CTAO
Cherenkov Telescope Array Observatory

Community Report

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Natthan Pigoux, Luisa Arrabito
natthan.pigoux@lupm.in2p3.fr, arrabito@in2p3.fr

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THE INTERWARE

LUPM
LABORATOIRE MONTPELLIER
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Summary

✦ Introduction on CTAO

✦ Processing Workflows example

✦ CTADIRAC usage in 2024

✦ Transformation Failover Agent development
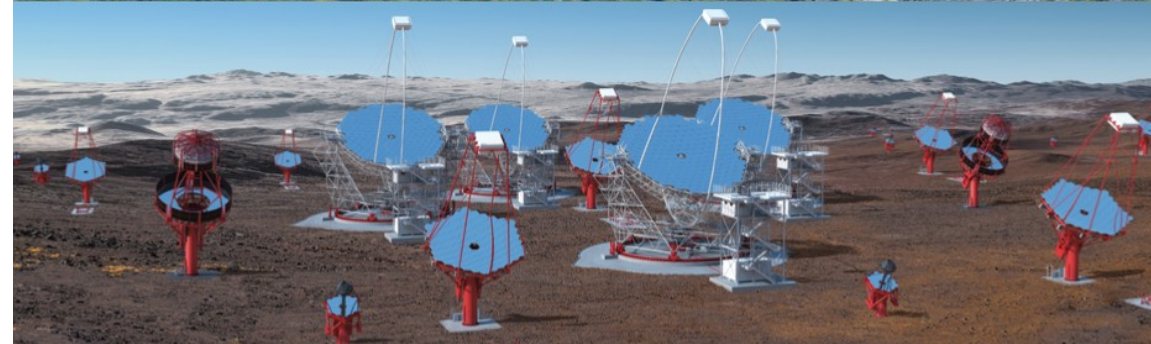
✦ Recent events

Introduction

CTAO

✦ Cherenkov Telescope Array Observatory (CTAO) will observe the high energy sky light in gamma rays

✦ CTADIRAC is the DIRAC extension for CTAO

- it is and will be used as Workload Management System for DL0 (after on site treatment) → DL2 data (scientific data)
- It has specific and complex workflows design using the DIRAC Production System
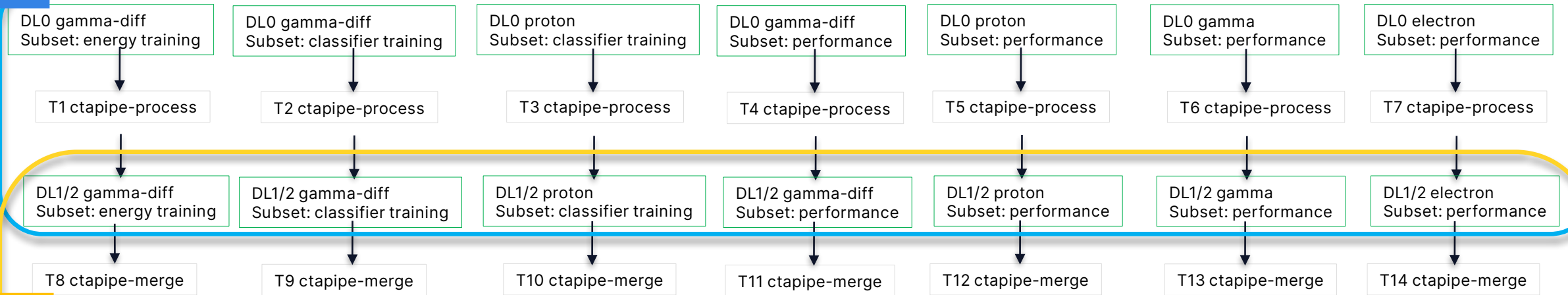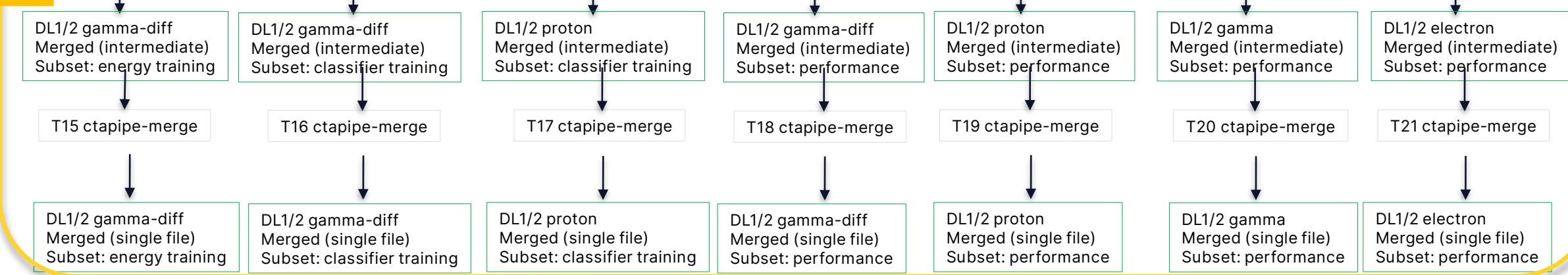- YAML and CWL workflow description

La Palma, Spain (North Site)

Paranal, Chili (South Site)
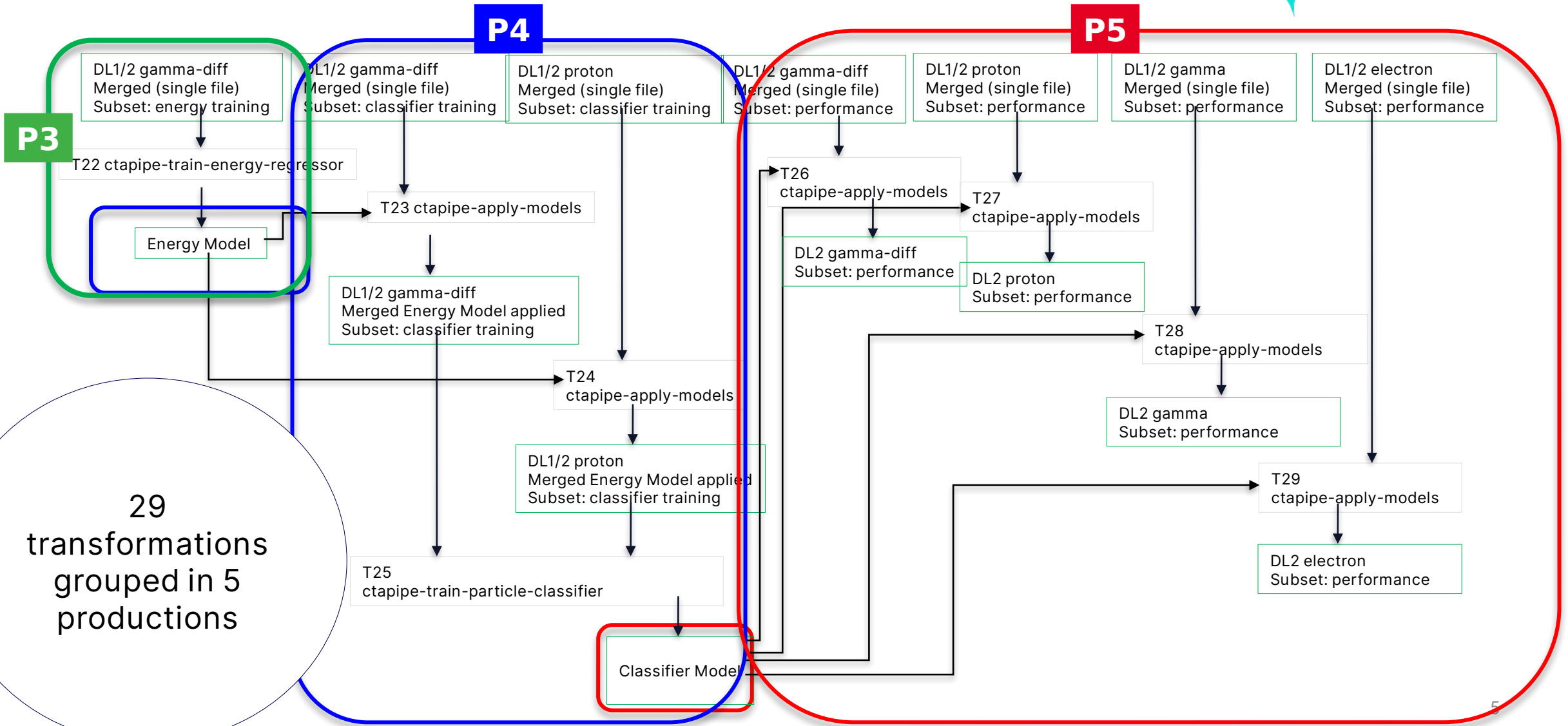
Processing Workflows Example (1/2)

CTAO

P4

P5

P3

DL1/2 gamma-diff
Merged (single file)
Subset: energy training

DL1/2 gamma-diff
Merged (single file)
Subset: classifier training

DL1/2 proton
Merged (single file)
Subset: classifier training

DL1/2 gamma-diff
Merged (single file)
Subset: performance

DL1/2 proton
Merged (single file)
Subset: performance

DL1/2 gamma
Merged (single file)
Subset: performance

DL1/2 electron
Merged (single file)
Subset: performance

T22 ctapipe-train-energy-regressor

T23 ctapipe-apply-models

Energy Model

DL1/2 gamma-diff
Merged Energy Model applied
Subset: classifier training

T24
ctapipe-apply-models

T26
ctapipe-apply-models

T27
ctapipe-apply-models

DL2 gamma-diff
Subset: performance

DL2 proton
Subset: performance

T28
ctapipe-apply-models

DL2 gamma
Subset: performance

DL1/2 proton
Merged Energy Model applied
Subset: classifier training

T29
ctapipe-apply-models

T25
ctapipe-train-particle-classifier

29
transformations
grouped in 5
productions

Classifier Model

DL2 electron
Subset: performance

Production's YAML description

```yaml
ProdSteps:
  - ID: 1
    input_meta_query:
      parentID:
      MCCampaign: PROD5b
      array_layout: Alpha
      site: LaPalma
      particle: gamma-diffuse
      thetaP: 20.0
      phiP: 180.0
      split: train_en
      analysis_prog: ctapipe-process
      analysis_prog_version: v0.19.0
      data_level: 2
      outputType: Data
      configuration_id: 8
      merged: 0
      moon: dark
    job_config:
      type: Merging
      version: v0.19.0
      group_size: 50
      output_extension: merged.DL2.h5
  - ID: 2
    input_meta_query:
      parentID: 1
    job_config:
      type: Merging
      version: v0.19.0
      group_size: 10000
      output_extension: alpha_train_en_merged.DL2.h5
      options: --no-dl1-images --no-true-images
      catalogs: DIRACFileCatalog
```

cta-prod-submit prod_name workflow.yaml

Production System
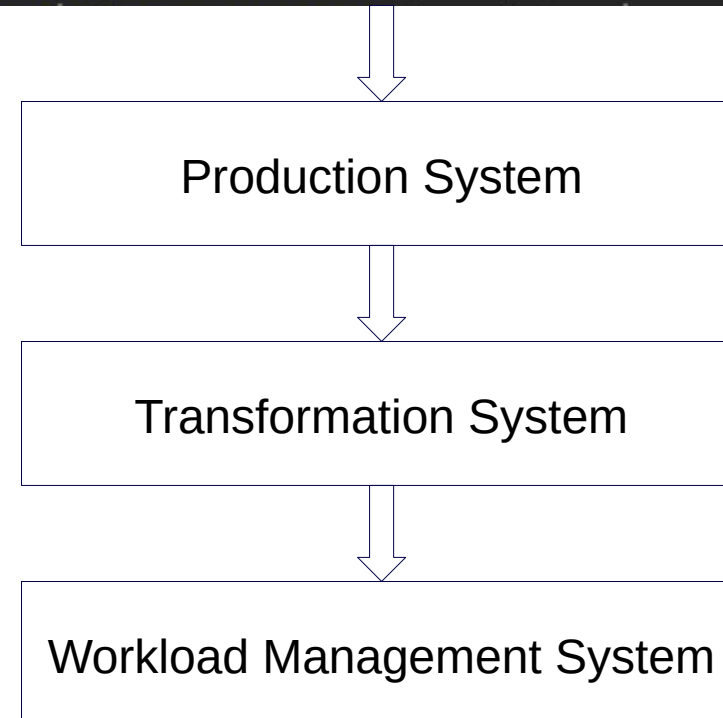
↓

Transformation System

↓

Workload Management System

Figure: Yaml description of a Production

Current CTADIRAC Infrastructure

✦ CTADIRAC services, agents and DBs are hosted on VMs :
  - 3 at CSCS
  - 2 at PIC
  - 1 at DESY-Zeuthen

✦ 3 VMs at DESY host the CTADIRAC certification instance

✦ DESY provides us an OpenSearch instance and a Rancher (K8) cluster

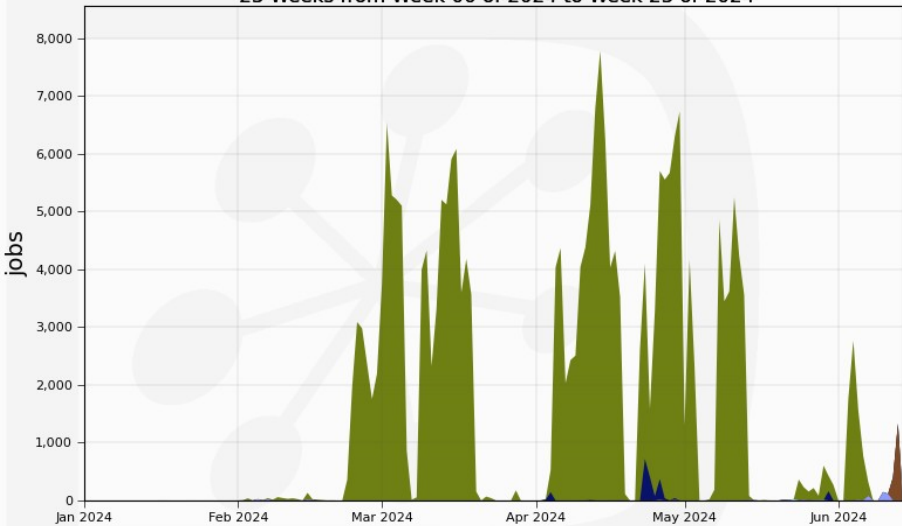✦ CTADIRAC uses now essentially the 4 official CTAO data centers (DESY, PIC, CSCS and FRASCATI) as computing sites

Production in 2024

CTAO

Consume ~115 Mh HS06 since beginning of 2024

Transformation Failover Agent

CTAO
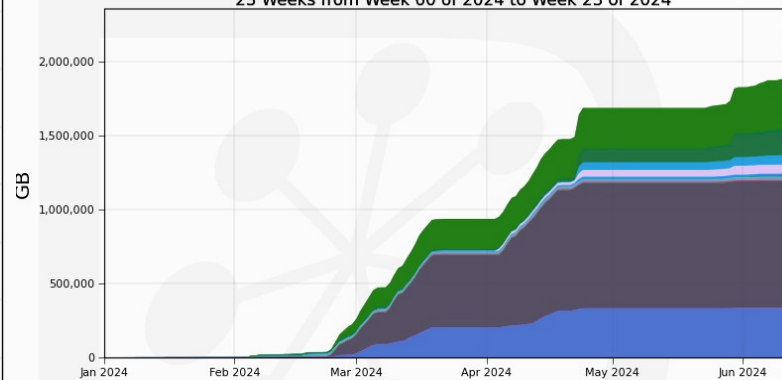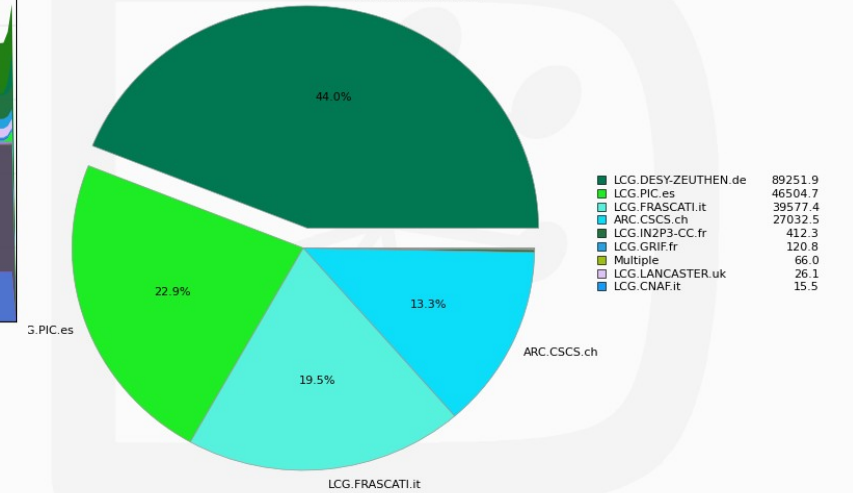
✦ Why write a new agent?
  - It's rare that a transformation ends completely on its own.
  - It takes a lot of work to monitor transformations and to get them finish.

✦ Why not use the existing DataRecoveryAgent?
(DataRecoveryAgent = "An agent to ensure consistency for transformation jobs, tasks and files.")

  - No "ProductionOutputData" parameter which is a necessary condition for the DataRecoveryAgent to work
  - Need to act at transformations level:
    ◆ Some "child" transformations have to start when their parent is completed (example: Merging)
    ◆ Need to Flush transformation to process the last files that do not match the GroupSize
    ◆ Want to perform different actions based on transformation's type
    ◆ Create a report on transformation when there are failed jobs

Transformation Failover Agent

⇒ How does it work?

✦ Select transformations based on type
✦ Then create threads to treat each transformation:
  • Check if transformation can be completed
  • Check if transformation needs to be flushed
  • Set "Assigned" files to "Unused" if associated to failed jobs (to trigger job rescheduling)
  • Create a report on transformations with failed jobs
  • Send mail notifications for each of those conditions

⇒ Remark:
Transformation tasks status in Transformation DB is not updated from Job DB → do it inside the agent for now

```
─ 📁 TransformationFailoverAgent
    ├─ 📄 PollingTime = 600
    ├─ 📄 maxThreadsInPool = 10
    ├─ 📄 MailFrom =
    ├─ 📄 MailTo = natthan.pigoux@cta-consortium.org, arrabito@in2p3.fr
    ├─ 📄 TransformationStatus = Active
    ├─ 📄 Report =
    ├─ 📄 Reassign = DataReprocessing, Merging, Training, ApplyModel
    ├─ 📄 Flush = DataReprocessing, Merging
    ├─ 📄 MaxReassign = 3
    └─ 📄 Complete = DataReprocessing, Merging, Training, ApplyModel
```

Figure: Configuration of the agent in the CS

Transformation Failover Agent

Transformation: 4848

Status	MinorStatus	ApplicationStatus	Site	Total
Done	Execution Complete	Workflow successful, end of FailoverRequest module execution.	LCG.IN2P3-CC.fr	1029
Done	Execution Complete	Workflow successful, end of FailoverRequest module execution.	LCG.LANCASTER.uk	106
Done	Execution Complete	Workflow successful, end of FailoverRequest module execution.	LCG.CNAF.it	14
Done	Execution Complete	Workflow successful, end of FailoverRequest module execution.	LCG.GRIF.fr	726
Done	Total: Execution Complete	-	-	1875 (97.9%)
Done	Requests done	Workflow successful, end of FailoverRequest module execution.	LCG.IN2P3-CC.fr	35
Done	Requests done	Workflow successful, end of FailoverRequest module execution.	LCG.GRIF.fr	6
Done	Total: Requests done	-	-	41 (2.1%)
Total: Done	-	-	-	1916 (85.4%)
Failed	Application Finished With Errors	Operation not permitted (1 : cta-prod-setup-software Exited With Status 1)	LCG.LANCASTER.uk	1
Failed	Total: Application Finished With Errors	-	-	1 (0.3%)
Failed	Maximum of reschedulings reached	Failed Input Data Resolution	LCG.GRIF.fr	149
Failed	Maximum of reschedulings reached	Failed Input Data Resolution	LCG.IN2P3-CC.fr	135
Failed	Maximum of reschedulings reached	Failed Input Data Resolution	LCG.LANCASTER.uk	41
Failed	Total: Maximum of reschedulings reached	-	-	325 (99.1%)
Failed	Received Kill signal	Executing Step1_ctapipe_process	LCG.GRIF.fr	2
Failed	Total: Received Kill signal	-	-	2 (0.6%)
Total: Failed	-	-	-	328 (14.6%)
Total # tasks:	-	-	-	2244

Figure: Mail report on transformation with failed job generated by the agent

Recent activities

CTAO

✦ Integration between DIRAC, RUCIO and CTA Pipeline Softwares
  - Done using Docker-Compose in a Gitlab-CI pipeline

✦ Migration of CTADIRAC services and databases from CC-IN2P3 to CSCS

✦ Migrate the monitoring service from ElasticSearch at CC-IN2P3 to Opensearch at DESY-Zeuthen
  - After some time got issues with Desy infrastructure leading to errors in services using the Monitoring System → Broke some services
  - → MS deactivated at the moment

✦ Started Prod5b processing and continue the Prod6 MC simulations in 2024

Conclusion

✦ The MC simulations and processing continue to run well using the CTADIRAC instance and on the 4 CTAO computing centers

✦ The TransformationFailoverAgent saves us a lot of time during these productions and will be improved as we continue using it

✦ I'm wondering if the report created by the agent can be replaced by a Kibana dashboard generated using the OpenSearch API

✦ It would be a good thing to generalize this agent and merge it with the DataRecoveryAgent at some point

✦ We are looking forward to test the first DiracX release with CTADIRAC

Thank you

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