Bundesministerium
für Bildung
und Forschung

Grid – Introduction

ATLAS-D Physics Meeting Freiburg 2018

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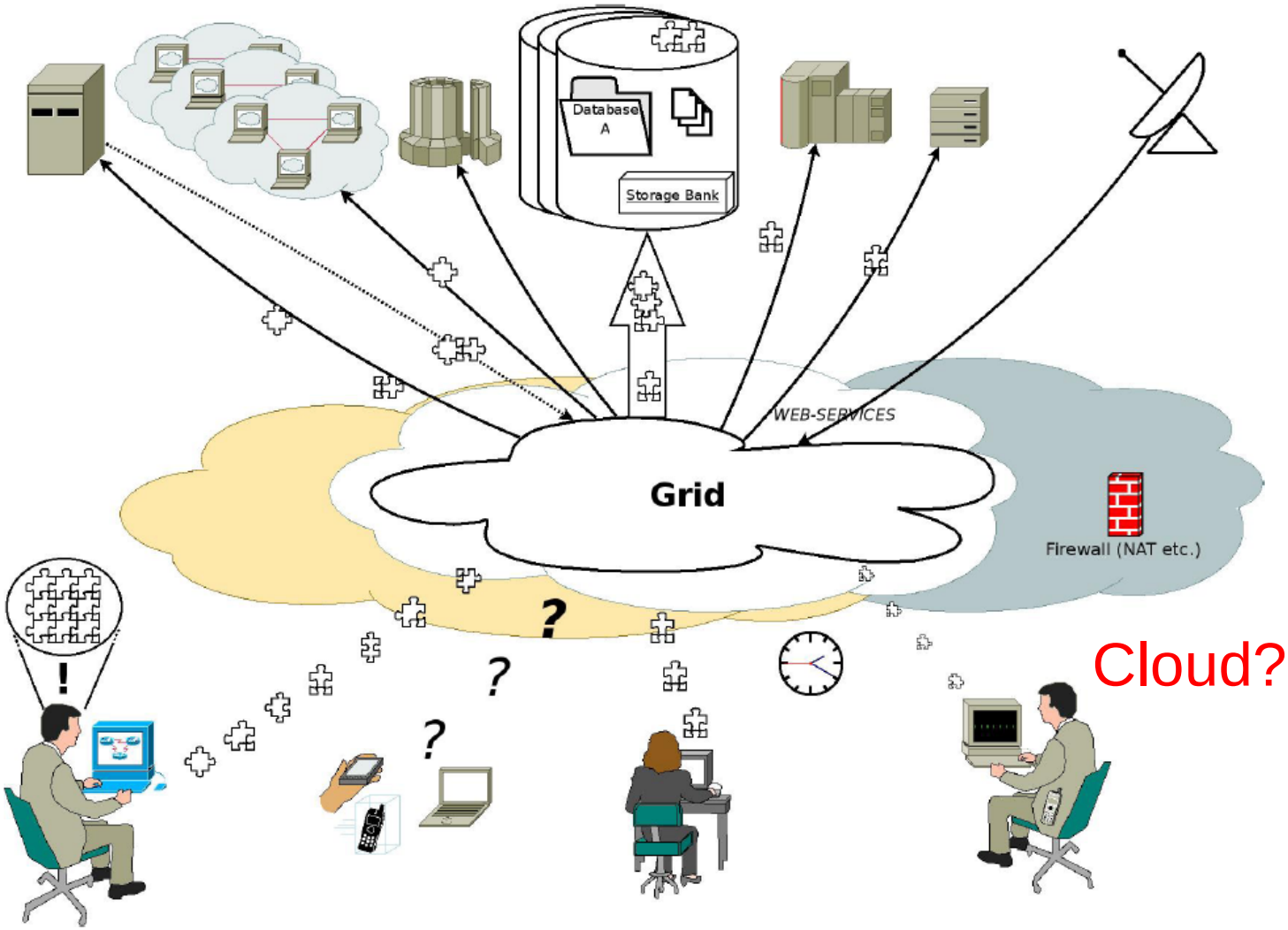
Overview (30mins)

- Introduction to ATLAS Grid computing
  - Concepts
  - Certificate Authorities and VOMS
  - ATLAS Grid computing & WLCG Resources
  - Grid job
  - Grid user interface (CLI) and CVMFS
- PanDA (ATLAS job management system)
- ATLAS Metadata Interface (AMI)
- Rucio (ATLAS data management system)
  - Rucio basic concept
  - RSE expressions
- Links ad references
- Bakckup
  - ATLAS Resources
  - Job allocation (a tip)

Introduction to ATLAS Grid Computing

Introduction to Grid computing - 1



Introduction to Grid computing - 2

- Data intensive Physical Sciences
  - High Energy & Nuclear Physics
    - Including LHC experiments at CERN
  - Gravitational wave searches
    - LIGO
  - Time-dependent 3D systems
    - Earth observation, climate modelling
    - Geophysics, earthquake modelling
    - Fluid dynamics
    - Bioinformatics, Protein simulations
  - Astronomy

Introduction to Grid computing - 3

- A comparison
  - Serial
    - Fetch/Store, Compute
  - Parallel
    - Fetch/Store
    - Compute/Communicate
    - Cooperative
  - *Grid*
    - *Geographically independent based on internet backbone*
    - *Fetch/Store (from remote data)*
    - *Resource discovery*
    - *Interaction with remote applications*
    - *Authentication/Authorization/Standard Security*
    - *Built around internet standard*
    - *Compute in parallel*

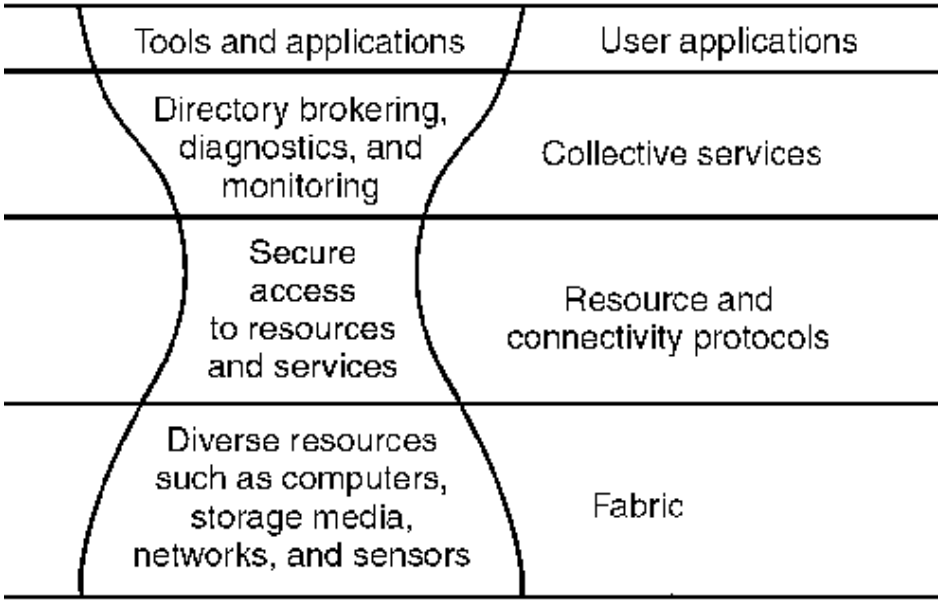


Fig. Grid Hourglass model

Introduction to Grid computing - 4

- Grid
  - Enhancement of possibilities of the Internet to the area of high capacity computations and distributed data management
  - *Ian Foster*: three point checklist (2002):
    - No central administration of computing resources
    - Open standards are used
    - Non trivial quality of service
  - *IBM*
    - A Grid is a type of parallel and distributed system that enables the sharing, selection, and aggregation of resources distributed across multiple administrative domains based on the resources availability, capacity, performance, cost and users' quality-of-service requirements"

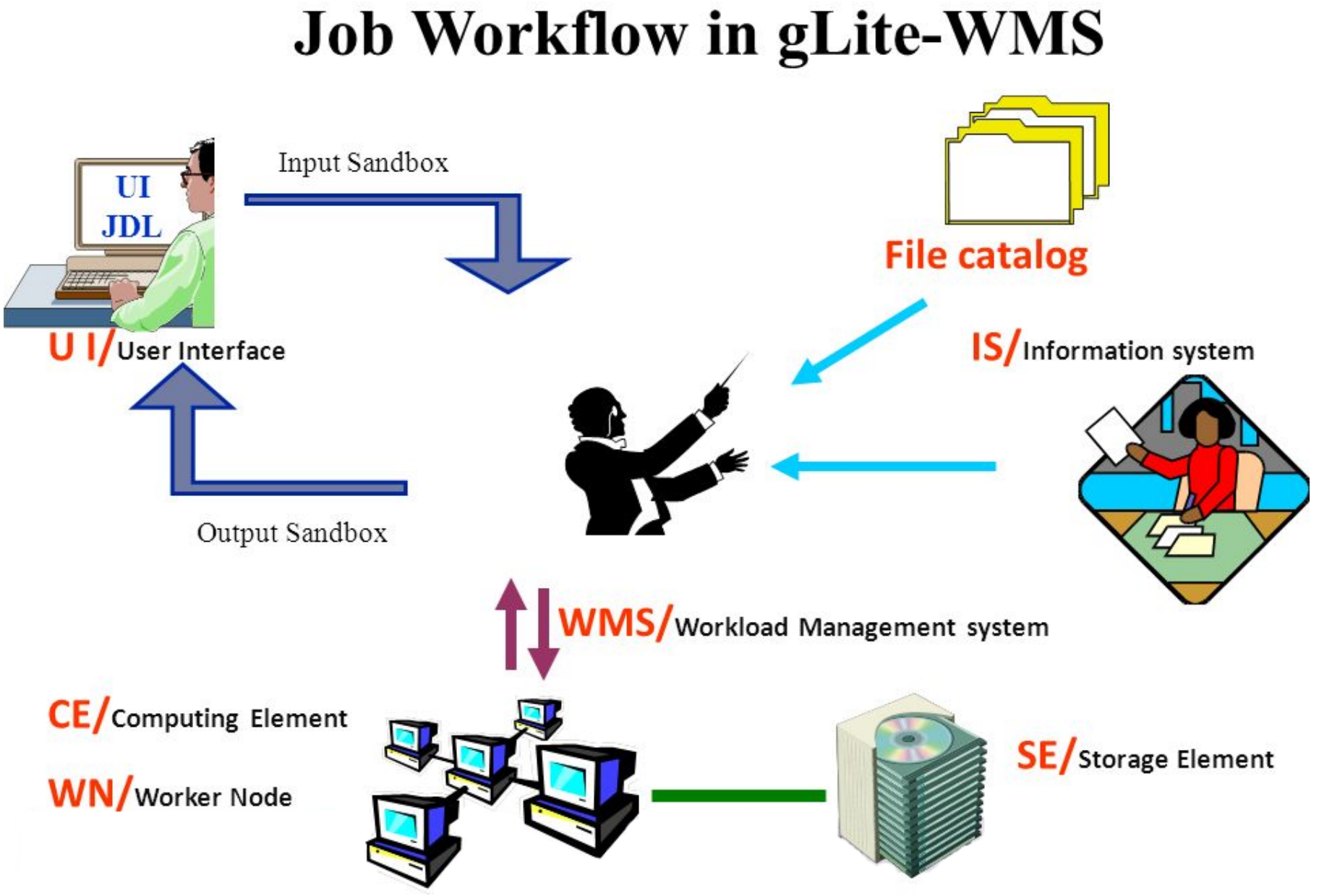
Introduction to Grid computing - 5

- Short history
  - *2002*: Ian Foster and Carl Kesselman (eds.), The Grid: Blueprint for a New Computing Infrastructure, 2nd edition, Morgan Kaufmann Publishers,
  - *2004*: middleware developent: Globus, Legion, Condor, NWS, SRB, NetSolve, *gLite*, etc
  - *2000+*: start of the Global Grid
    - Global Grid Forum
    - Almost standards (Globus, Condor, ...)
  - *2006*: GGF (Global Grid Forum), EGA (Enterprice Grid Alliance (launch 2004))
    - OGF (Open Grid Forum)

Introduction to Grid computing - 6

- Classification of Grid
  - Based on Globus toolkit
    - *Gloubs toolkit*
    - *gLite (developed for LCG – LHC Computing Grid)*
    - *NorduGrid*
    - TeraGrid
    - UNICORE
  - Cloud computing
    - Amazon
    - Google
    - Yahoo
    - Microsoft
    - Etc...
- Workload balancing system
  - Sun Grid Engine (SGE)
  - LSF
  - OpenPBS
  - HT-Condor
- Community Grid (using idle resources, cycle stealing)
  - BOINC
  - SETI@HOME
  - LHC@HOME
- Application
  - Computational Grids, Data Grids

Introduction to Grid computing - 6

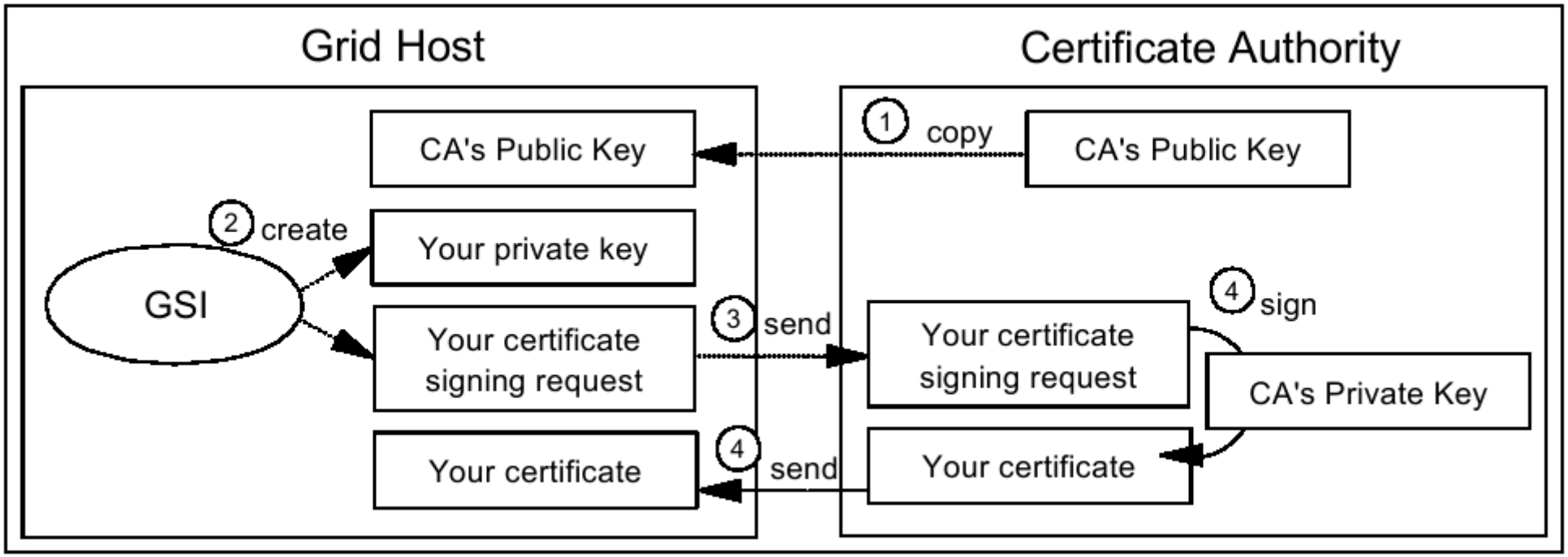


GSI - 1

- GSI: Grid Security Infrastructure
  - Key concepts
    - PKI
    - Digital signature
    - Certificates
    - Authentication/Authorization
    - Delegation and single sign-on
  - Extra
    - Virtual Organization (VO)

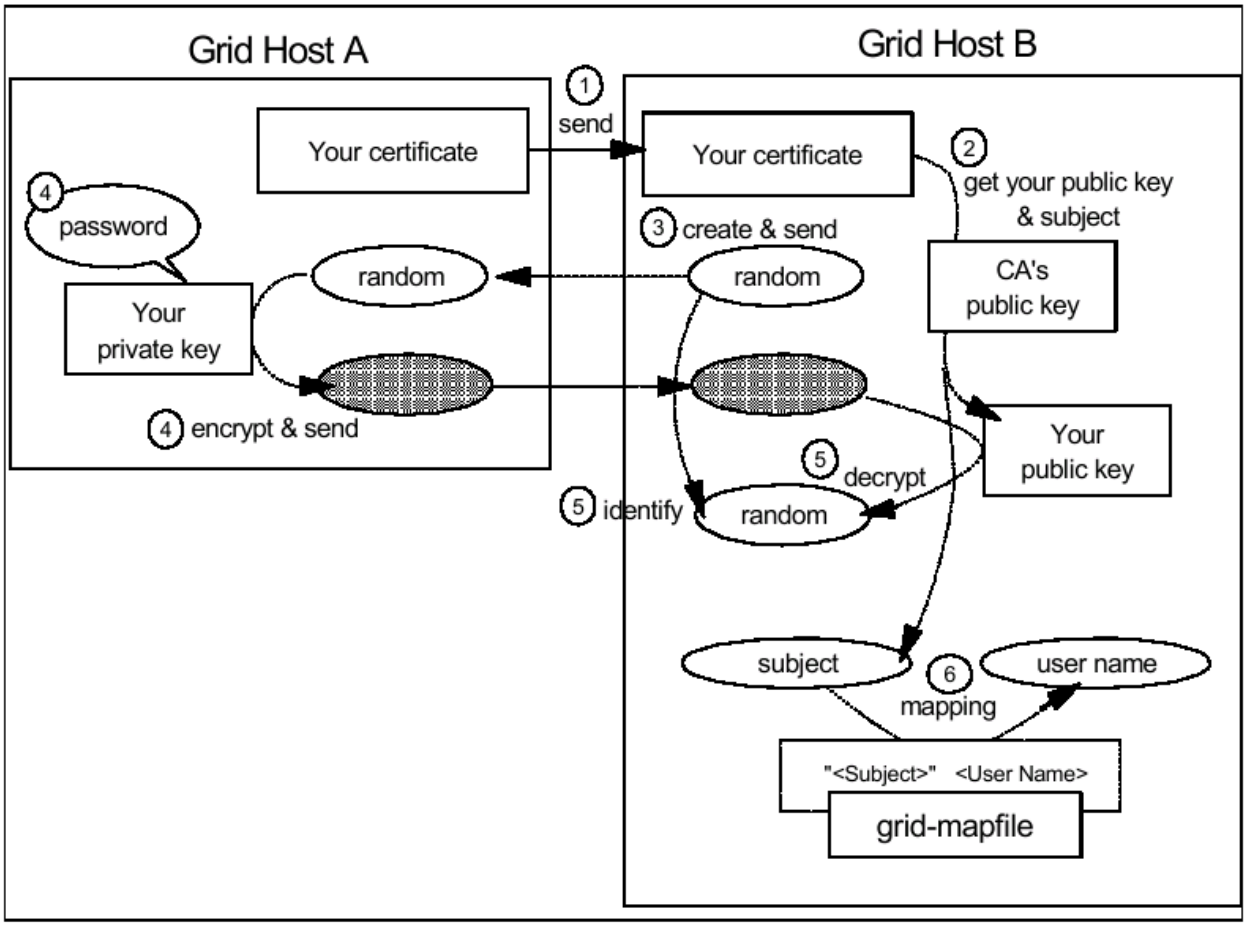
GSI - 2

- GSI: Grid Security Infrastructure
  - Issuing → Digital signature on a PKI key



GSI - 3

- GSI: Grid Security Infrastructure
  - Connecting to Host A from Host B



GSI - 4

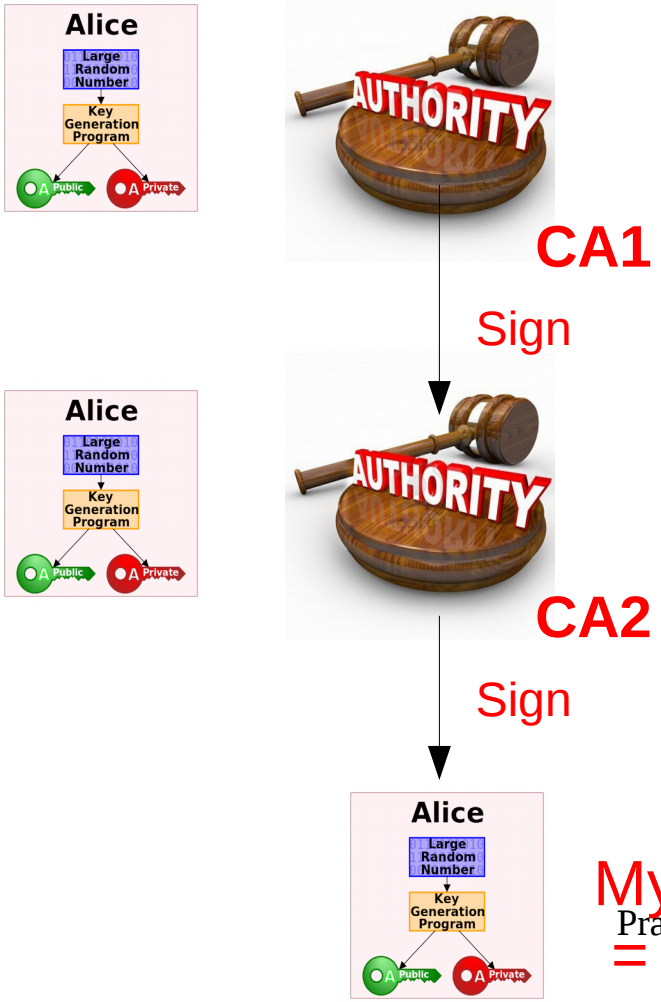
- GSI: Grid Security Infrastructure
  - Connecting to Host A from Host B
    - SSL/TLS layer from (A) to (B)
    - Forward X.509 certificate → Who I am, Which CA signed
    - Validity check through the CA public key in (B)
    - Check if (A) on the key is correct
      - (B) generates a key *t*, and request (A) to encrypt it
      - (A) encrypt *t* with its private key *s=crypt(t)*, return it to (B)
      - (B) decrypt *r=decrypt(s)* using public key of (A)
      - If *r == s*, (A) is the right one
    - Vice versa (B) → (A)
    - Perform *grid user authorization* (using *grid-map*)

GSI - 5

- GSI: Grid Security Infrastructure
  - Proxy certificate
    - Local *voms-proxy-init* command generate a PKI key pair, and Grid user certificate can sign on it

Proxy certificate - 1

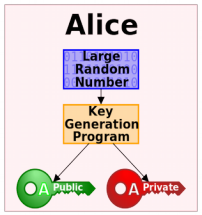
- Then, hierarchical signatures



My X509 Certificate
= Grid user certificate

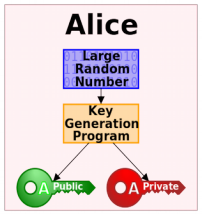
Proxy certificate - 2

- Generating a new certificate = proxy certificate



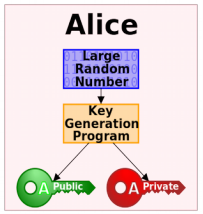
CA1

Sign



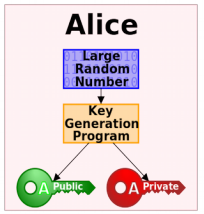
CA2

Sign



Verifiable

Proxy certificate
(with limited validity)



Generating primary numbers +
Signed by you + PK

My X509 Certificate
= Grid user certificate

Proxy certificate - 3

- Virtual Organization (VO), VOMS
  - VOMS extends a certificate with a VO

Certificate Authority

Sign

User certificate

Sign

Proxy certificate
= a limited copy of your certificate

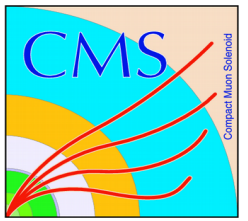
Requesting VO
voms-proy-init

VOMS server

ATLAS VOMS
CMS VOMS
LHCb VOMS

Obtaining VO extension

VOs



Proxy certificate - 4

- A similar analogy
  - Authenticated and authorized for your tasks

Certificate Authority

Sign

User certificate

Sign

Proxy certificate
= a limited copy of your certificate

Controlled

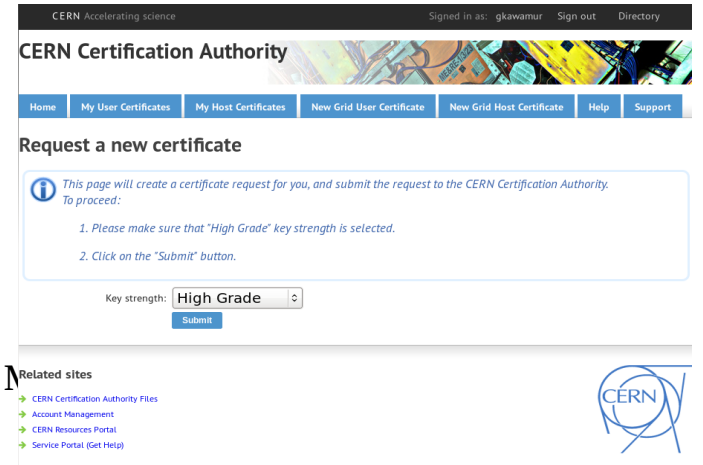
Authentication
= who you are?

Authorization
= can enter a new land (Grid)

Certificate Authorities and VOMS

- Germany (FZK)
  - https://gridka-ca.kit.edu/

- CERN
  - https://ca.cern.ch/ca/user/Request.aspx?template=EE2User

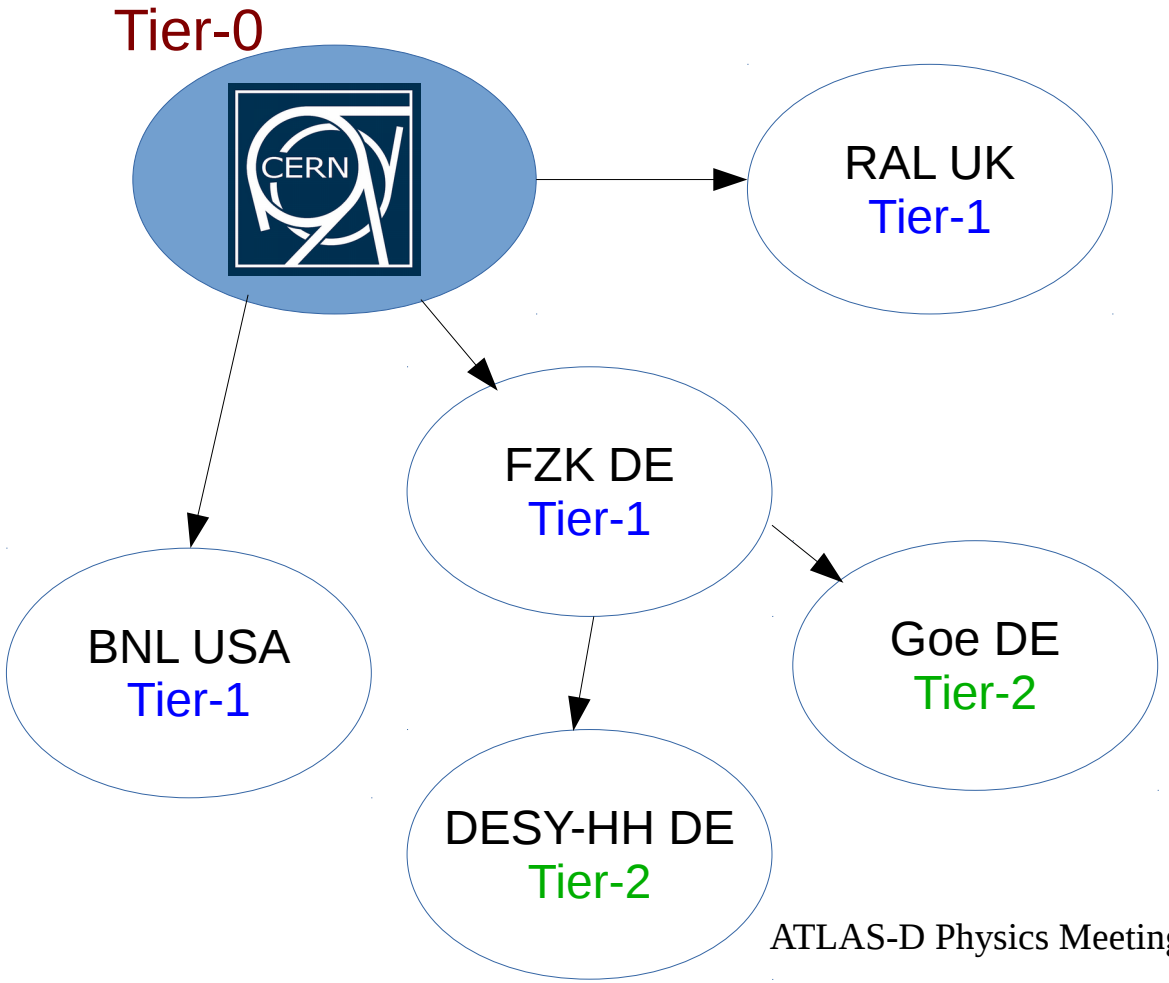


Certificate Authorities and VOMS

- VOMS top page
  - https://voms2.cern.ch:8443/
- VOMS ATLAS (request your ATLAS VO)
  - https://voms2.cern.ch:8443/voms/atlas
- VOMS ATLAS users in Germany
  - https://voms2.cern.ch:8443/voms/atlas/services/VOMSCompatibility?method=getGridmapUsers&container=/atlas/de

ATLAS Grid computing and WLCG resources - 1

- LHC multi-tier structure
  - WLCG = Worldwide LHC Computing Grid



Tier-0: Raw data, Data store (in tape), Pre-processing, Reconstruction

Tier-1: National LCG-Centre, faster network connections and lager storage spaces (e.g. Tape), MC production, user analysis, etc.

Tier-2: University or Facility level computing sites. MC production, user analysis, etc.

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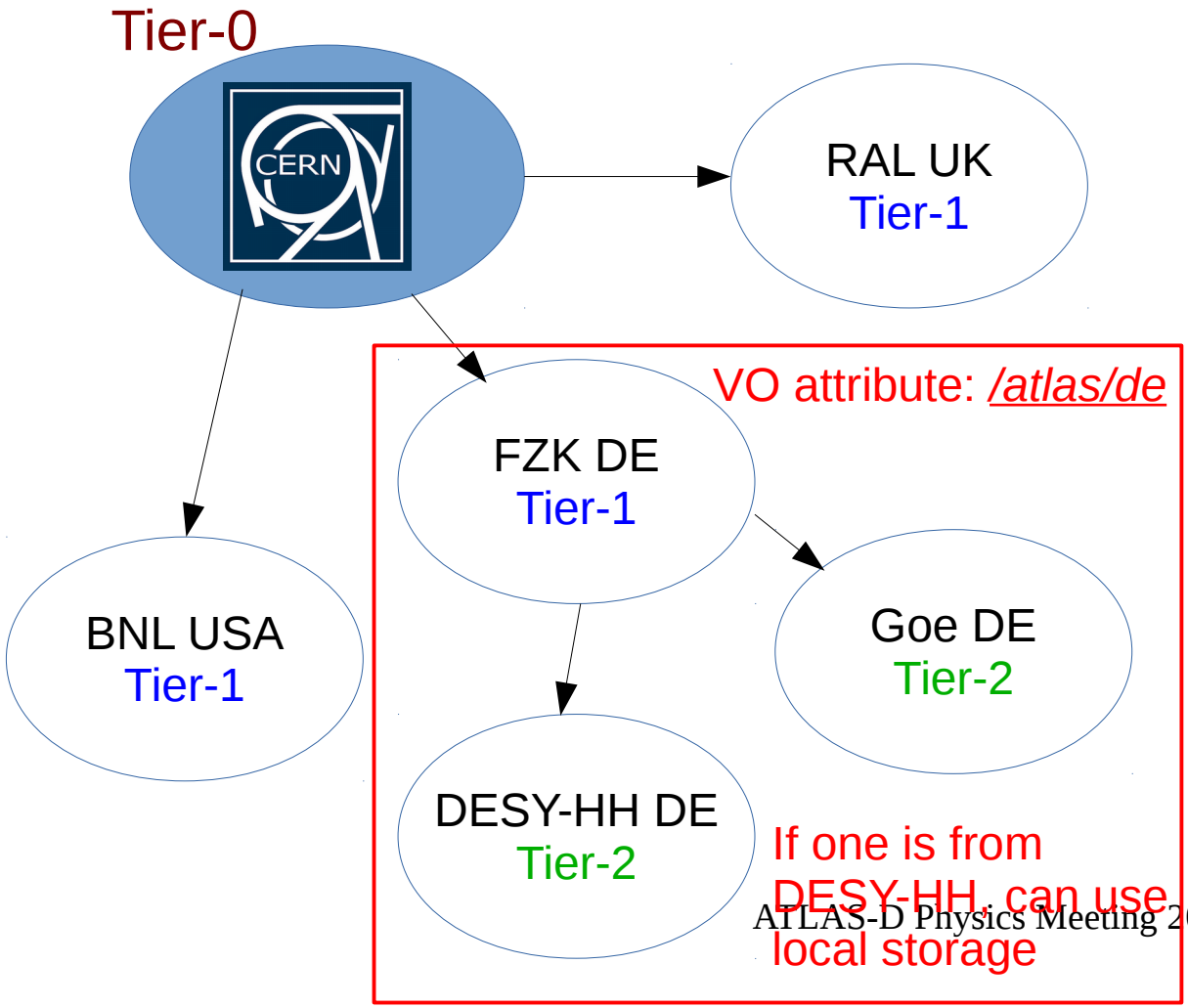

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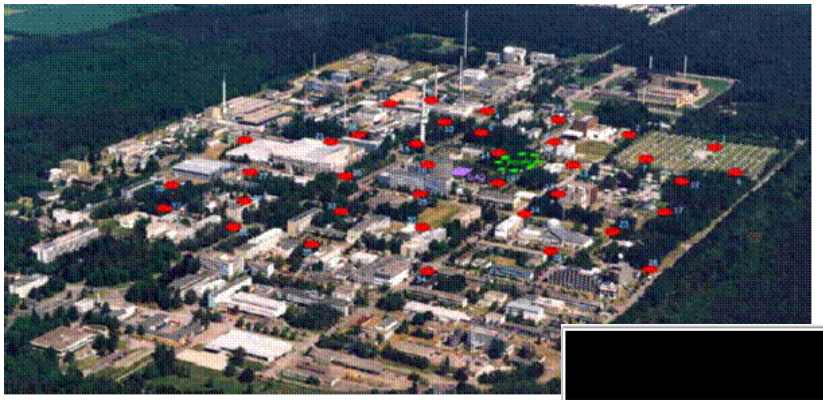
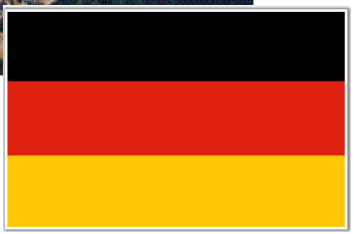
ATLAS Grid computing and WLCG resources - 2

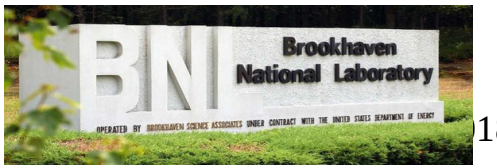
- FZK Tier-1



Forschungszentrum Karlsruhe
in der Helmholtz-Gemeinschaft

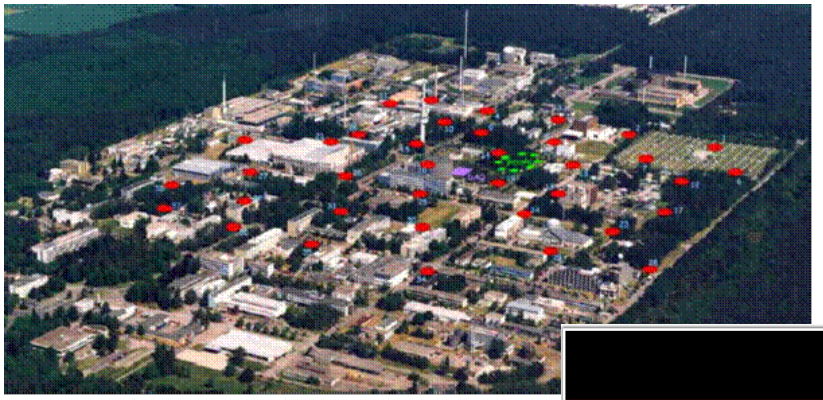


- BNL Tier-1



ATLAS Grid computing and WLCG resources - 2

- FZK Tier-1



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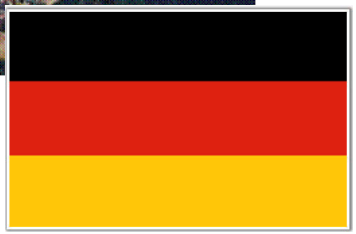
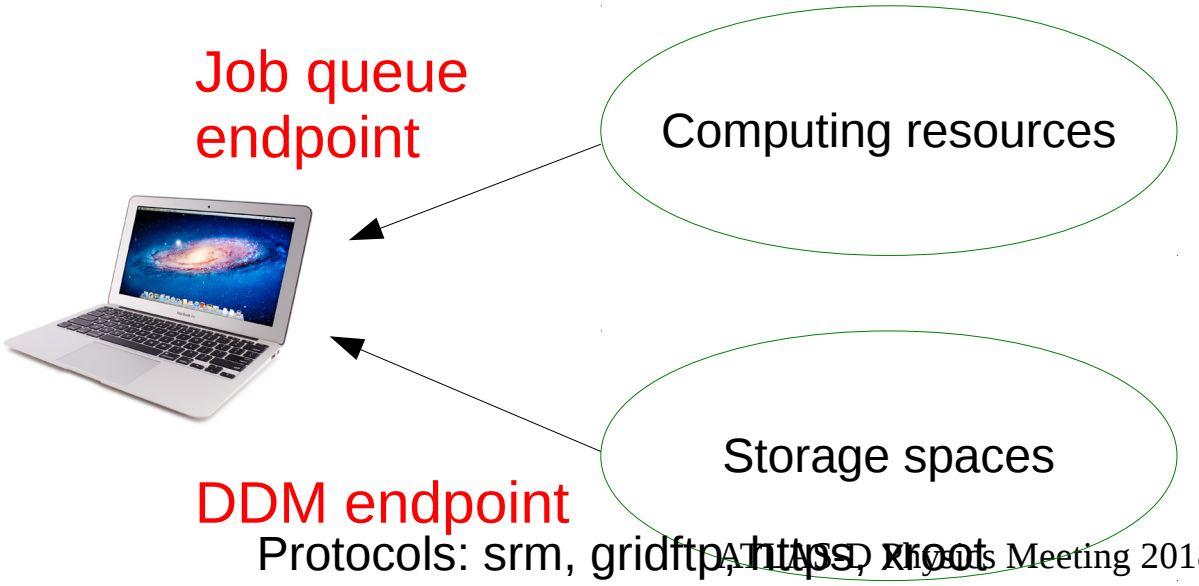


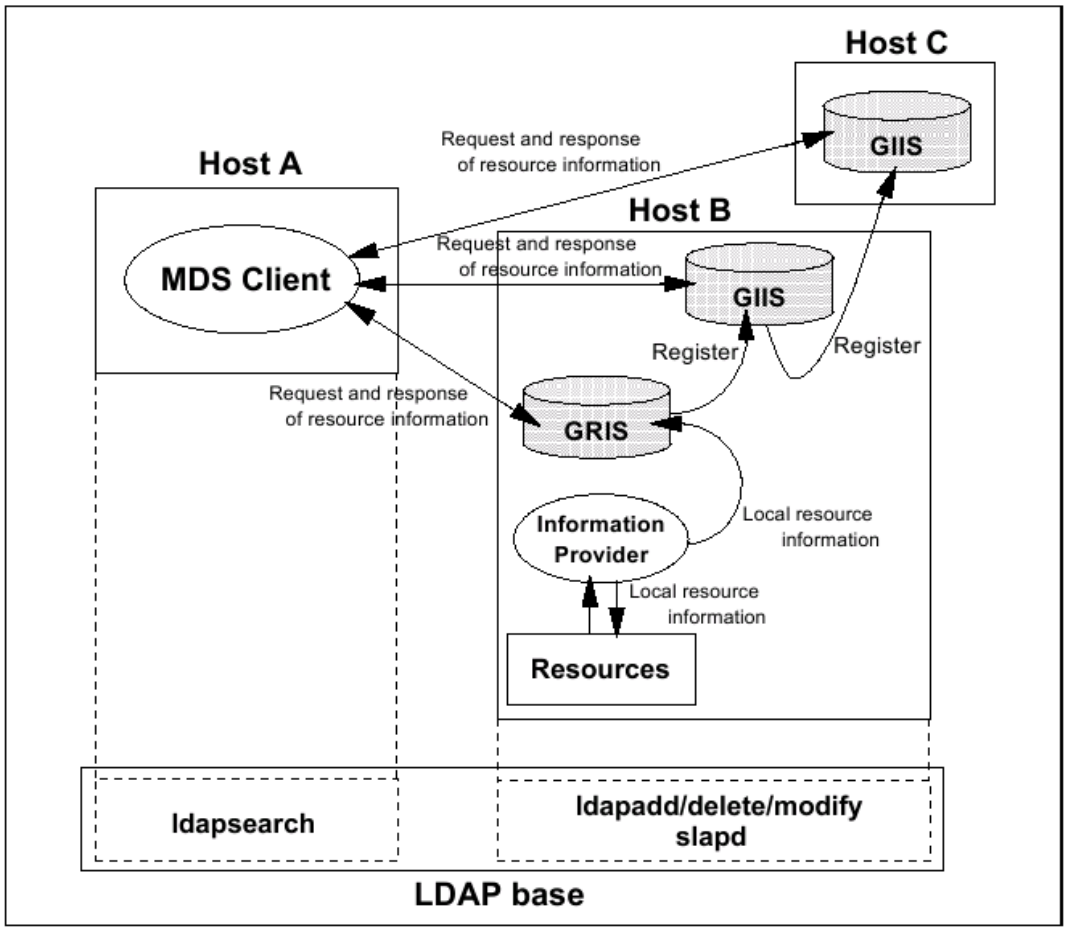


FZK Computing centre

DDM = Distributed Data Management

Information Provider

- Information Provider (MDS: Monitoring and Discovery Service)
  - Enables dynamic/static status retrieval
    - GRIS – Grid Resource Information Service
    - GIIS – Grid Index Information Service
    - has hierarchical structure similarly to DNS
    - Software based on LDAP (Lightweight Directory Access Protocol) client command *ldapsearch*
  - For example,
    - Name of services
    - Ports
    - Resources
    - Versions
    - Running/acceptable jobs

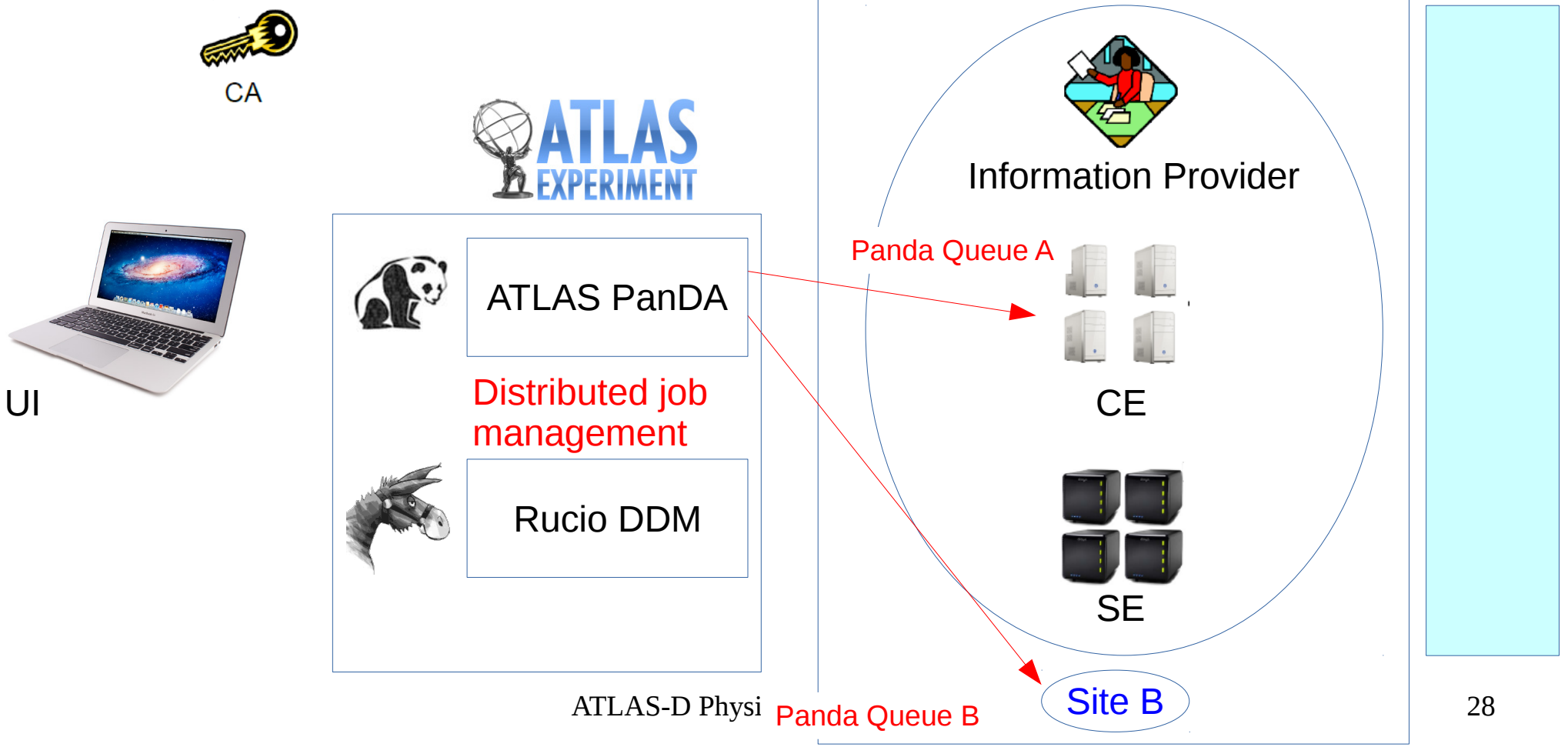


ATLAS Grid job - 1

- Some technical terms you may often need (however not in Physics)
  - User certificate, proxy certificate, CA, Virtual Organization (VO), VOMS, authentication, authorization, Computing Element, Storage Element, Worker nodes, Workload Management System, data management system, Job, data replica, information provider, site

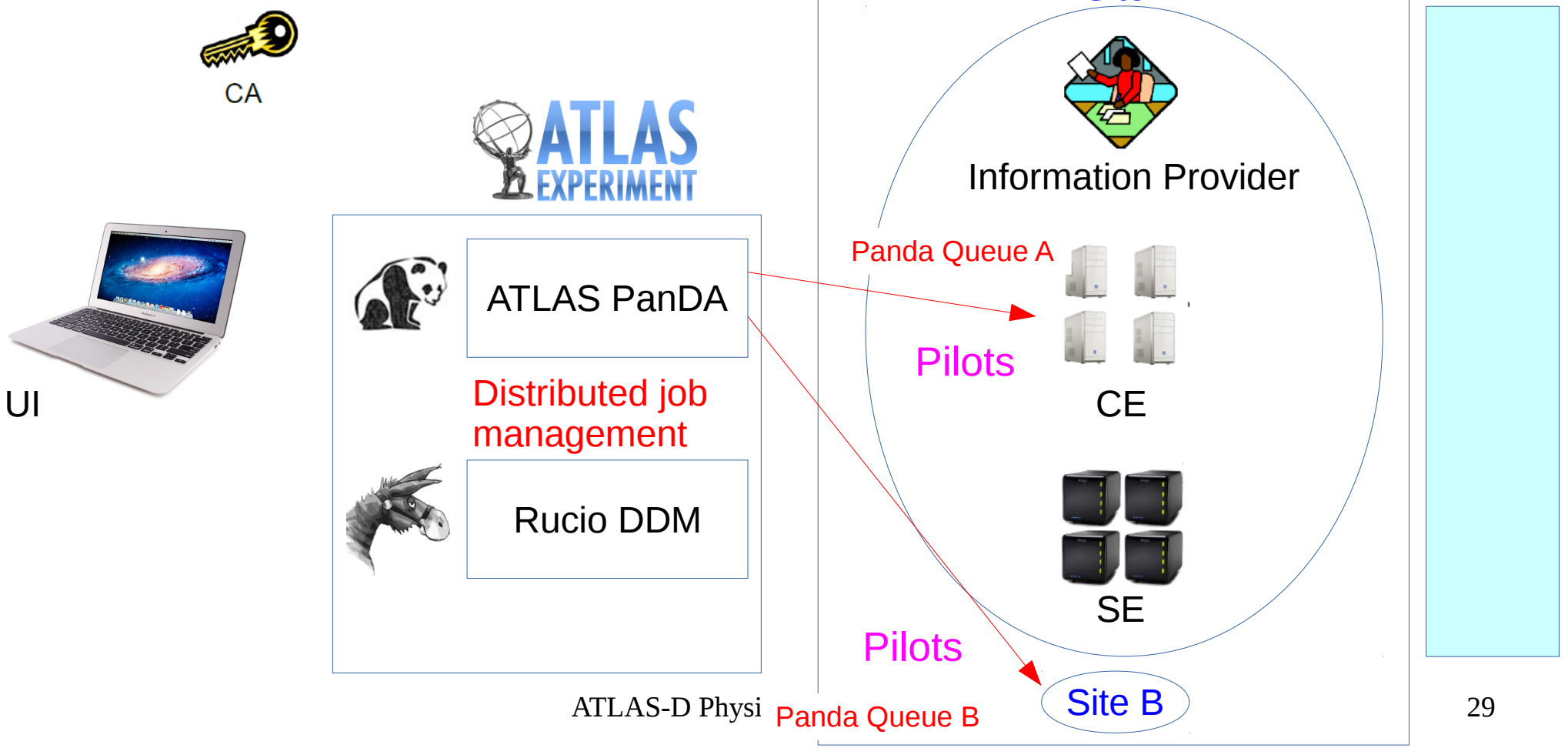
ATLAS Grid job - 2

- How do they work?



ATLAS Grid job - 3

- How do they work?

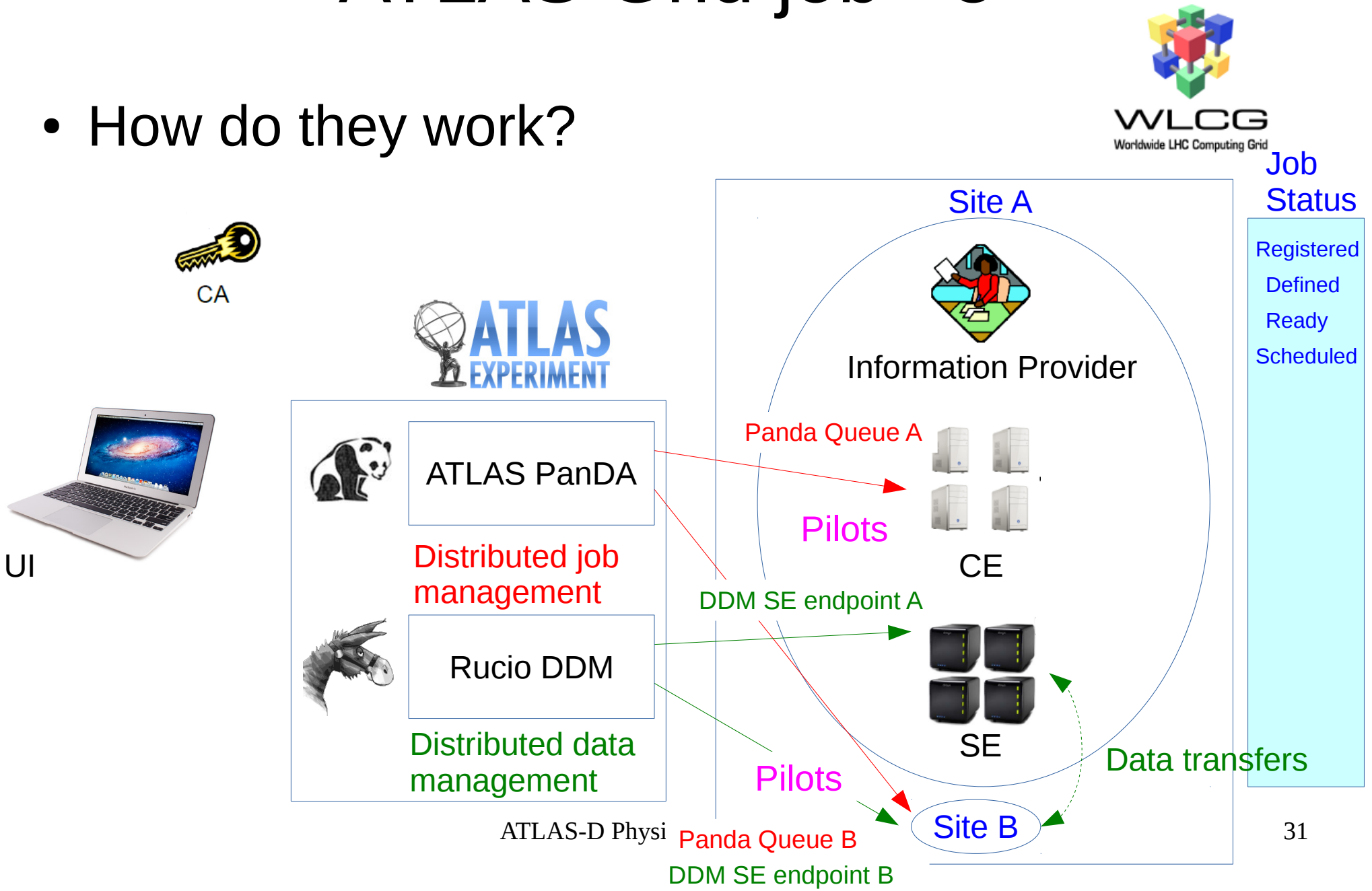


ATLAS Grid job - 4

- How do they work?

ATLAS Grid job - 5

- How do they work?



ATLAS Grid job - 6

- How do they work?

CA

UI

ATLAS PanDA

Distributed job management

Rucio DDM

Distributed data management

Site A

Information Provider

Panda Queue A

Running!

CE

DDM SE endpoint A

Analysis data

SE

Site B

Panda Queue B

DDM SE endpoint B

Job Status

Registered

Defined

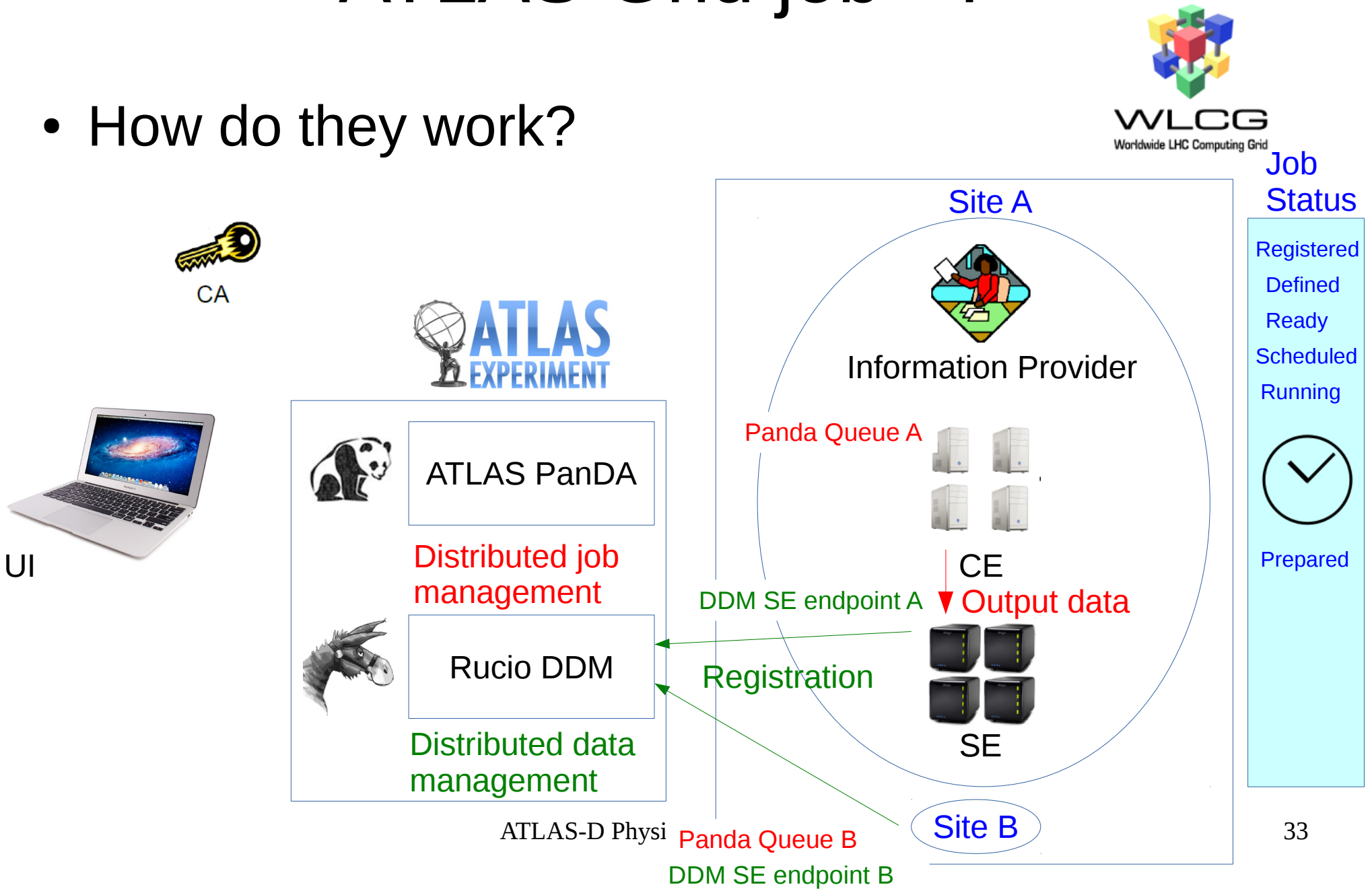
Ready

Scheduled

Running

ATLAS Grid job - 7

- How do they work?



ATLAS Grid job - 8

- How do they work?

CA

UI

ATLAS PanDA

Distributed job management

Rucio DDM

Distributed data management

Site A

Information Provider

Panda Queue A

Done!

CE

DDM SE endpoint A

SE

Site B

Panda Queue B

DDM SE endpoint B

Job Status

Registered

Defined

Ready

Scheduled

Running

Prepared

Done

Grid User Interface and CVMFS

- Grid client software originally supported by *European Middleware Initiative* (EMI)
- CVMFS is a remote repository using FUSE file system
  - e.g. /cvmfs/atlas.cern.ch → A repository of all client software we need
  - Internally using HTTP → Need of network access
- Panda client using ATLAS PanDA server is a tool to manage jobs
  - BigPanda monitoring system provides a Web interface
- Rucio client is a tool to interact with data

ATLAS Athena physics framework

Data management
Rucio client

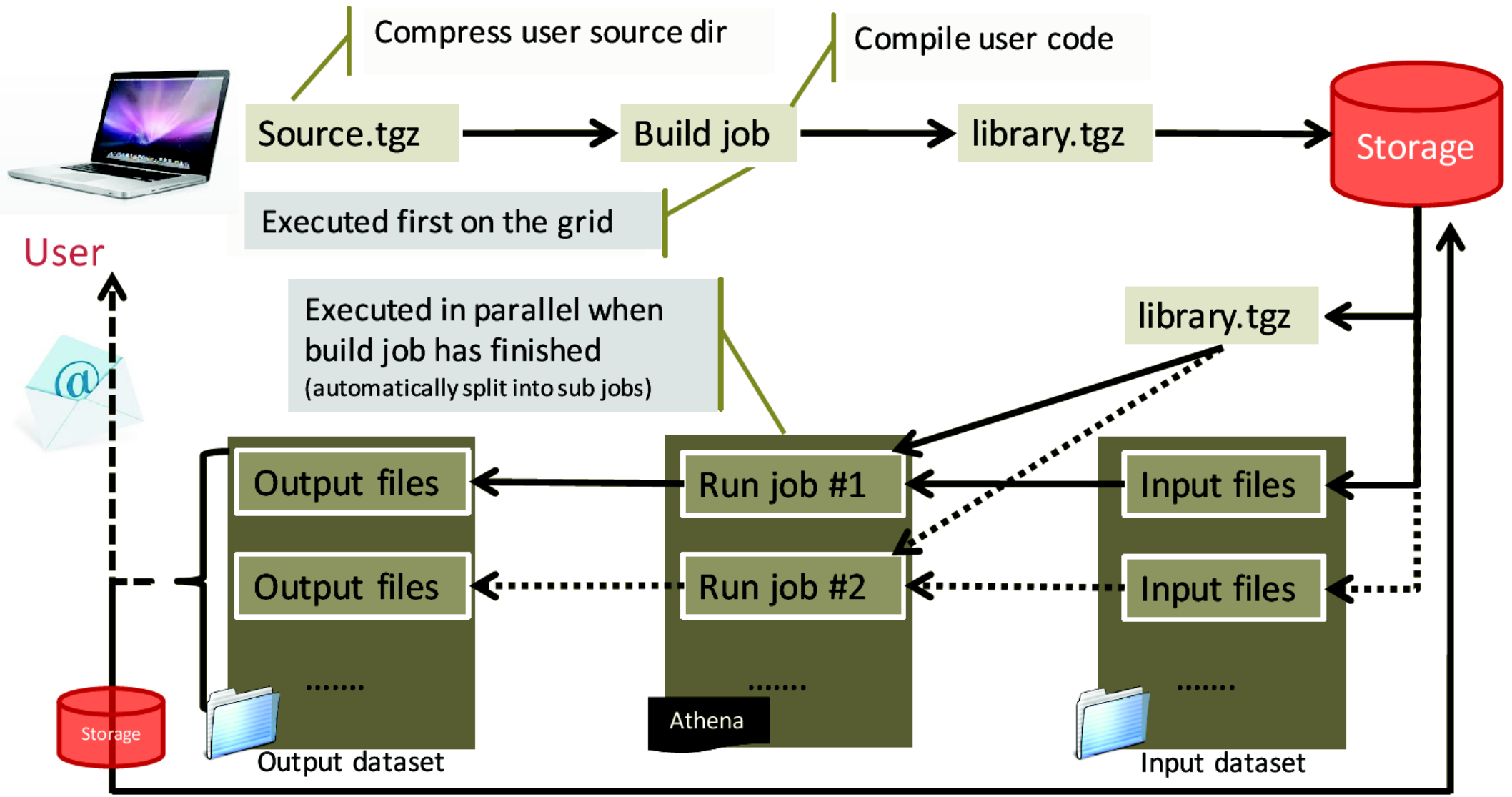
Job management
Panda client

Grid client software
EMI LCG tools

Just try it out!

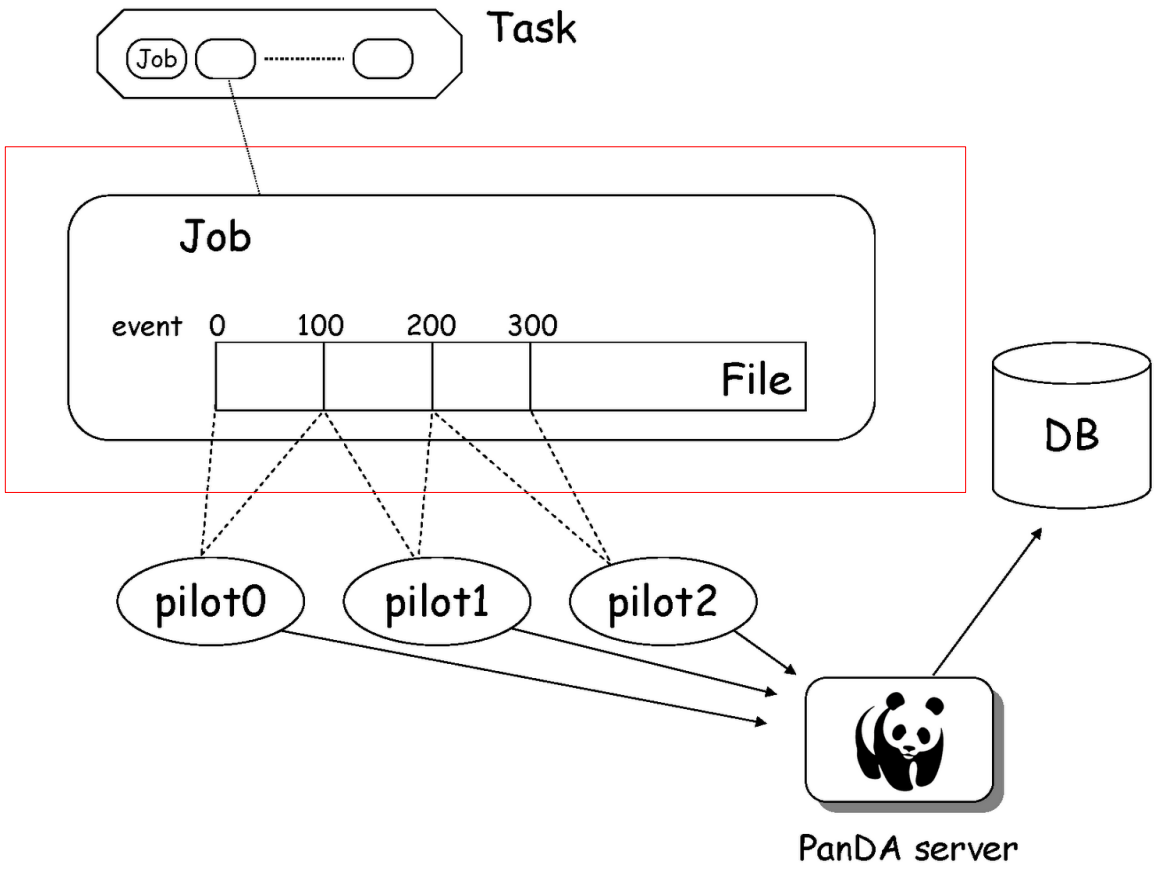
PanDA (ATLAS Job Management System)

Build job & Run job



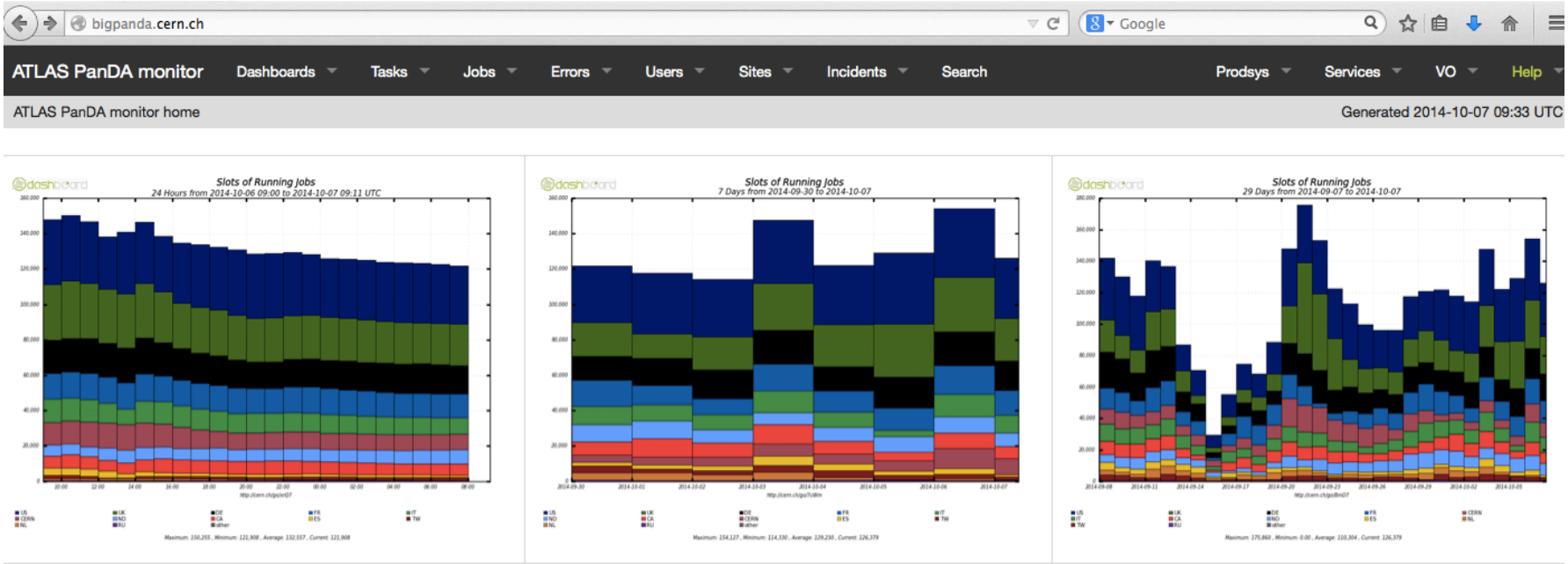
Event level processing

- Task (calculation) can be split by evenl level handler
  - Event Level Handler can generate basic pilot jobs according to events in given file(s)



Monitoring PanDA jobs (1/5)

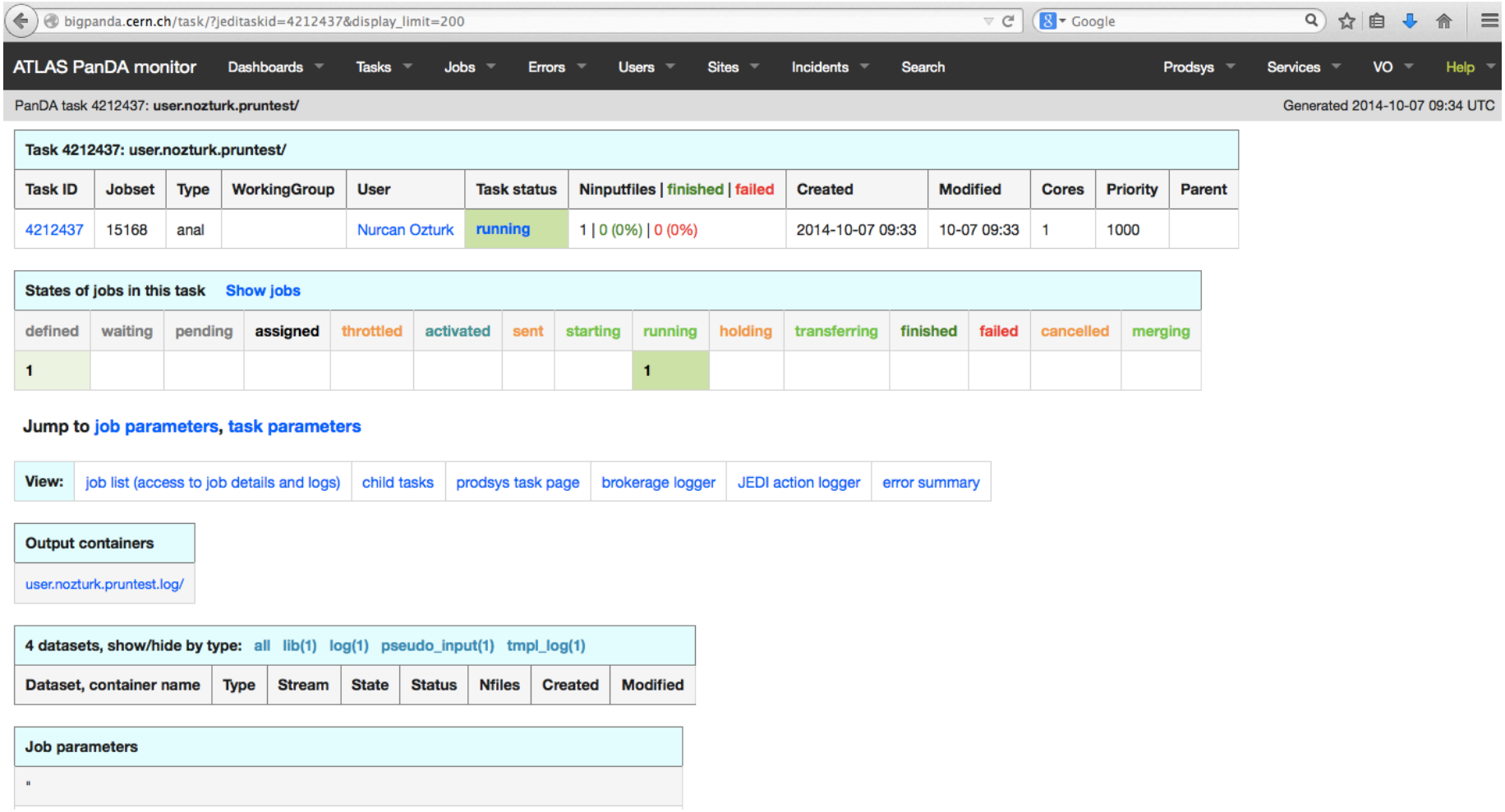
Go to: http://bigpanda.cern.ch and enter your jediTaskID



here

Monitoring PanDA jobs (2/5)

Task is running



bigpanda.cern.ch/task/?jeditaskid=4212437&display_limit=200

ATLAS PanDA monitor | Dashboards | Tasks | Jobs | Errors | Users | Sites | Incidents | Search | Prodsys | Services | VO | Help

PanDA task 4212437: **user.nozturk.pruntest/** — Generated 2014-10-07 09:34 UTC

Task 4212437: user.nozturk.pruntest/

Task ID	Jobset	Type	WorkingGroup	User	Task status	Ninputfiles | finished | failed	Created	Modified	Cores	Priority	Parent
4212437	15168	anal		Nurcan Ozturk	running	1 | 0 (0%) | 0 (0%)	2014-10-07 09:33	10-07 09:33	1	1000	

States of jobs in this task Show jobs

defined	waiting	pending	assigned	throttled	activated	sent	starting	running	holding	transferring	finished	failed	cancelled	merging
1								1						

Jump to job parameters, task parameters

View: job list (access to job details and logs) | child tasks | prodsys task page | brokerage logger | JEDI action logger | error summary

Output containers

user.nozturk.pruntest.log/

4 datasets, show/hide by type: all lib(1) log(1) pseudo_input(1) tmpl_log(1)

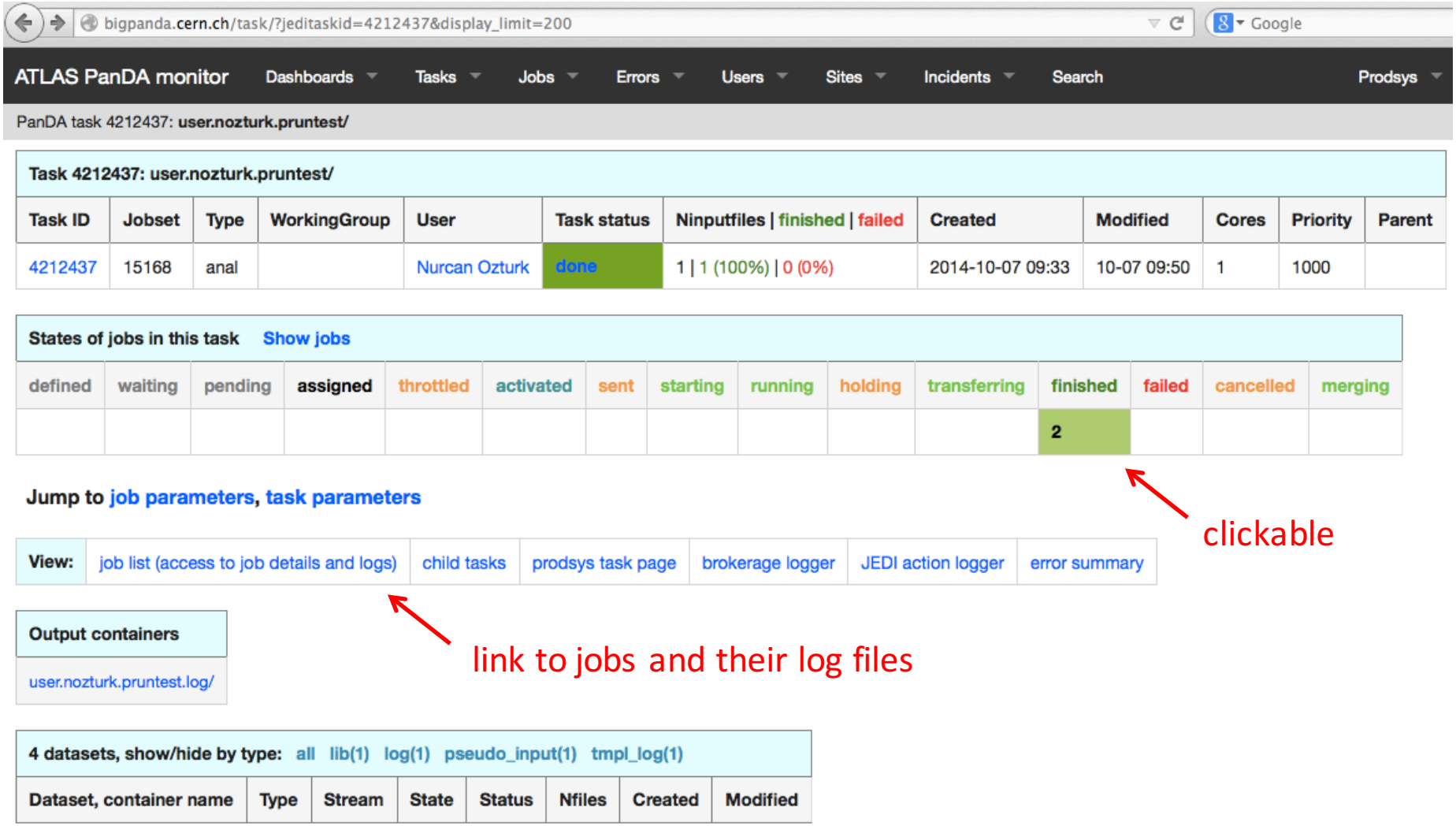
Dataset, container name	Type	Stream	State	Status	Nfiles	Created	Modified

Job parameters

"

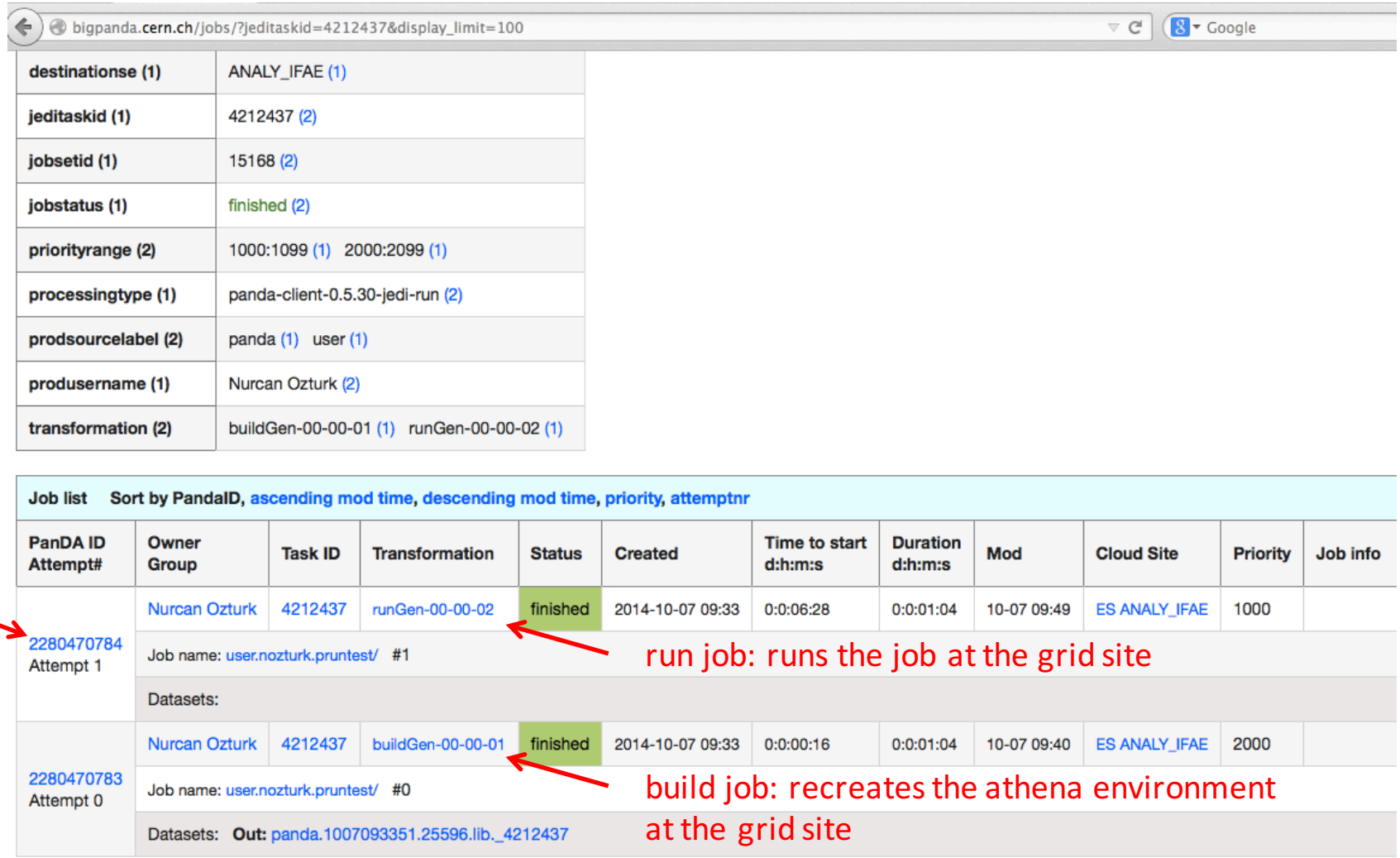
Monitoring PanDA jobs (3/5)

Task is done



Monitoring PanDA jobs (4/5)

Task details, list of jobs. Click on “PanDA ID” to go to the job details, job log files



bigpanda.cern.ch/jobs/?jeditaskid=4212437&display_limit=100

destinationse (1)	ANALY_IFAE (1)
jeditaskid (1)	4212437 (2)
jobsetid (1)	15168 (2)
jobstatus (1)	finished (2)
priorityrange (2)	1000:1099 (1) 2000:2099 (1)
processingtype (1)	panda-client-0.5.30-jedi-run (2)
prodsourcelabel (2)	panda (1) user (1)
produsername (1)	Nurcan Ozturk (2)
transformation (2)	buildGen-00-00-01 (1) runGen-00-00-02 (1)

Job list Sort by PandaID, ascending mod time, descending mod time, priority, attemptnr

PanDA ID Attempt#	Owner Group	Task ID	Transformation	Status	Created	Time to start d:h:m:s	Duration d:h:m:s	Mod	Cloud Site	Priority	Job info
2280470784 Attempt 1	Nurcan Ozturk	4212437	runGen-00-00-02	finished	2014-10-07 09:33	0:0:06:28	0:0:01:04	10-07 09:49	ES ANALY_IFAE	1000	
	Job name: user.nozturk.pruntest/ #1										
	Datasets:										
2280470783 Attempt 0	Nurcan Ozturk	4212437	buildGen-00-00-01	finished	2014-10-07 09:33	0:0:00:16	0:0:01:04	10-07 09:40	ES ANALY_IFAE	2000	
	Job name: user.nozturk.pruntest/ #0										
	Datasets: **Out:** panda.1007093351.25596.lib._4212437										

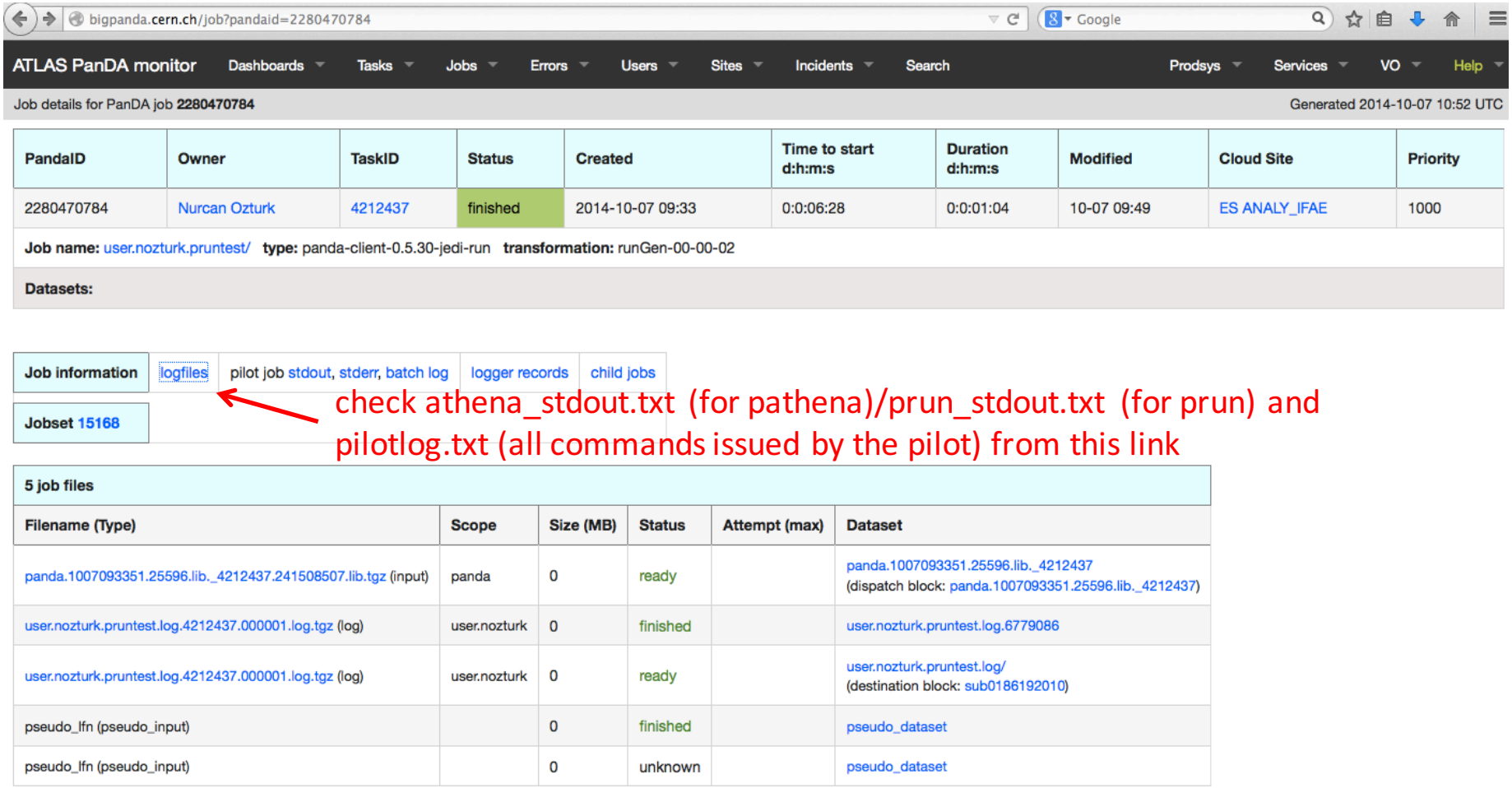
click

run job: runs the job at the grid site

build job: recreates the athena environment at the grid site

Monitoring PanDA jobs (5/5)

How to find job log files



bigpanda.cern.ch/job?pandaid=2280470784

ATLAS PanDA monitor | Dashboards | Tasks | Jobs | Errors | Users | Sites | Incidents | Search | Prodsys | Services | VO | Help

Job details for PanDA job **2280470784** — Generated 2014-10-07 10:52 UTC

PandaID	Owner	TaskID	Status	Created	Time to start d:h:m:s	Duration d:h:m:s	Modified	Cloud Site	Priority
2280470784	Nurcan Ozturk	4212437	finished	2014-10-07 09:33	0:0:06:28	0:0:01:04	10-07 09:49	ES ANALY_IFAE	1000

Job name: user.nozturk.pruntest/ **type:** panda-client-0.5.30-jedi-run **transformation:** runGen-00-00-02

Datasets:

Job information | logfiles | pilot job stdout, stderr, batch log | logger records | child jobs

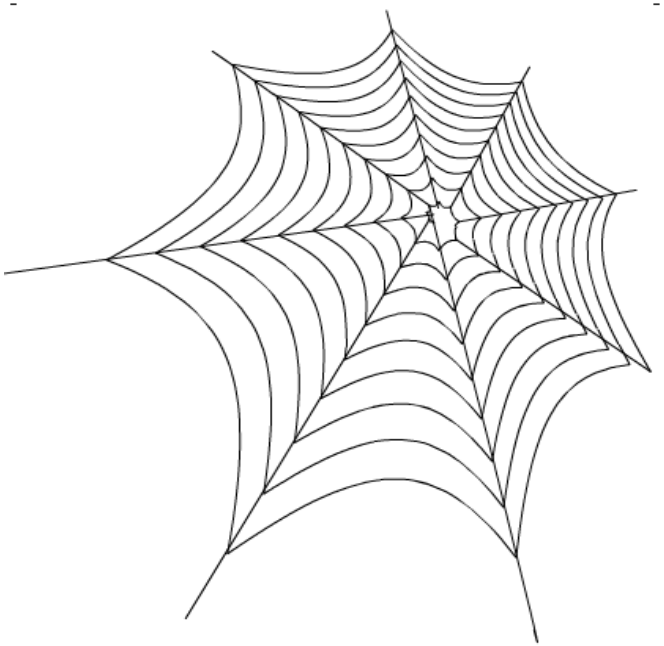
Jobset 15168

check athena_stdout.txt (for pathena)/prun_stdout.txt (for prun) and pilotlog.txt (all commands issued by the pilot) from this link

5 job files

Filename (Type)	Scope	Size (MB)	Status	Attempt (max)	Dataset
panda.1007093351.25596.lib._4212437.241508507.lib.tgz (input)	panda	0	ready		panda.1007093351.25596.lib._4212437 (dispatch block: panda.1007093351.25596.lib._4212437)
user.nozturk.pruntest.log.4212437.000001.log.tgz (log)	user.nozturk	0	finished		user.nozturk.pruntest.log.6779086
user.nozturk.pruntest.log.4212437.000001.log.tgz (log)	user.nozturk	0	ready		user.nozturk.pruntest.log/ (destination block: sub0186192010)
pseudo_lfn (pseudo_input)		0	finished		pseudo_dataset
pseudo_lfn (pseudo_input)		0	unknown		pseudo_dataset

ATLAS Metadata Interface (AMI)

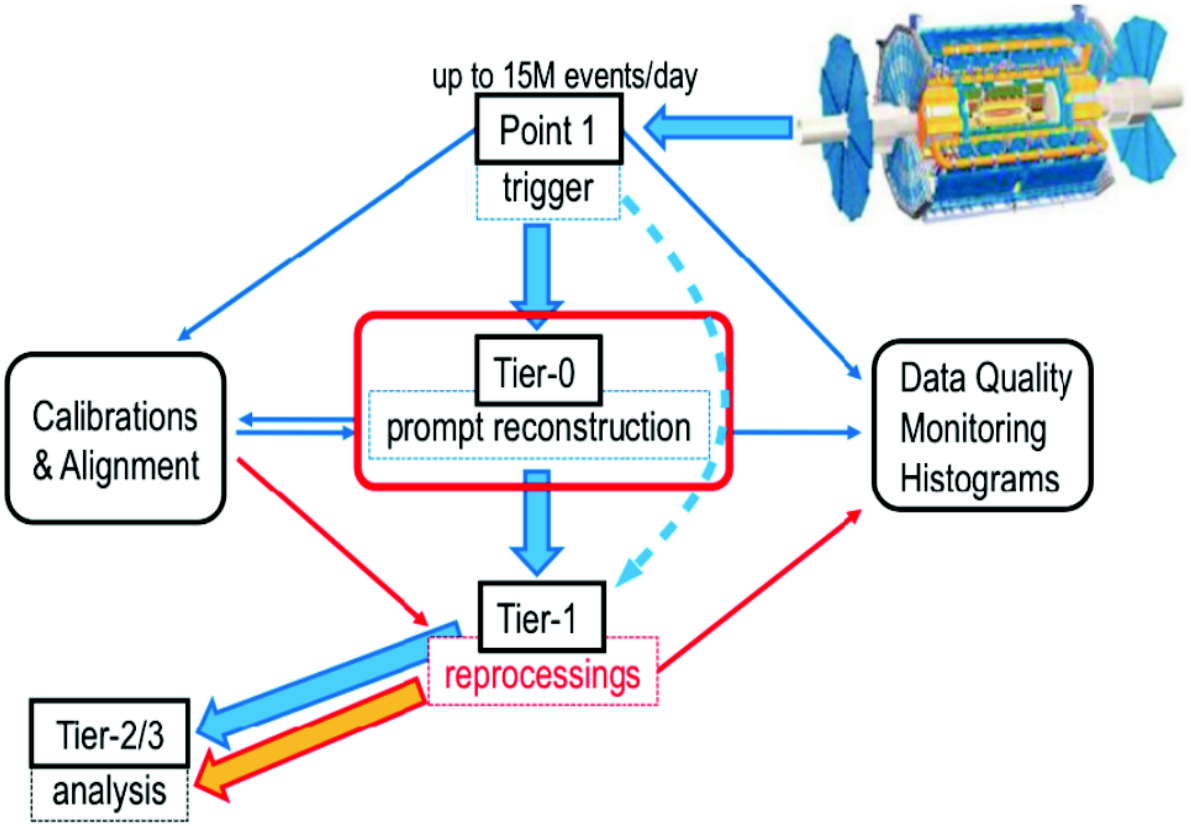


AMI (ATLAS Metadata Interface)

- Metadata = Data of Data (Description of data)
- Key of ATLAS Data Life Cycle Management
- On each step of data reconstruction in ATLAS, AMI Tags are generated
  - ATLAS data set, metadata link
    - Size and origin of dataset
    - File, number of events
    - Software parameter (AMI Tags)
    - MC parameter (PDF, generator, cross section, etc)
    - Lost files and Lumi blocks
    - Link to other applications (COMA, Rucio)
    - Data period
      - Luminosity, Trigger, Data of RAW data creation etc
  - Special Interface
    - AMI-Tags
      - Software Configuration Parameters
    - AMI-Glance
      - Data + Publication
    - Definition of data periods
    - Definition of physics containers
    - Reprocessing campaigns
    - Event count comparator

ATLAS Dataset - 2

- Tier-0
  - RAW is produced
  - Prompt data reconstruction
- ProdSys2
  - MC + Reprocessing
  - PanDA, JEDI, DEFT
- Distribution of dataset
  - Rucio



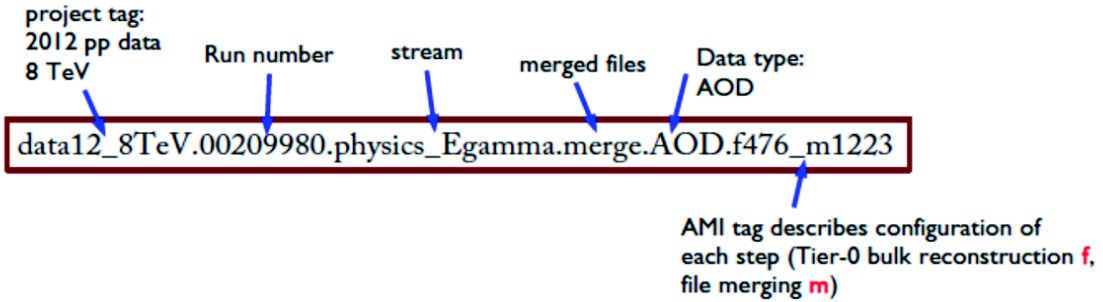
ATLAS Dataset - 3

- Data reconstruction → Example ： x353 = AMI tag
  - Reco_tf.py —AMI=x353 --inputBSFile=tier0_RawData.data
- Reprocessing Campaign
  - After improvement of ATLAS software or framework, often huge reconstruction jobs can run
    - The campaign require many computing resources
    - As a result, many different versions of AOD (Analysis Object Data)
      - Derivation framework: AOD → Derived AOD
      - About 1% size of ogirinal AOD
      - Selection of particular event, parameter etc
      - Different configurations, software and conditions

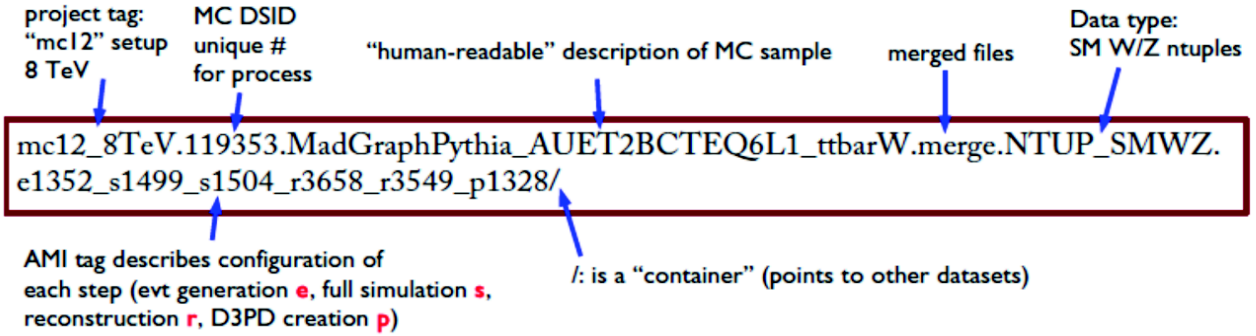
ATLAS Dataset - 4

- Dataset = Collection of files
  - Collision data (data) and Monte Carlo (mc)

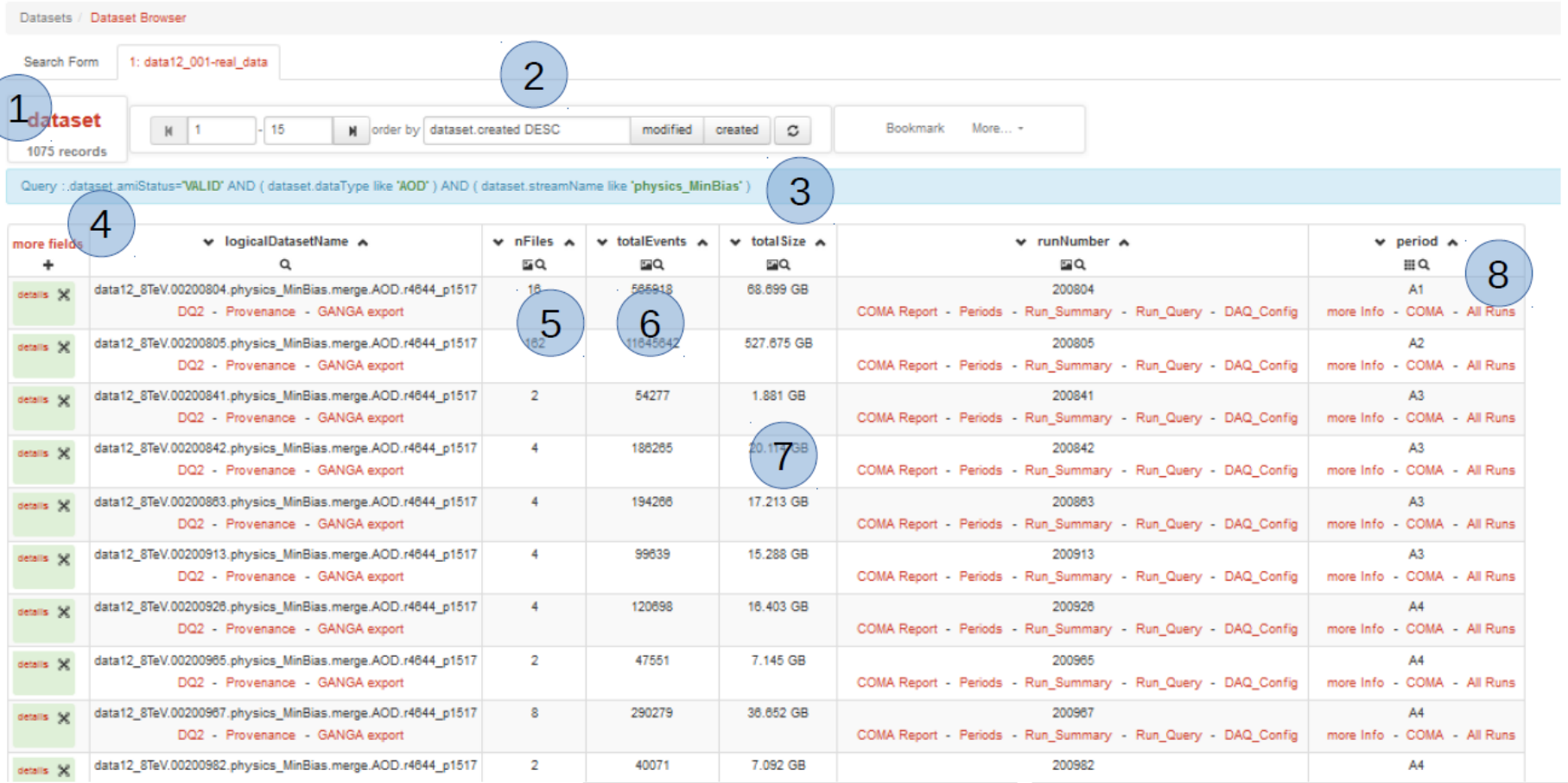
Data:



Simulation:



AMI WebUI - 1

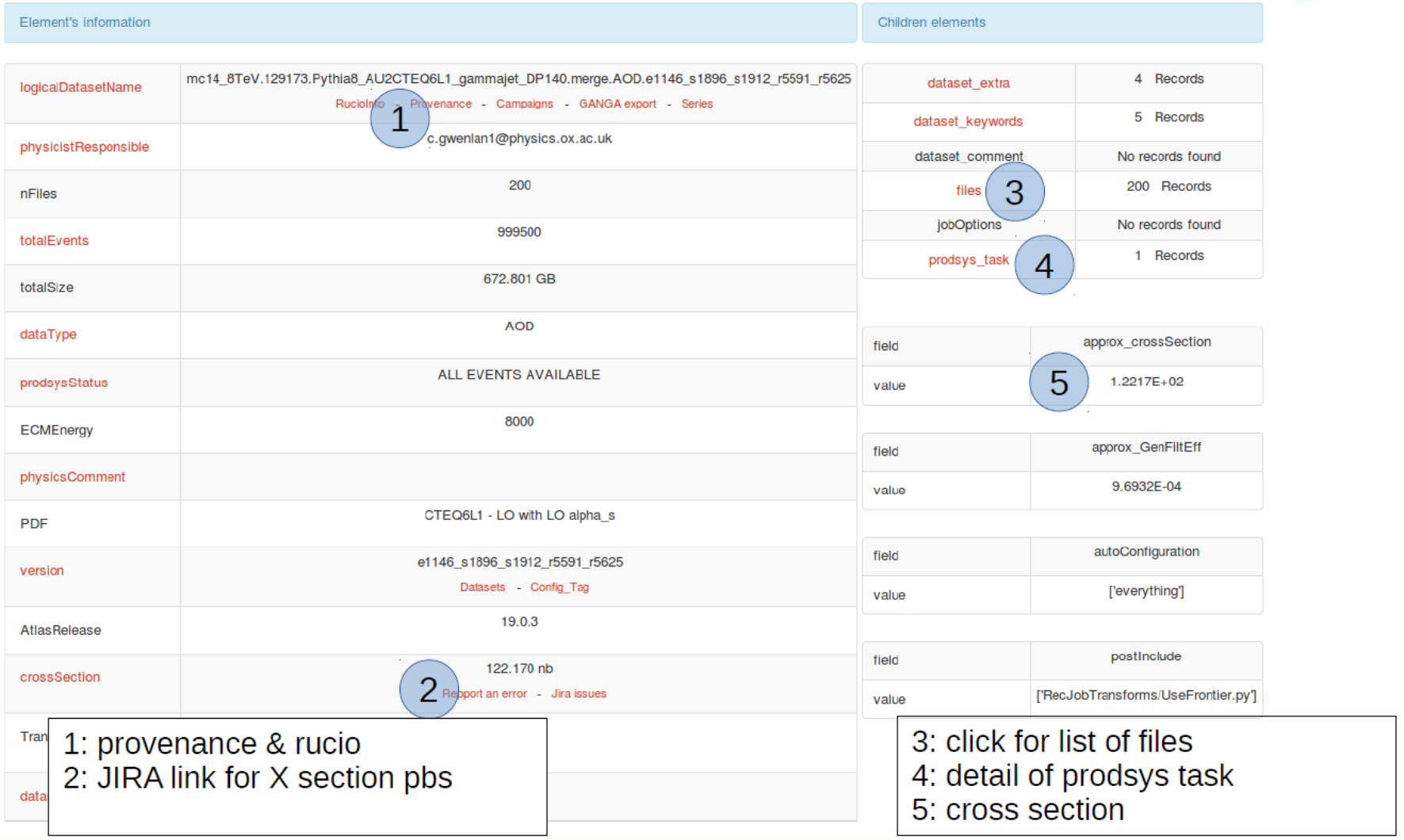


1: number of results
2: default order, more recent first

3: query clauses
4: +/- fields
5,6: filter,calculator

7: conversion of units
8: group by, order by tools

AMI WebUI - 2


Element's information
Children elements
logicalDatasetName
mc14_8TeV.129173.Pythia8_AU2CTEQ6L1_gammajet_DP140.merge.AOD.e1146_s1896_s1912_r5591_r5625
RucioInfo - Provenance - Campaigns - GANGA export - Series
1
physicistResponsible
c.gwenlan1@physics.ox.ac.uk
nFiles
200
totalEvents
999500
totalSize
672.801 GB
dataType
AOD
prodsysStatus
ALL EVENTS AVAILABLE
ECMEnergy
8000
physicsComment
PDF
CTEQ6L1 - LO with LO alpha_s
version
e1146_s1896_s1912_r5591_r5625
Datasets - Config_Tag
AtlasRelease
19.0.3
crossSection
122.170 nb
2
Report an error - Jira issues
dataset_extra
4 Records
dataset_keywords
5 Records
dataset_comment
No records found
files
3
200 Records
jobOptions
No records found
prodsys_task
4
1 Records
field
approx_crossSection
value
5
1.2217E+02
field
approx_GenFiltEff
value
9.6932E-04
field
autoConfiguration
value
['everything']
field
postInclude
value
['RecJobTransforms/UseFrontier.py']
1: provenance & rucio
2: JIRA link for X section pbs
3: click for list of files
4: detail of prodsys task
5: cross section

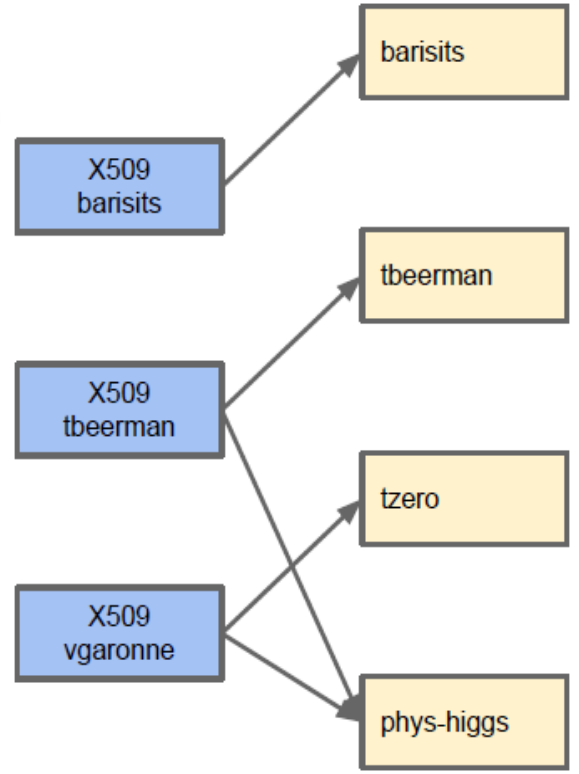
Rucio (ATLAS data management system)

Rucio basic concepts - 1

- Data Management System for Run-2 in ATLAS distributed computing system
  - Used to download outputs of Grid jobs, moving data and searching for them
- Rucio CLI tools from CVMFS
  - Web interface provides similar functionality

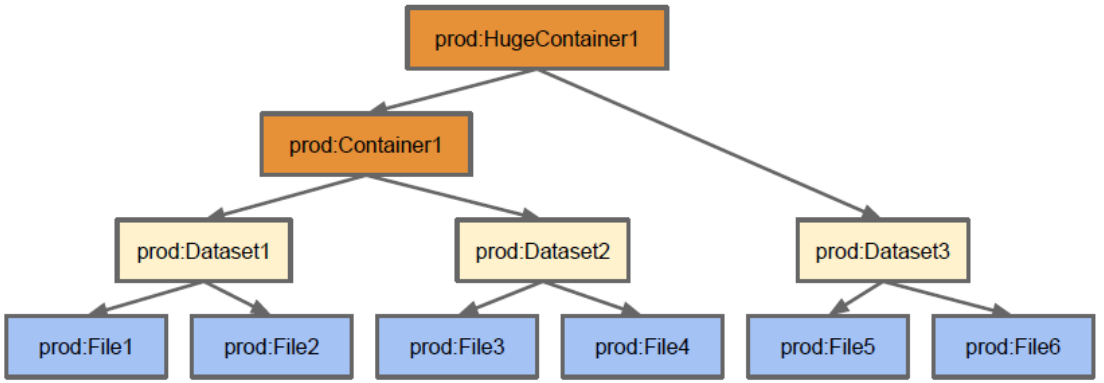
Rucio basic concepts - 2

- Accounts
  - A Rucio Account can represent users, groups (phys-susy) or activities (panda, tzero)
  - Quota and permissions are associated to an account
  - One can connect to a Rucio account using X509 certificates/proxies, Kerberos
  - One credential can be used to map to different accounts.



Rucio basic concepts - 3

- Rucio namespace
  - 3 types of Data Identifiers (DIDs): File, Datasets, Containers.
    - Dataset: Collection of Files
    - Containers: Collection of Datasets or Containers
  - The namespace is divided using scopes. A name is unique within a scope but can be used in other scopes. A DID is identified by a scope and a name



Rucio basic concepts - 4

- Rucio Storage Elements (RSEs)
  - Name for a storage endpoint in Rucio, e.g.: GOEGRID_LOCALGROUPDISK or CERN-PROD_DATADISK
  - Can be grouped using tags (e.g. tier=2, cloud=DE)
- Replication Rules
  - Define how to replicate Data Identifiers to Rucio Storage Elements
  - E.g.: Make one replica of dataset user.gen:my.dataset on DESY-HH_LOCALGROUPDISK
  - Using RSE expression: 2 replicas at cloud=DE&type=LOCALGROUPDISK (any German LOCALGROUPDISK)
  - Will create the minimum number of replicas to optimise storage space and minimise transfers

RSE expressions

- Rules can be created either with an exact RSE name or by using tags that are defined on an RSE, this is then called an RSE expression
  - Examples:
    - RSEs in German cloud: cloud=DE
    - LOCALGROUPDISKs in UK: country=UK&type=LOCALGROUPDISK
    - Any T2 in Italy but not INFN-NAPOLI: cloud=FR&tier=2\INFN-NAPOLI
  - More about this can be found in the Rucio documentation:
    - http://rucio.cern.ch/replication_rules_examples.html
- When using RSE expressions you can define a replication factor, so you can create multiple replicas for one datasets with on rule
- Also you can define the grouping of the data:
  - ALL: Rucio selects an RSE and all files will be copied to this RSE
  - DATASET: If there are multiple datasets Rucio will pick an RSE for each one and will copy all files in the same dataset to the same RSE
  - NONE: Rucio will pick a new RSE for every file, so that they spread over all available RSEs

Links and references

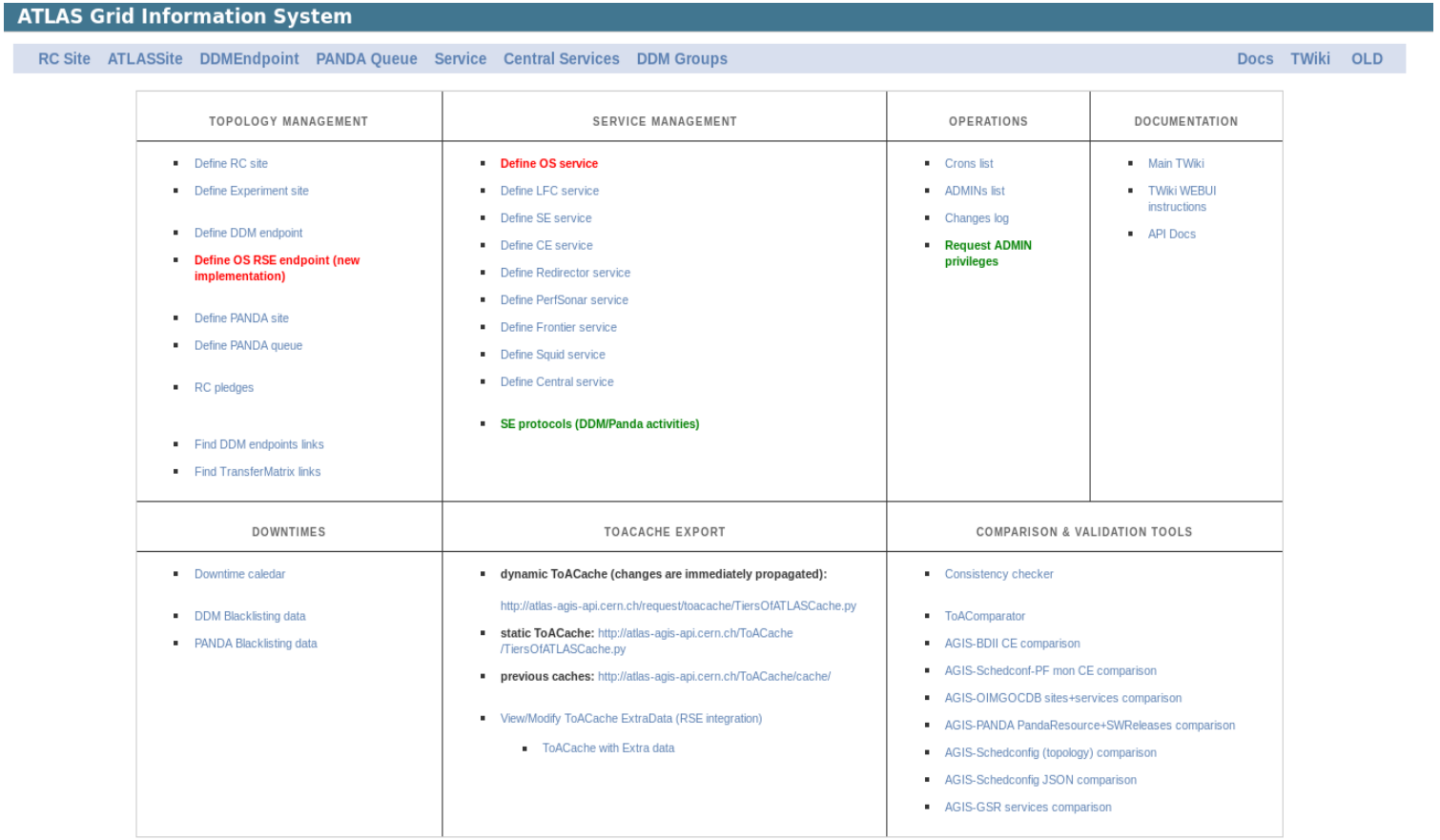
- RucioUI
  - https://rucio-ui.cern.ch/
- Rucio Documentation
  - http://rucio.cern.ch/index.html
- Software twiki tutorial
  - https://twiki.cern.ch/twiki/bin/viewauth/AtlasComputing/SoftwareTutorialGettingDatasets
- Athena Docker setup
  - https://twiki.cern.ch/twiki/bin/viewauth/AtlasComputing/AthenaMacDockerSetup
- Docker container for CVMFS
  - https://github.com/sbinet/docker-containers/tree/master/cvmfs-atlas
- Binet, Sébastien, and Ben Couturier. "*docker & HEP: Containerization of applications for development, distribution and preservation.*" Journal of Physics: Conference Series. Vol. 664. No. 2. IOP Publishing, 2015.
  - http://iopscience.iop.org/article/10.1088/1742-6596/664/2/022007/meta
- ATLAS-D meeting 2015 Rucio Tutorial, Thomas Beermann
- Monitoring Your Grid Jobs, Andrew Washbrook University of Edinburgh, ATLAS Software & Computing Tutorials 14th January 2015 PUC, Chile
- Athena Mac Docker
  - https://twiki.cern.ch/twiki/bin/viewauth/AtlasComputing/AthenaMacDockerSetup
- Software tutorial using Grid
  - https://twiki.cern.ch/twiki/bin/viewauth/AtlasComputing/SoftwareTutorialUsingTheGrid

Enjoy your hands-on exercise!

Backup

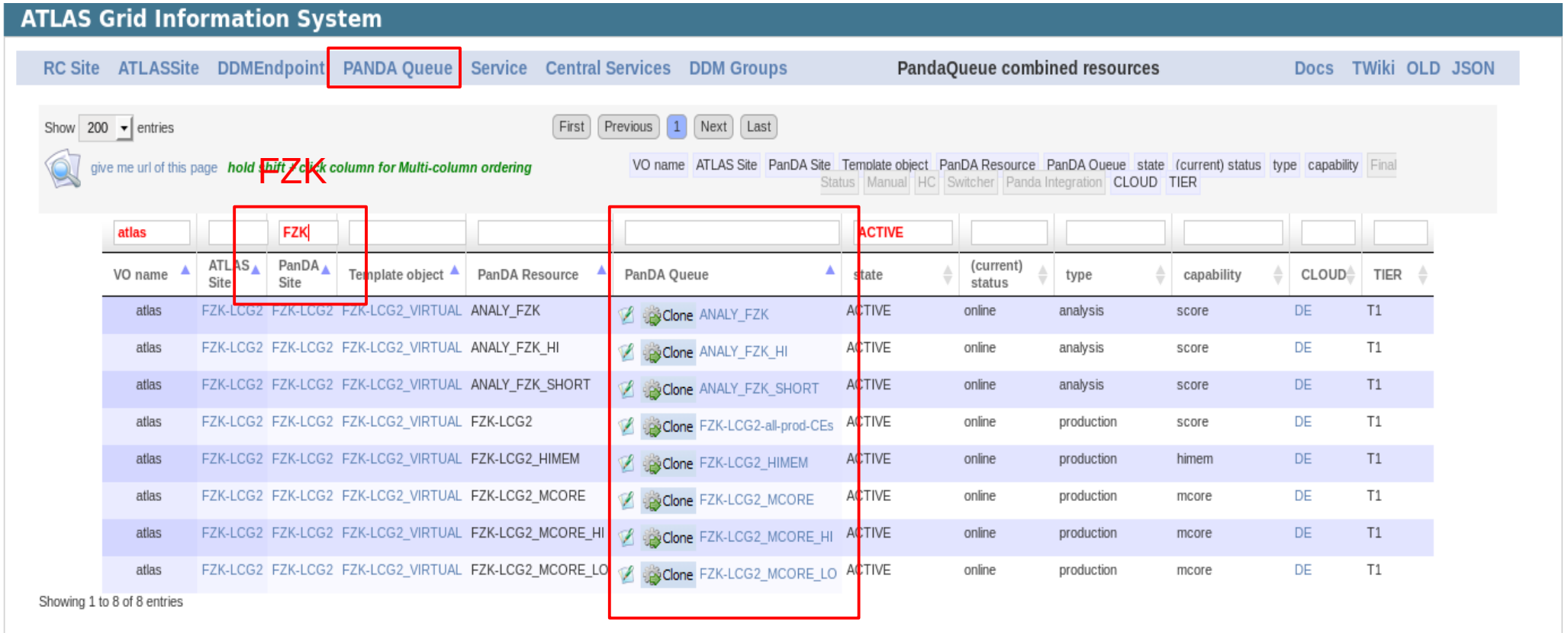
ATLAS Resources - 1

- AGIS (ATLAS Grid Information Sysgtem)
  - http://atlas-agis.cern.ch/agis/



ATLAS Resources - 2

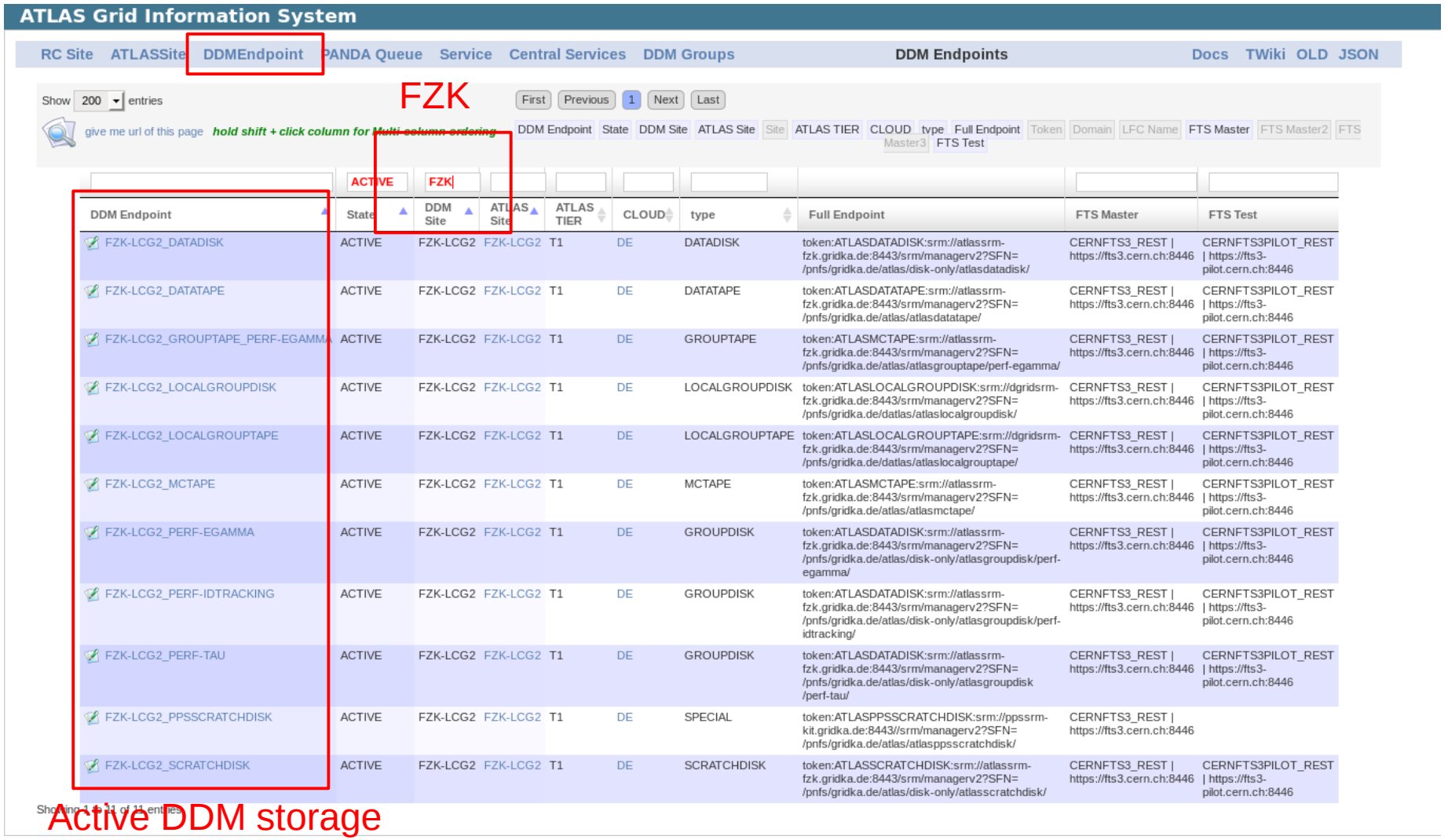
- PanDA queue end points



Active PanDA (job) queues
ANALY_ …. = Analysis queue

ATLAS Resources - 3

- DDM end points



ATLAS Resources - 4

- SCRATCHDISK (Tier1 + Tier2s in Germany)
  - FZK-LCG2_SCRATCHDISK
  - DESY-HH_SCRATCHDISK
  - DESY-ZN_SCRATCHDISK
  - LRZ-LMU_SCRATCHDISK
  - WUPPERTALPROD_SCRATCHDISK
  - UNI-FREIBURG_SCRATCHDISK
  - GOEGRID_SCRATCHDISK
- LOCALGROUPDISK (e.g. DESY-HH and UniGoettingen)
  - DESY-HH_LOCALGROUPDISK
  - GOEGRID_LOCALGROUPDISK
  - …... _LOCALGROUPDISK

ATLAS Resources - 4

- SCRATCHDISK (Tier1 + Tier2s in Germany)
  - FZK-LCG2_SCRATCHDISK
  - DESY-HH_SCRATCHDISK
  - DESY-ZN_SCRATCHDISK
  - LRZ-LMU_SCRATCHDISK
  - WUPPERTALPROD_SCRATCHDISK
  - UNI-FREIBURG_SCRATCHDISK
  - GOEGRID_SCRATCHDISK

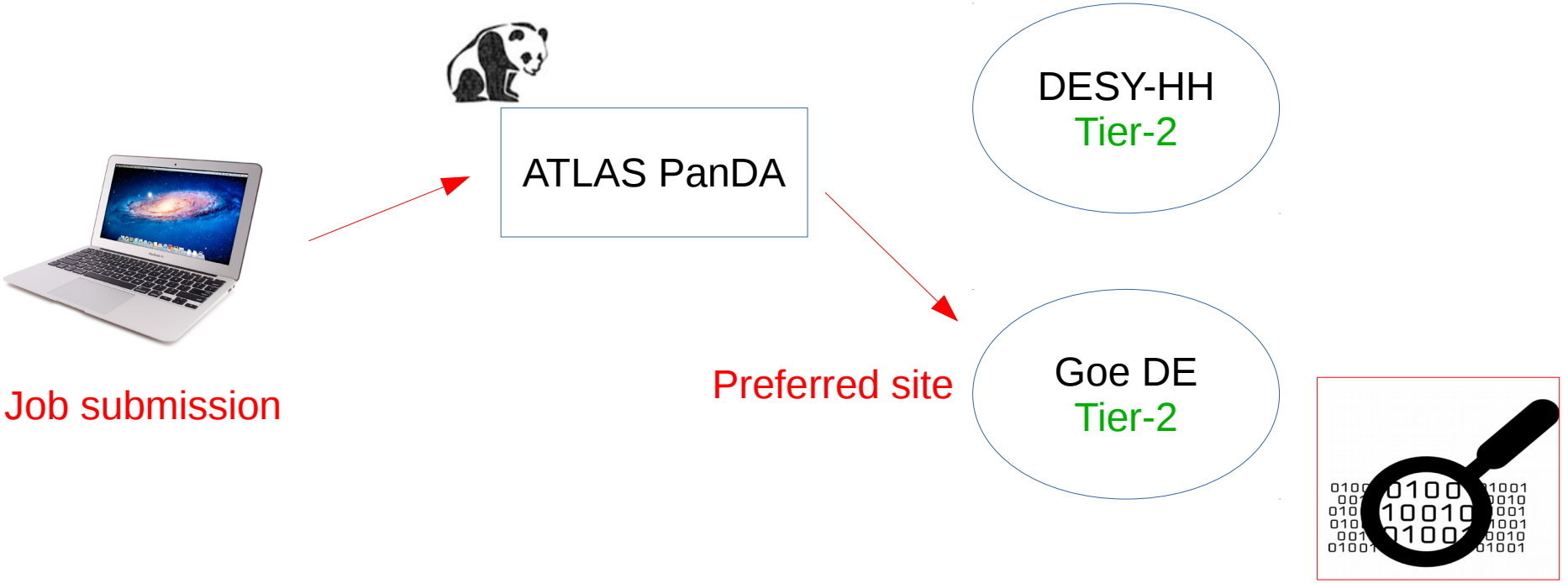
→ Storages for temporary data of PanDA jobs. Would be automatically *REMOVED*!

- LOCALGROUPDISK (e.g. DESY-HH and UniGoettingen)
  - DESY-HH_LOCALGROUPDISK
  - GOEGRID_LOCALGROUPDISK
  - …... _LOCALGROUPDISK

→ Permanently *KEPT*. Generally speaking, in total a few hundred TB in each site

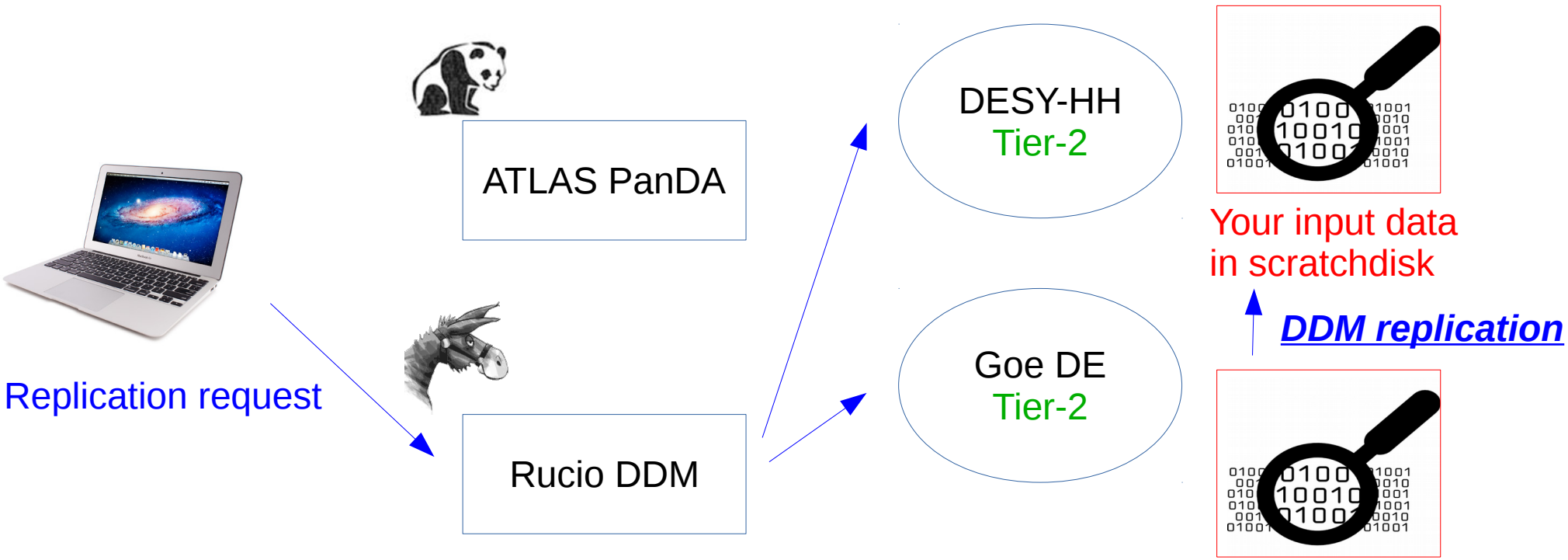
Job allocation (a tip) - 1

- A tip: User job allocation policy among sites
  - Rule: Grid jobs (should) go to their data locations



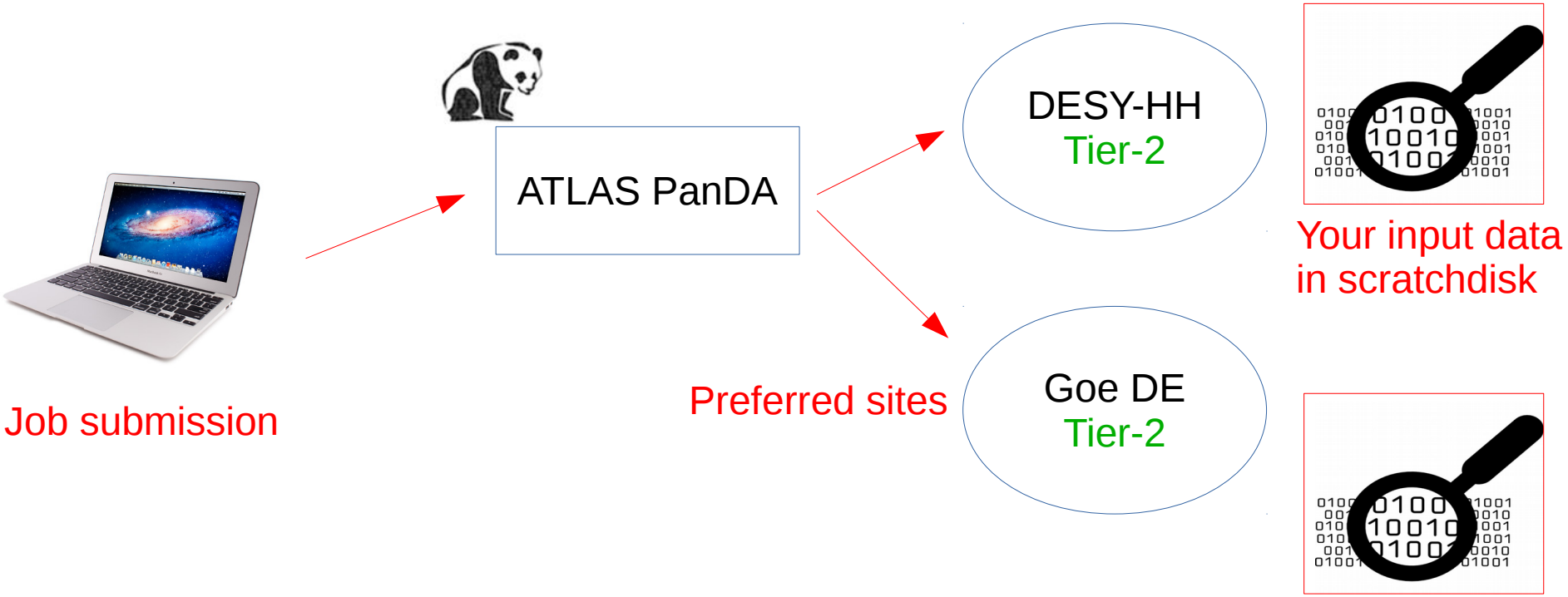
Job allocation (a tip) - 2

- A tip: User job allocation policy among sites
  - Rule: Grid jobs (should) go to their data locations



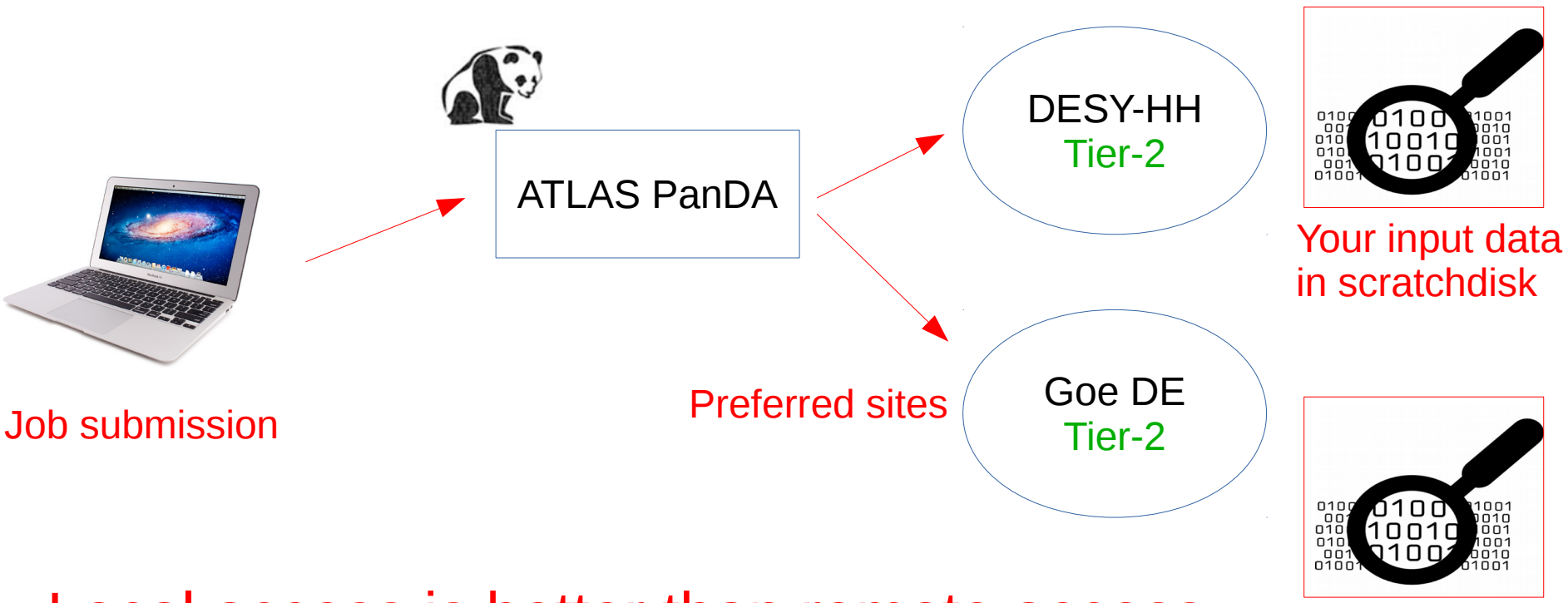
Job allocation (a tip) - 3

- A tip: User job allocation policy among sites
  - Rule: Grid jobs (should) go to their data locations



Job allocation (a tip) - 4

- A tip: User job allocation policy among sites
  - Rule: Grid jobs (should) go to their data locations



Local access is better than remote access
(or to avoid an error in PanDA, “local data does not exist”)