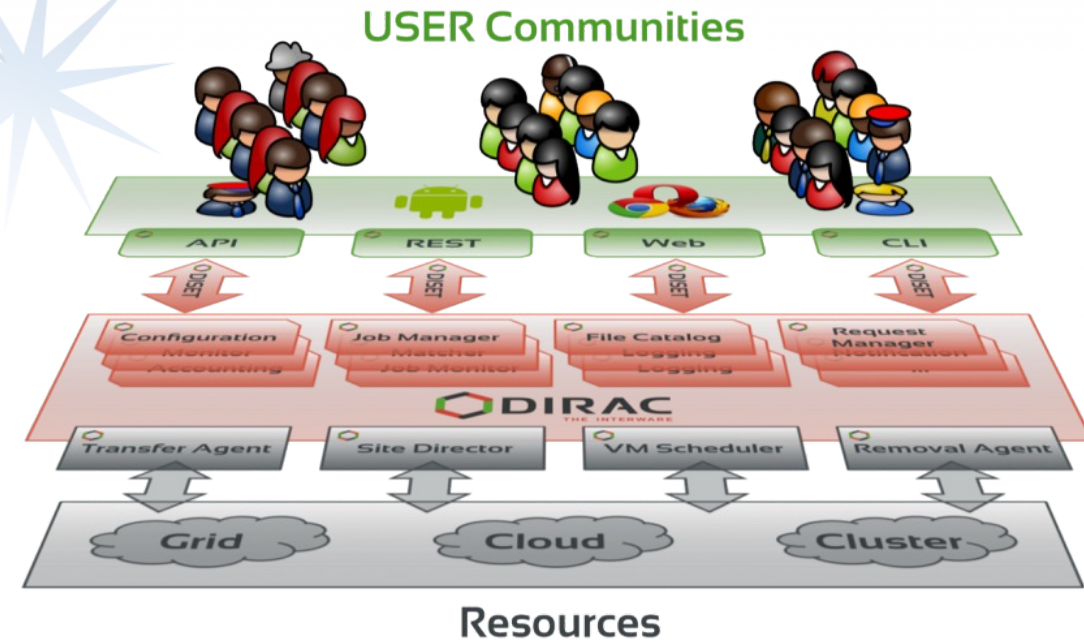
SEED2_C - SEED FOR 2. RANDOM NUMBER SEQUENCE:

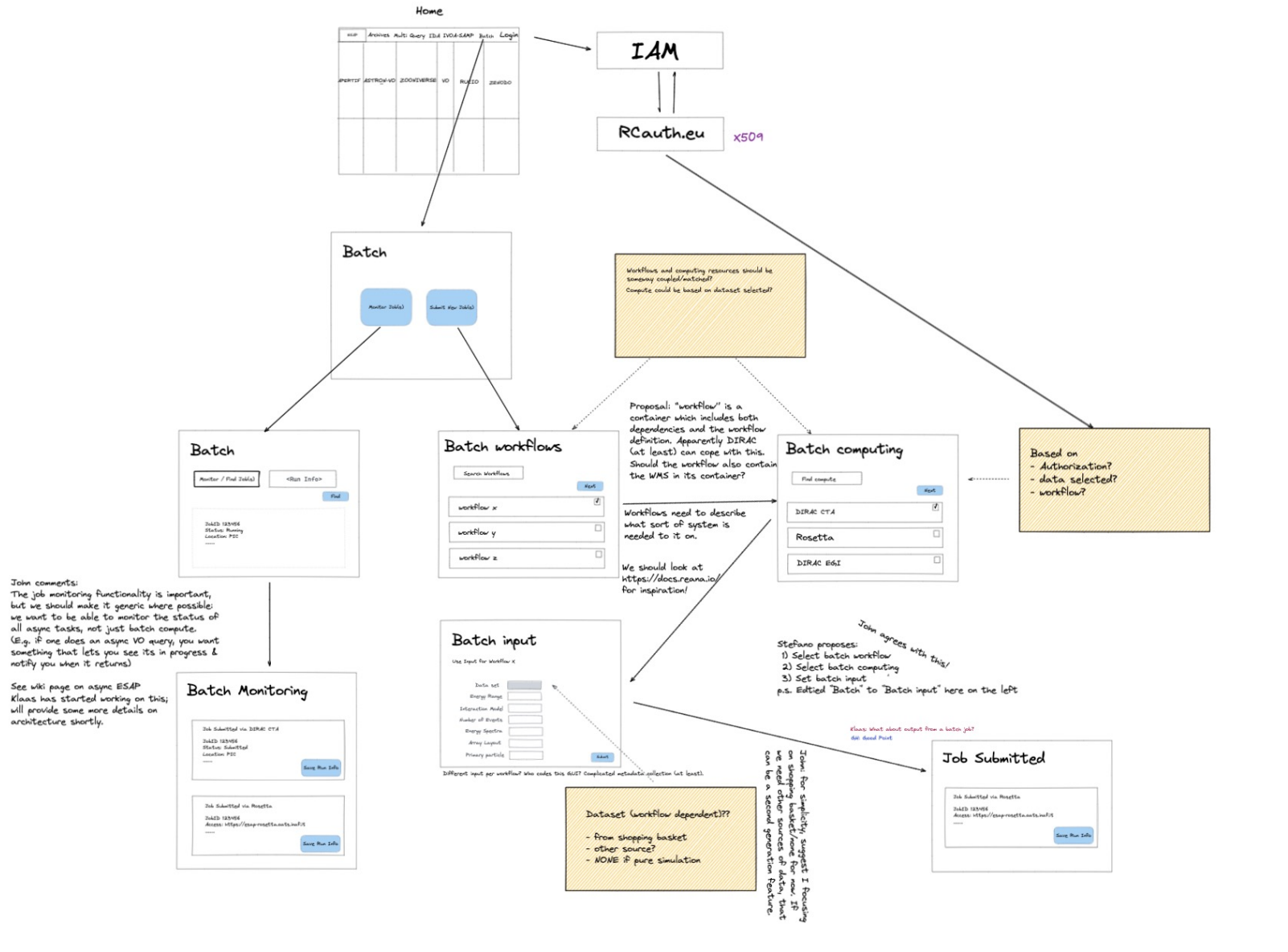
OBSLEV - OBSERVATION LEVEL (IN CM):

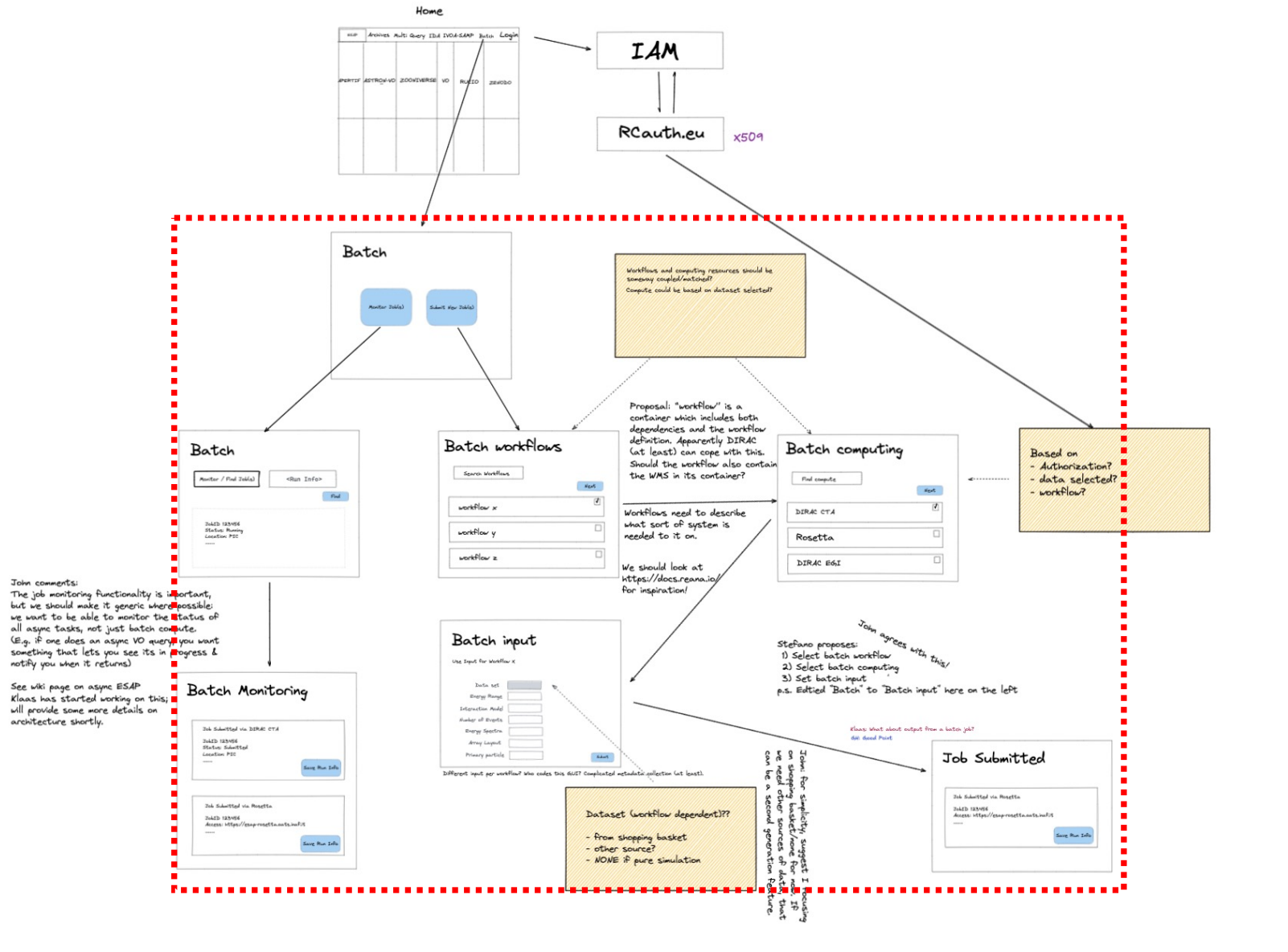


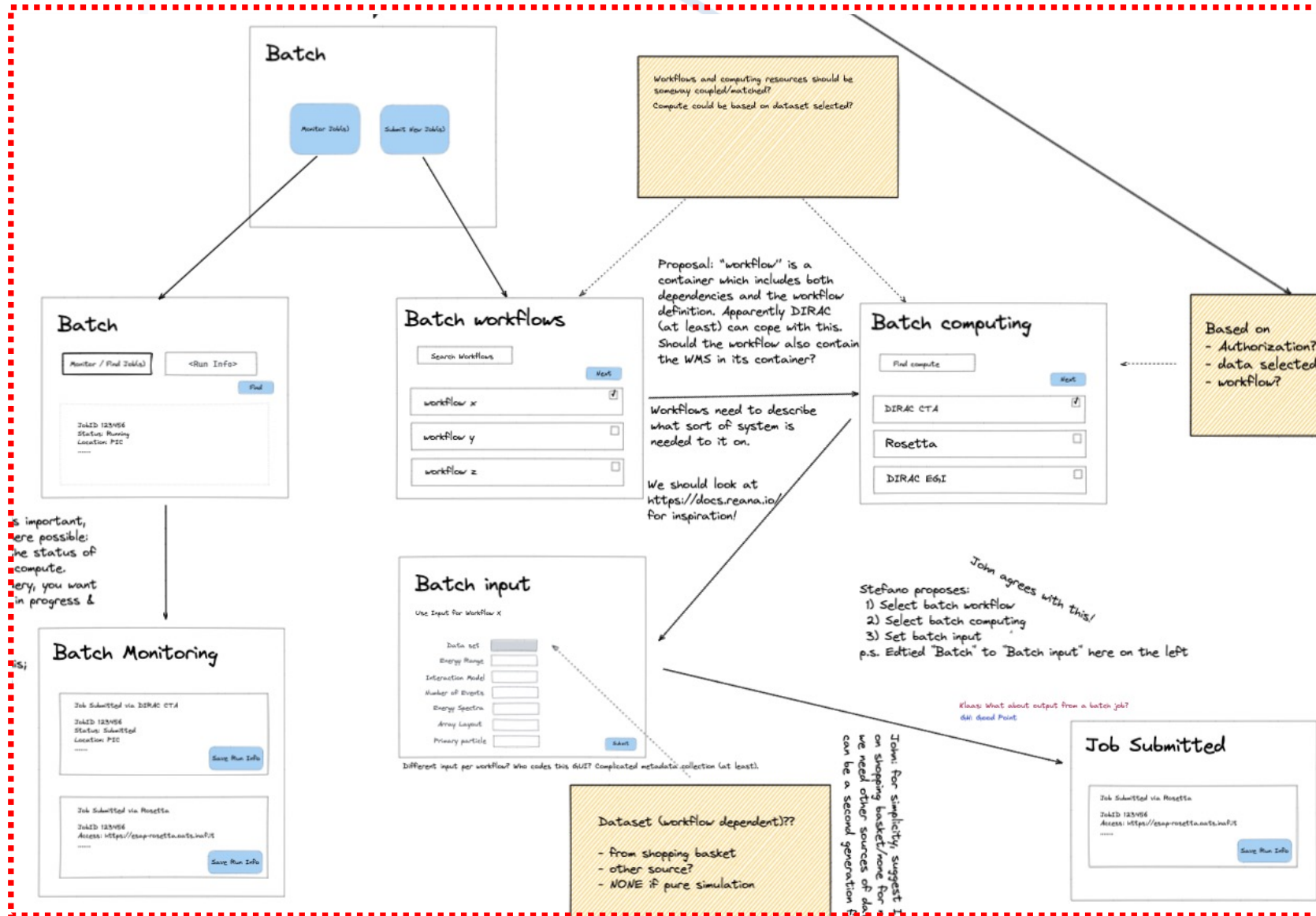
What is DIRAC

- DIRAC: **D**istributed **I**nfrastructure with **R**emote **A**gent **C**ontrol
- An open source **software framework** for distributed computing
 - <http://diracgrid.org/>
- Started at CERN, LHCb
 - Used by a large number of high energy and astronomy experiments
- Systems include:
 - workload management
 - data management
 - Job management API
 - accounting (provenance)
 - +++ Much more
- DIRAC Workload Management System (WMS)
 - uses novel approach of pilot jobs
 - allows for detailed job monitoring
 - can submit to a wide range of computing centers (HPC/HTC/Cloud)
 - able to create workflows: full automatization of multi-step workflow execution
- CTA has its own CTADIRAC instance



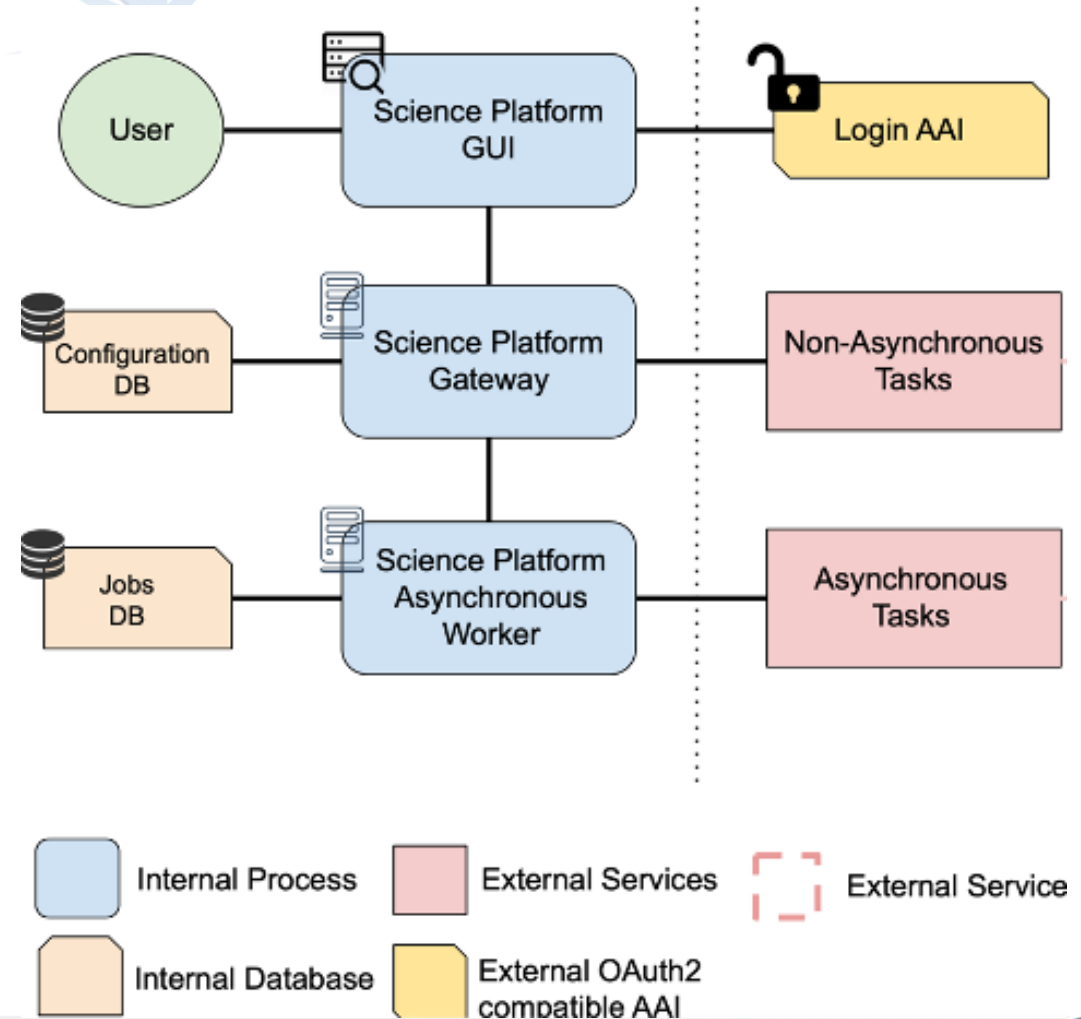






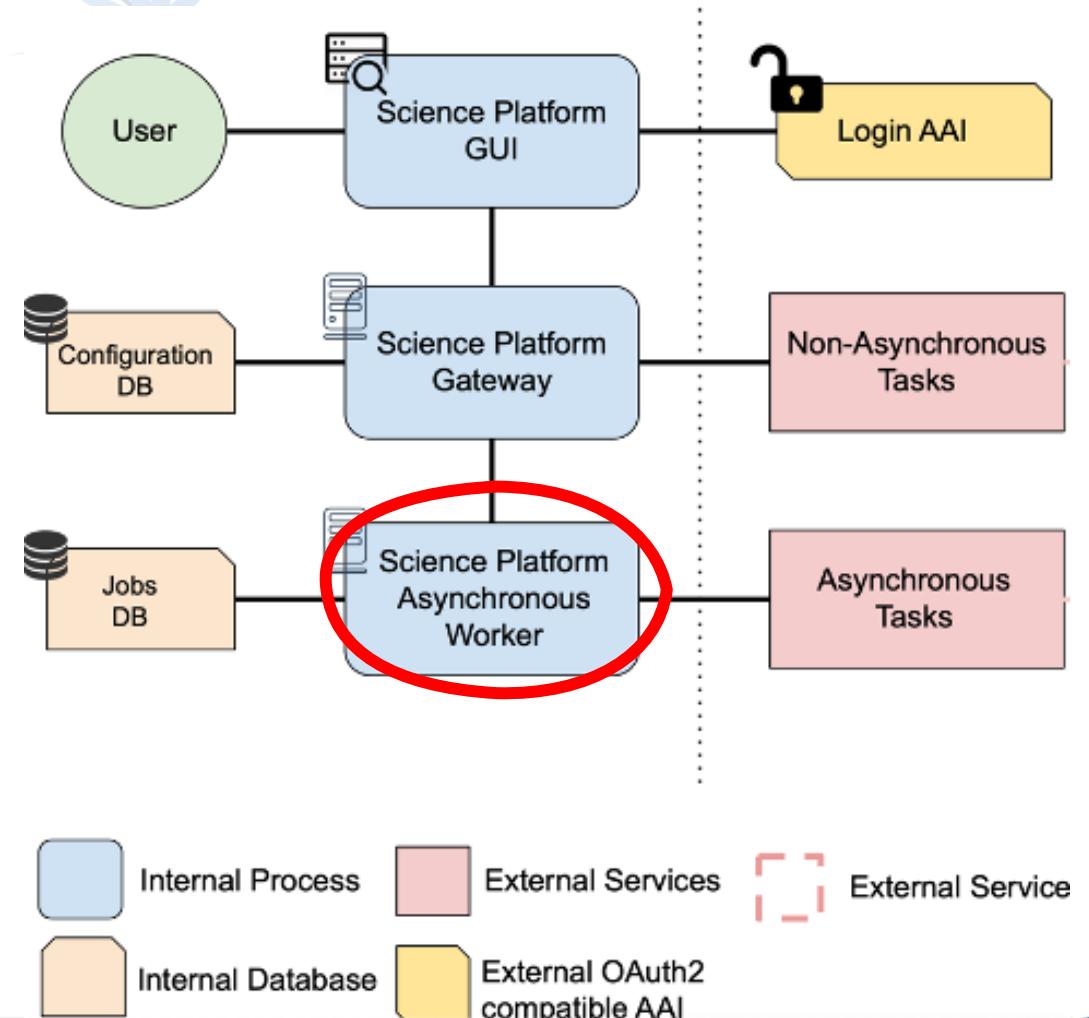
Components

- Involves all three major components of ESAP
- Authorization will be mentioned at the end
- Main part lives in the Asynchronous Worker

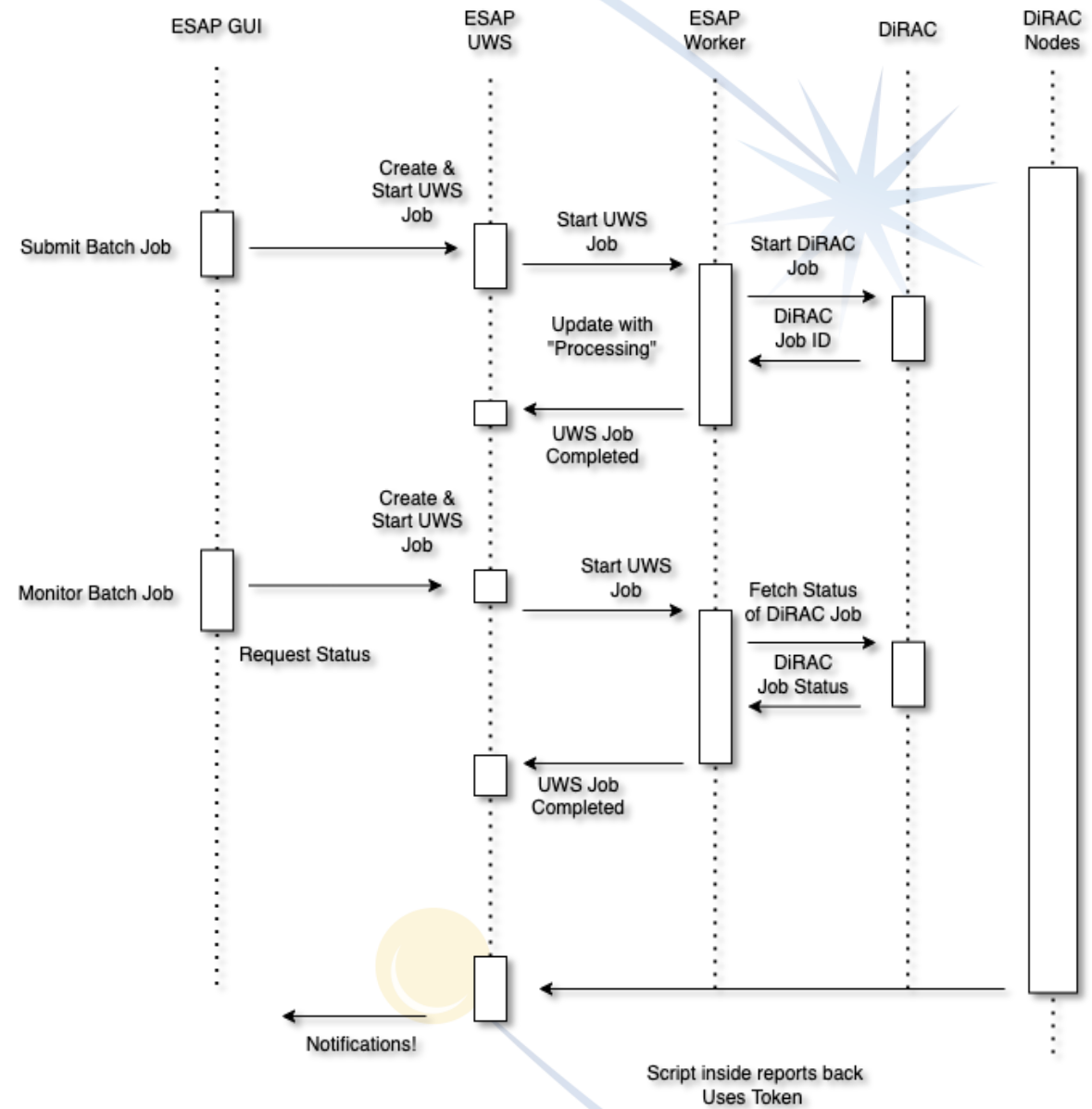


Components

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- Main part lives in the Asynchronous Worker

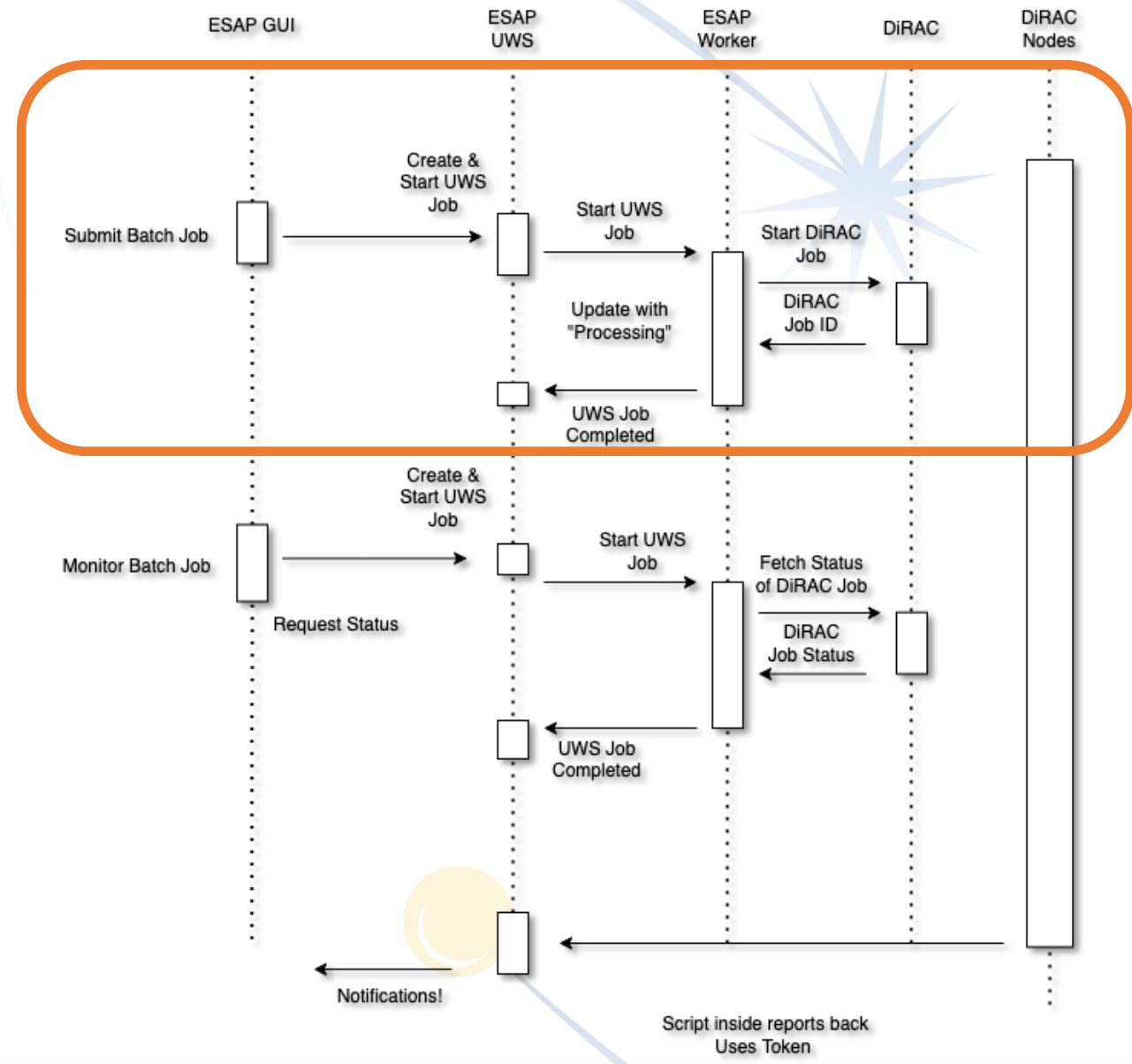


The Plan

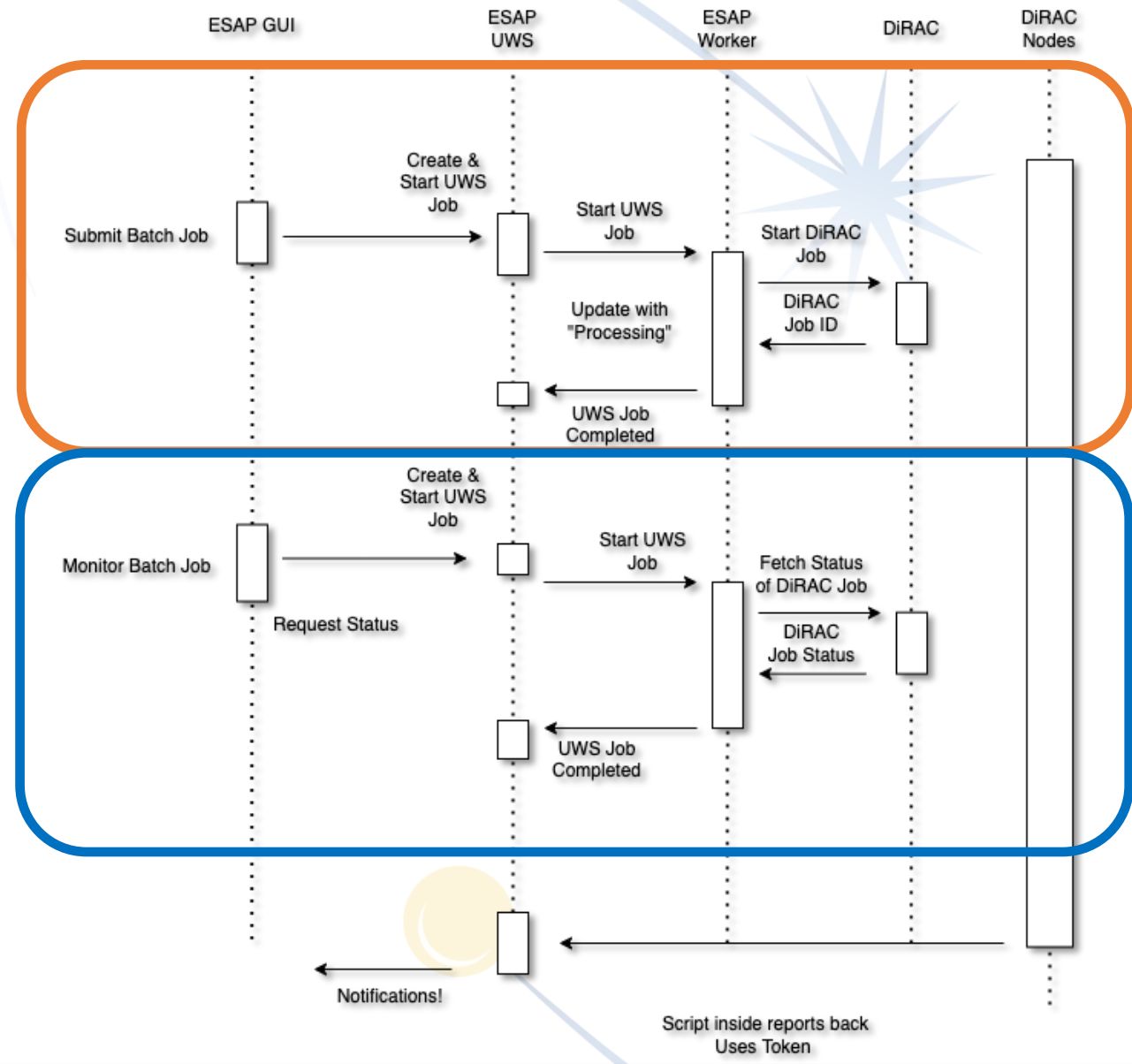


The Plan

Submission



The Plan

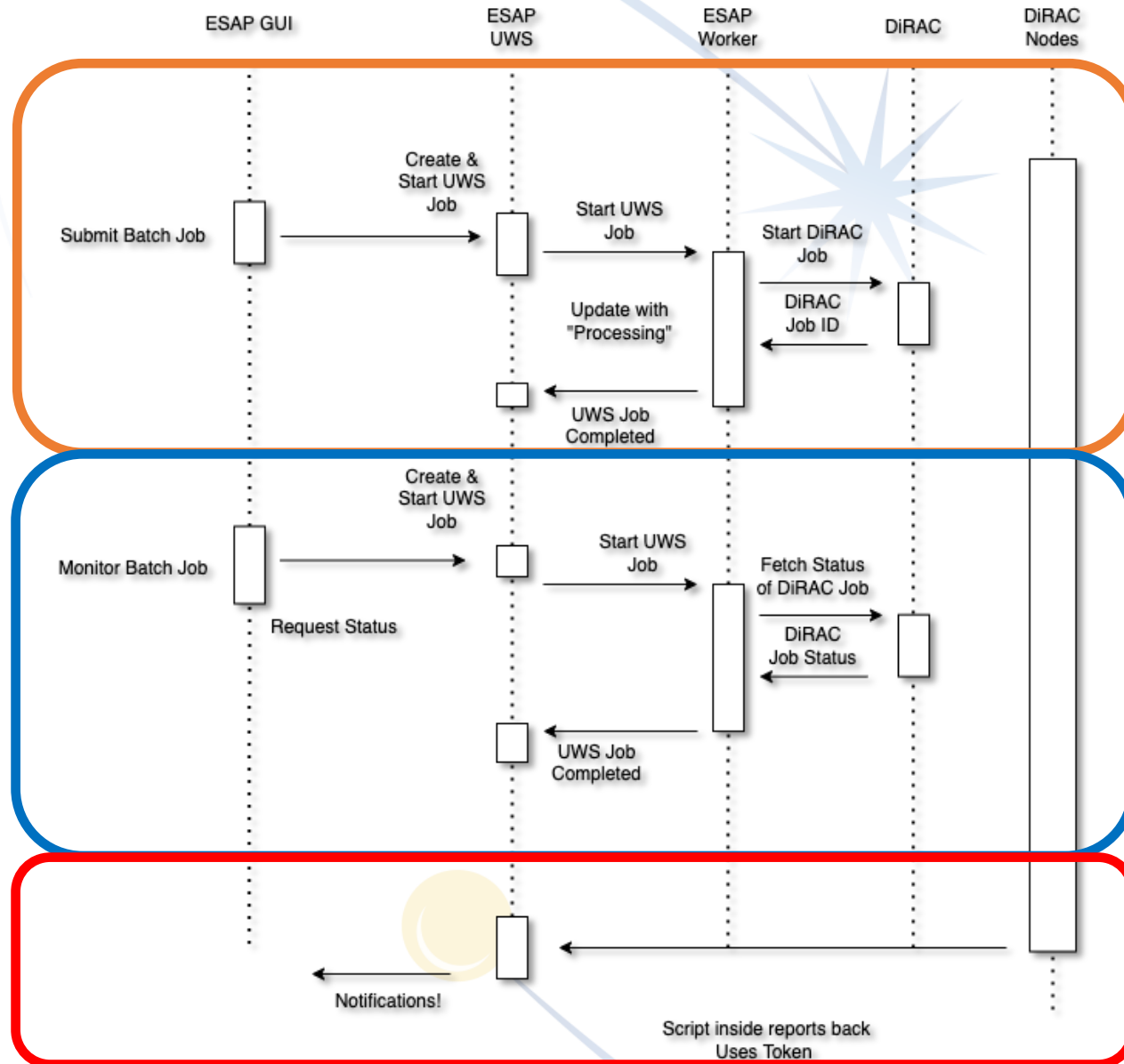


Submission

Monitoring



The Plan



Submission

Monitoring

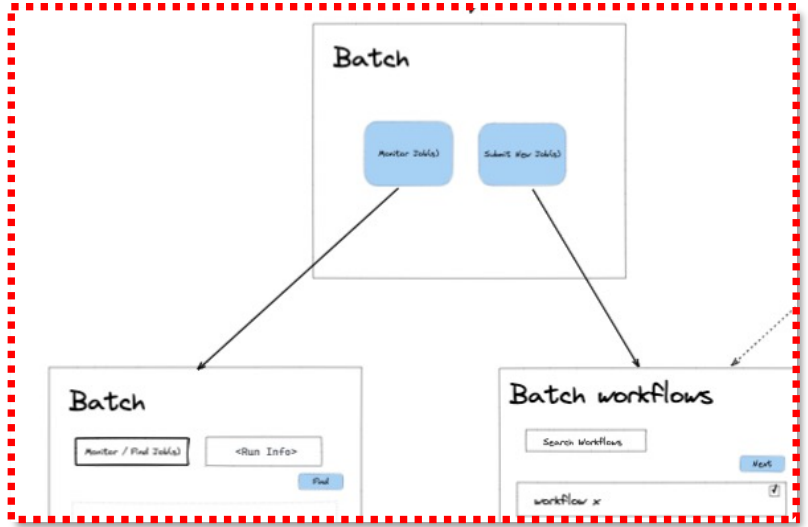
Reporting



Batch Analysis

[Monitor Batch Jobs](#)
[Submit Batch Jobs](#)

esap-gui version 21 jan 2022 - 10:00



localhost:3000/esap-gui/batch

<https://youtu.be/4kAskIWFuFk>



Batch Analysis

[Monitor Batch Jobs](#)
[Submit Batch Jobs](#)

```
[16:56:ghughes@DIRACExampleWorkFlows]$ more concordia.json
{
  "uuid": "fa2b5ebc-ee25-10ec-7ea1-0247ac120006",
  "type": "URL",
  "title": "ESAP CONCORDIA",
  "description": "This workflow is the example",
  "workflow": "CONCORDIA",
  "Parameters": {
    "singularity_image": "http://doublehi5.com/helloworld.sif",
    "output_file_name": "output.tar",
    "cputime": "500",
    "job_name": "ESAPTEST",
    "group_name": "ESAPTEST_GROUP",
    "dirac_path": "/vo.cta.in2p3.fr/user/g/ghughes/",
    "dirac_SE": "CC-IN2P3-USER",
    "argument1": "1",
    "argument2": "2",
    "argument3": "3"
  }
}
```

Next

- CONCORDIA

Description: Containerized Corsika on DIRAC

Keywords:

Steering File: DIRACExampleWorkFlows/concordia.json
- Hello World

Description: This is the hello world example

Keywords:

Steering File: DIRACExampleWorkFlows/helloworld.json



```

[[16:54:ghughes@esap]$ more esap_batch_config.yaml
- model: batch.facility
  pk: 1
  fields:
    name: CTADIRAC
    description: CTA-DIRAC instance
    url: https://pypi.org/project/CTADIRAC/
    facilitytype: DIRAC
    runtimeengine: Docker
- model: batch.facility
  pk: 2
  fields:
    name: Rosetta @ INAF OATS
    description: The Rosetta platform deployed at INAF OATS computing centre
    url: https://esap-rosetta.oats.inaf.it/
    facilitytype: rosetta
    runtimeengine: Singularity
- model: batch.workflow
  pk: 1
  fields:
    name: CONCORDIA
    description: Containerized Corsika on DIRAC
    url: DIRACExampleWorkFlows/concordia.json
    ref: HEAD
    workflowtype: container
- model: batch.workflow
  pk: 2
  fields:
    name: Hello World
    description: This is the hello world example
    url: DIRACExampleWorkFlows/helloworld.json
    ref: HEAD
    workflowtype: container
[[16:54:ghughes@esap]$ █

```

Batch Analysis

[Monitor Batch Jobs](#)
[Submit Batch Jobs](#)

Deploy

- CTADIRAC

Description: CTA-DIRAC instance
Runtime Engine: Docker
- Rosetta @ INAF OATS

Description: The Rosetta platform deployed at INAF OATS computing centre



Batch Analysis Submission

ESAP CONCORDIA

This workflow is the example

```
[16:56:ghughes@DIRACExampleWorkflows]$ more concordia.json
{
  "uuid": "fa2b5ebc-ee25-10ec-7ea1-0247ac120006",
  "type": "URL",
  "title": "ESAP CONCORDIA",
  "description": "This workflow is the example",
  "workflow": "CONCORDIA",
  "Parameters": {
    "singularity_image": "http://doublehi5.com/helloworld.sif",
    "output_file_name": "output.tar",
    "cputime": "500",
    "job_name": "ESAPTEST",
    "group_name": "ESAPTEST_GROUP",
    "dirac_path": "/vo.cta.in2p3.fr/user/g/ghughes/",
    "dirac_SE": "CC-IN2P3-USER",
    "argument1": "1",
    "argument2": "2",
    "argument3": "3"
  }
}
```

singularity_image	<input type="text" value="http://doublehi5.com/"/>
output_file_name	<input type="text" value="output.tar"/>
cputime	<input type="text" value="500"/>
job_name	<input type="text" value="ESAPTEST"/>
group_name	<input type="text" value="ESAPTEST_GROUP"/>
dirac_path	<input type="text" value="/vo.cta.in2p3.fr/user/g"/>
dirac_SE	<input type="text" value="CC-IN2P3-USER"/>
argument1	<input type="text" value="1"/>
argument2	<input type="text" value="22"/>
argument3	<input type="text" value="3"/>

Job Number: 33
Status: PENDING

Select RUN to submit the job with the above parameters or ABORT to cancel.



Batch Analysis

Monitor Batch Jobs

Submit Batch Jobs

Input Job ID to find information on batch jobs:

Find Batch Jobs

```

Job ID: 19427291
Job Status: COMPLETED
Creation Time: 2022-08-30T14:20:11.530724Z

Job Status: [{"key": "JobStatus", "value": "Done", "size": null, "mimeType": null}]
    
```

esap-gui version 21 jan 2022 - 10:00

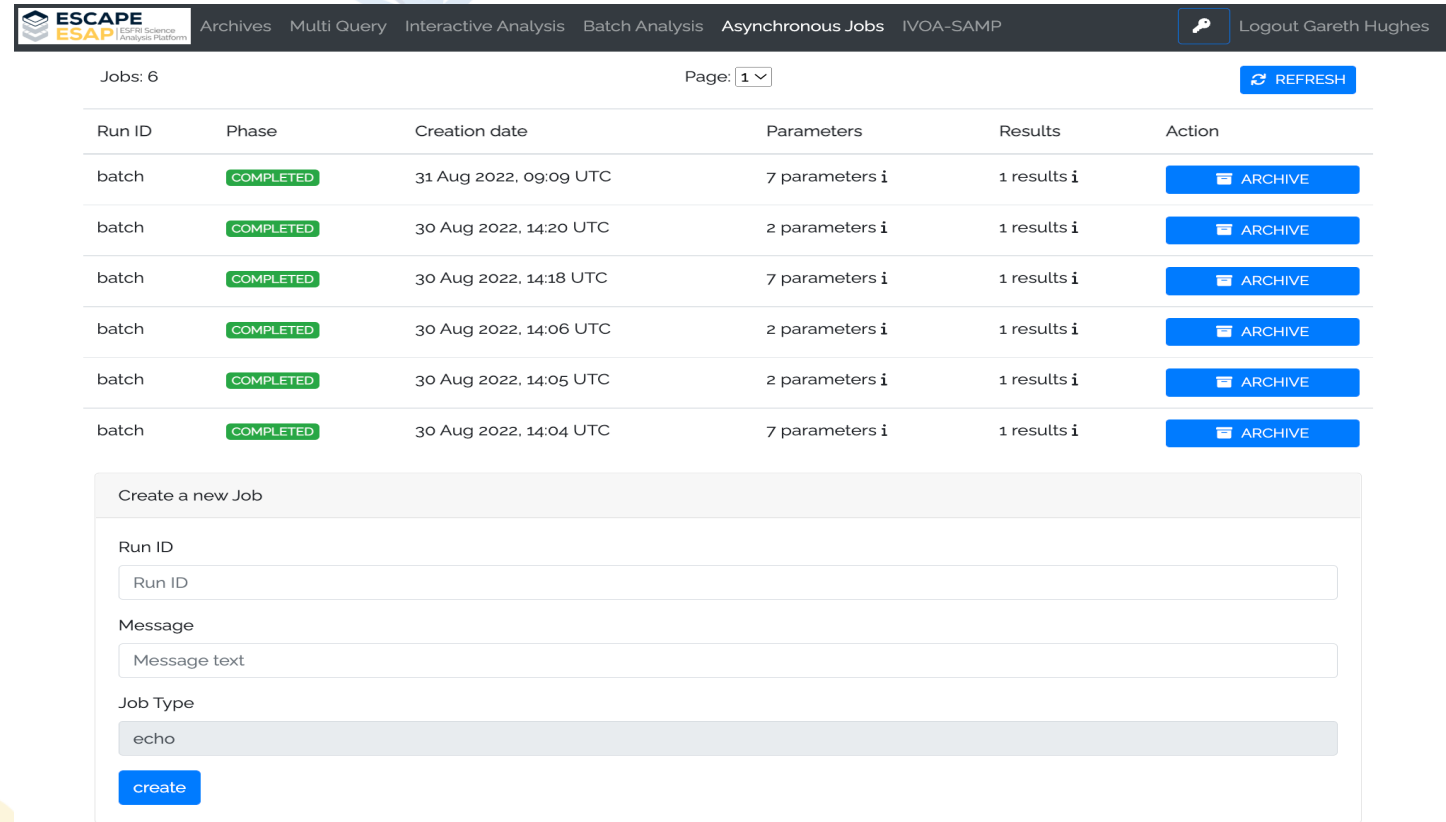
Can check to confirm on the CLI

```

base) root@13cf83eb3f93:/ESAPWORKER/esap-worker# dirac-wms-job-status 19427291
JobID=19427291 ApplicationStatus=echo '{"Parameter1": "999", "Parameter2": "2", "Parameter3": "33", "Parameter4": "GG", "Parameter5": "test", "Parameter6": "default", "type": "batch.submit"}' successful; MinorStatus=Execution Complete; Status=Done; Site=LCG.IN2P3-CC.fr;
    
```



Able to monitor UWS jobs on the Async



ESCAPE ESAP ESFRI Science Analysis Platform

Archives Multi Query Interactive Analysis Batch Analysis Asynchronous Jobs IVOA-SAMP

Logout Gareth Hughes

Jobs: 6 Page: 1

Run ID	Phase	Creation date	Parameters	Results	Action
batch	COMPLETED	31 Aug 2022, 09:09 UTC	7 parameters i	1 results i	ARCHIVE
batch	COMPLETED	30 Aug 2022, 14:20 UTC	2 parameters i	1 results i	ARCHIVE
batch	COMPLETED	30 Aug 2022, 14:18 UTC	7 parameters i	1 results i	ARCHIVE
batch	COMPLETED	30 Aug 2022, 14:06 UTC	2 parameters i	1 results i	ARCHIVE
batch	COMPLETED	30 Aug 2022, 14:05 UTC	2 parameters i	1 results i	ARCHIVE
batch	COMPLETED	30 Aug 2022, 14:04 UTC	7 parameters i	1 results i	ARCHIVE

Create a new Job

Run ID
Run ID

Message
Message text

Job Type
echo

create

esap-gui version 21 jan 2022 - 10:00



What is missing

- Authentication
 - x509
- Defining and finding the steering file
 - IVOA Execution Planner
- How to get your output
- More general framework for other WMS



● DIRAC-Rucio developments

- WP2/DIOS CTA Rucio-DIRAC work
- DIRAC-Rucio workshop!

● DIRAC developments

- Tokens being brought into DIRAC
- DIRAC REST API
- DIRAC Jupyter-notebook extension

● CTA-ESAP deployment

- CSCS & Observatoire de Paris working on deployments

DIRAC & Rucio workshop 2023

- October 16-20 2023
- KEK, Tsukuba, Japan
- Stay tuned for more...



2022-11-11

M. Barisits - Workshop Closing

6



Things to note:

REANA

- <https://reanahub.io/>
- Reproducible research data analysis platform

DASK

- Python library for parallel computing
- Could be used within an interactive analysis

Provenance

- Observatoire de Paris
- UWS IVOA platform
 - able to perform local batch operations
 - captures provenance information

Things to note

reana



- Framework for adding batch computing exists in ESAP
- Authentication is hard
 - Future developments will likely make this much easier
- Some work to finish up in the next few weeks
 - Documentation to write
 - Then think about long term possibilities

