



# Overview of Rucio

## ATLAS Software Tutorial

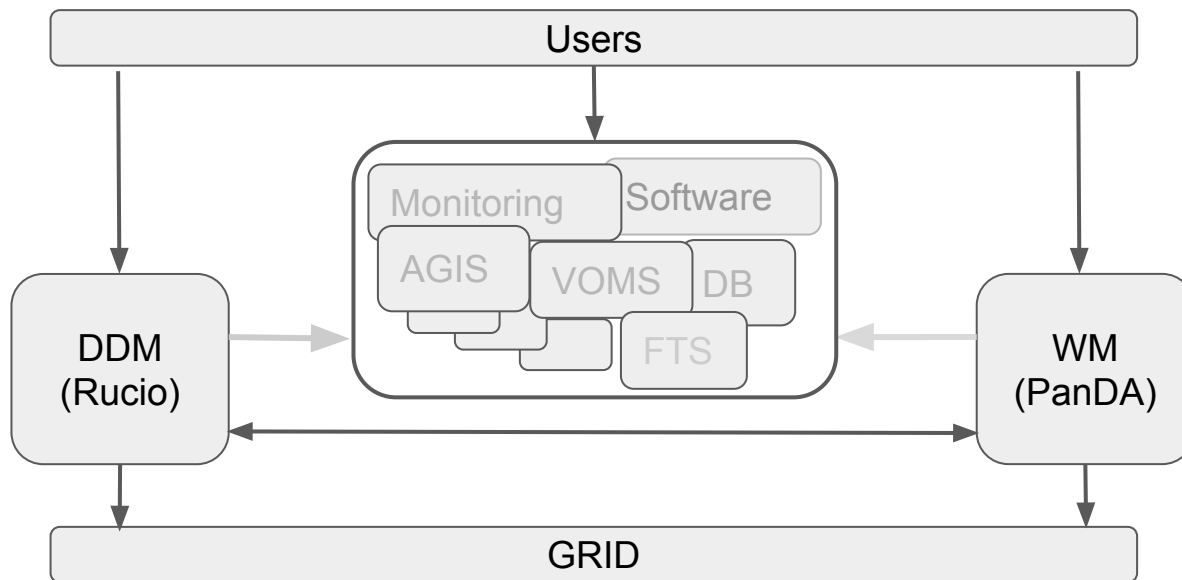
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Rucio team  
10. October 2019



# Rucio

- Rucio is the ATLAS Distributed Data Management system (DDM)
- It catalogs all ATLAS data and manages their replication and lifecycle





# Rucio main functionalities

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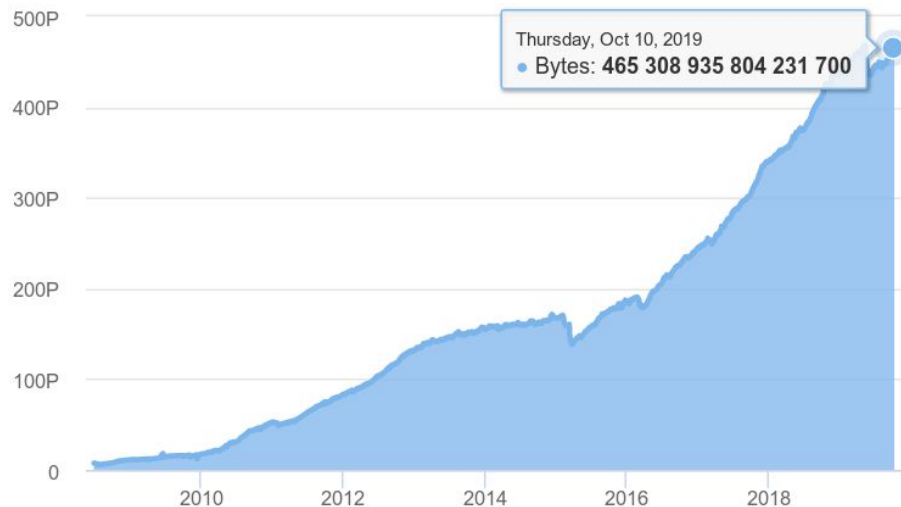
- Provides many features (can be enabled selectively)
  - File and dataset catalog (logical definition and replicas)
  - Transfers between sites and staging capabilities
  - Web Interface and Command Line Interface to discover/download/upload/transfer data
  - Extensive monitoring
  - Powerful policy engines (rules and subscriptions)
  - Bad file identification and recovery
  - Dataset popularity based replication
  - ...
- Rucio can be integrated with Workload and Workflow Management System
  - Already supporting PanDA (ATLAS WFMS)
  - Possibilities of integration with other like Dirac

More advanced features  
↓



# The ATLAS Data in Numbers

Stored volume	460+ PetaByte
Stored files	~1 Billion
Grid sites	130
Transfers/day	~2 Million files (2 PetaByte)



# Rucio Concepts



# Rucio Account

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- **For normal users the Rucio account is the same as the CERN login name**
- An account can represent:
  - single users (e.g. barisits)
  - groups (higgs)
  - activities (prod).
- Connection to a Rucio account possible via:
  - x509 certificate/proxy
  - Kerberos
  - Username/Password
- One credential can be used to map to different accounts
- Quota and permissions are tunable and applied per account



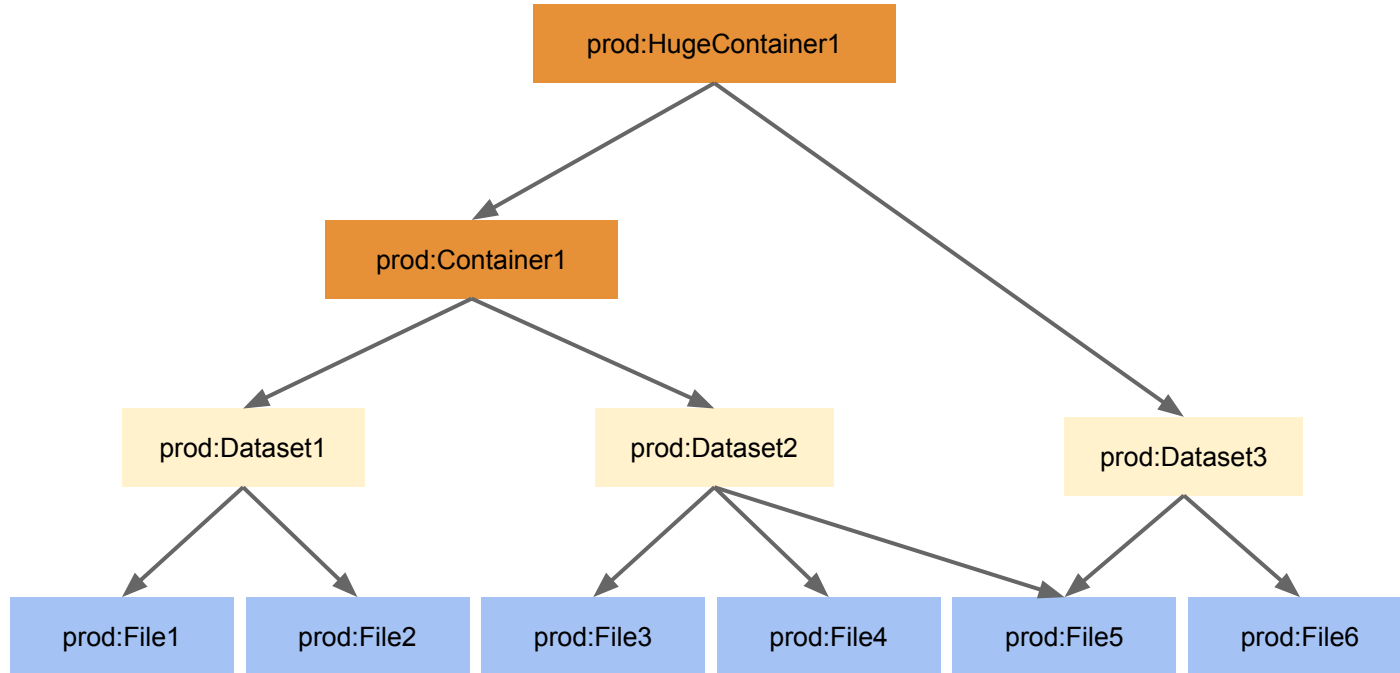
# Data Identifier

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- Rucio uses Data Identifiers (DID) to address data
- A DID is a string composed of a scope and a name
  - Name and scope are divided by a colon
  - The name is only unique within its scope
  - E.g.: `user.serfon:mytest.root`
- Three **logical** units can be addressed by a DID
  - Files
  - Datasets
  - Containers
- **The DID is globally unique (over all three units)**



# Hierarchical Data Structuring



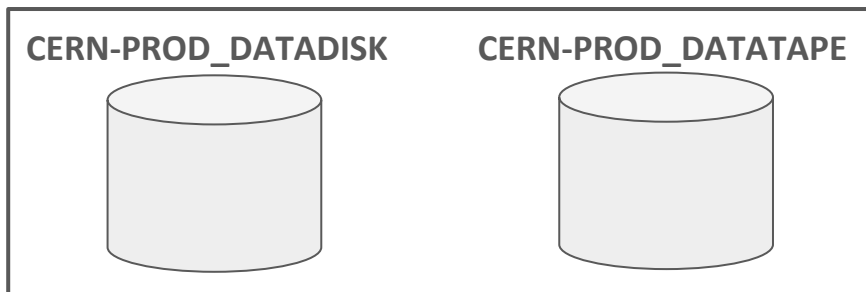




# Rucio Storage Elements

- Rucio defines Rucio Storage Elements (RSE) to maintain storage
- An RSE is an abstraction layer for a storage end-point
- RSEs are described by various attributes
  - site=CERN-PROD
  - type=DATADISK
  - cloud=CERN

## CERN-PROD



User Activities	Read	Write
DATADISK	✓	✗
LOCALGROUPDISK	✓	✓
SCRATCHDISK	✓	✓
TAPE	✗	✗



# Quotas

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- Two different types of RSEs are open to the end-users to store output datasets:
  - **SCRATCHDISK**
    - Default area for job outputs
    - Default lifetime: 14 days
  - **LOCALGROUPDISK**
    - For long term storage of user data
    - No default lifetime
- Every user has a quota on all **SCRATCHDISK** RSEs
- Every user a quota by default on **LOCALGROUPDISK** RSEs in their associated country
- Admins of the country can modify the quota, approve replication requests if quota is exceeded or no quota is set, and delete old data



# Replication

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- Rucio uses replication **rules** to specify how a DID will be distributed
  - E.g., there need to be 2 replicas of dataset x on RSEs with tier=1 and type=DATADISK
- Rucio evaluates the rules and
  - ensures only the minimum number of replicas will be created
  - ensures the number of transfers is minimized



# Subscriptions

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- Automated rules
- Replication policies based on DIDs metadata
- Matched against any DID that will be produced in the future
- E.g., make 2 replicas of datasets with `scope=data15_13TeV` and `datatype=AOD` on `tier=1&type=DATADISK`



# Key Concepts Summary

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- **Rucio account:** quotas, authentication
- **DID:** addresses data
- **RSE:** describes storage
- **rule:** replication of data
- **subscription:** automated creation of replication rules

# Client Tools



# Command Line Interface

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- Python script to interact with Rucio
  - Usage: `rucio <command> [options]`
- Common use cases:
  - Download/Upload data
  - Create replication rules
  - Check quota/space usage
- More details in the hands-on tutorial

```
>> ssh username@lxplus.cern.ch
>> setupATLAS
>> lsetup rucio
>> voms-proxy-init -voms atlas
>> rucio -h
```



# Web Interface

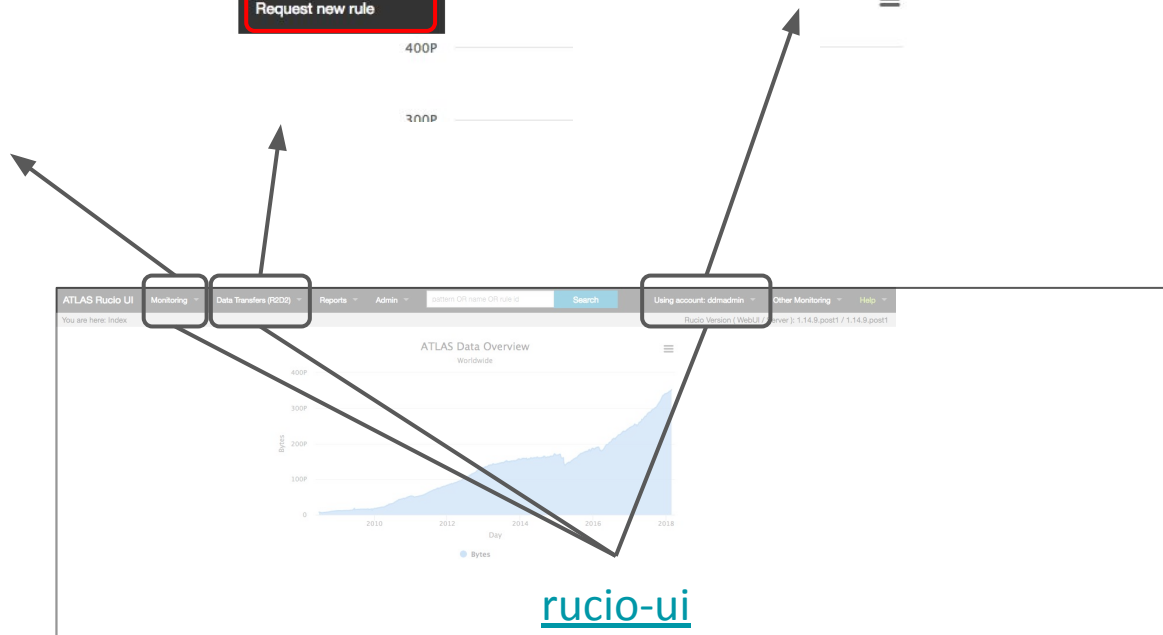
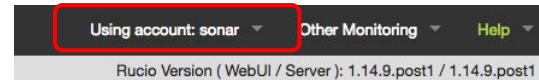
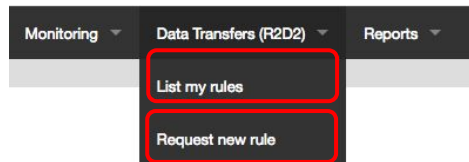
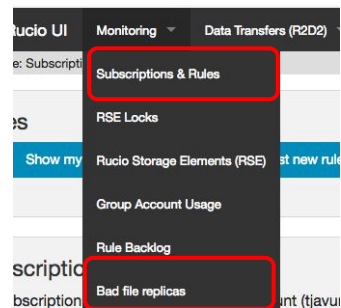
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- <https://rucio-ui.cern.ch>
- Search for DIDs or rules
- Provides various monitoring pages
  - Rules and Subscriptions overview
  - RSE list and usage
  - Group/Account quotas
- R2D2
  - Request new replication rules
  - Monitor replication rules
- Download files (if supported by storage)





# Web Interface





# Exercise: WebUI

## Creating a rule with R2D2

### 1. Select Data Identifiers (DIDs)

DID Pattern Search List of DIDs

Please start by entering a DID or DID wildcard and search for either containers or datasets. Please do not use a trailing '/' for containers.

Data pattern  Container Dataset

Show

entries

Name	
sonar.test.AGLT2_DATADISK	1
sonar.test.ANLASC_DATADISK	0
sonar.test.AUSTRALIA-ATLAS_DATADISK	0
sonar.test.BEIJING-LCQ2_DATADISK	0
sonar.test.BNL-AWSEAST_DATADISK	0
sonar.test.BNL-OSQ2_DATADISK	0
sonar.test.CA-MOGILL-CLUMIQ-T2_DATADISK	0
sonar.test.CA-SCINET-T2_DATADISK	0
sonar.test.CA-VICTORIA-WESTFORD-T2_DATADISK	0
sonar.test.CERN-PROD-RUCIOTEST_DATADISK	0

Name

Previous 1 2 3 4 5 ... 12 Next

Continue Select All

### 1. Select Data Identifiers (DIDs)

### 2. Select Rucio Storage Elements (RSEs)

Please enter an RSE or an RSE expression.

RSE (expression)

Check Quota

Total size of selected DIDs: 10.91 GB

RSE	Remaining Quota	Total Quota
CERN-PROD_SCRATCHDISK	225 TB	225 TB
Name	Remaining Quota	Total Quota

4

Continue

user.jdoe:jdoes.test.dataset

### 1. Select Data Identifiers (DIDs)

### 2. Select Rucio Storage Elements (RSEs)

### 3. Options

Please select/enter your wanted options and then submit your rule request.

Grouping  
☐ All ☒ Dataset ☐ None

Notifications  
☐ Yes ☒ No

Lifetime (in days). Leave empty for infinite lifetime.

1

Copies

1

Comment

Create sample ☐

Asynchronous Mode ☐

Number of files

Continue

5



# Download a file (WebUI)

ATLAS Rucio UI Monitoring Data Transfers (R2D2) Reports  Search Using account: tbeerman Other Monitoring Help

You are here: Search Rucio Version ( WebUI / Server ): 1.18.9 / 1.18.9

Data pattern: mc16\_13TeV:mc16\_13TeV.301040.PowhegPythia8EvtGen\_AZNLOCTEQ6L1\_DY Search Container & Dataset Container Dataset File

Show: 100 Search:

entries

DID

mc16\_13TeV:mc16\_13TeV.301040.PowhegPythia8EvtGen\_AZNLOCTEQ6L1\_DYtautau\_120M180.deriv.NTUP\_PILEUP.e3649\_e5984\_s3126\_r11152\_r10726\_p3604.tid16781247\_00

DID

Showing 1 to 1 of 1 entries Previous 1 Next

Files can be directly downloaded if the storage element supports it













Just search for a DID using the search box on the top of the page

Go to the DID page and scroll down to “File Replica States”

If the file can be downloaded a little icon will be displayed

File Replica States

Show 10 entries Search:

Filename	Replicas
mc16_13TeV:NTUP_PILEUP.16781247_000001.pool.root.1	CERN-PROD_DATADISK  MWT2_DATADISK  NDGF-T1_DATADISK 
mc16_13TeV:NTUP_PILEUP.16781247_000002.pool.root.1	CERN-PROD_DATADISK  MWT2_DATADISK  NDGF-T1_DATADISK 
mc16_13TeV:NTUP_PILEUP.16781247_000003.pool.root.1	CERN-PROD_DATADISK  MWT2_DATADISK  NDGF-T1_DATADISK 
mc16_13TeV:NTUP_PILEUP.16781247_000004.pool.root.1	CERN-PROD_DATADISK  MWT2_DATADISK  NDGF-T1_DATADISK 



# FAQ

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- I requested a transfer on R2D2 and my transfer is not progressing for X days
  - You can use on the Rucio UI (show locks/examine rule can give you some indication) to understand why the transfer are slow (e.g. some files on TAPE)
- I need a dataset that is available on TAPE for my analysis. Where should I copy it?
  - If you copy your dataset on a SCRATCHDISK area, it will be eligible for deletion after 2 weeks. If you want to keep it a big longer, request a copy on a DATADISK endpoint. It'll be approved if it's not too much space <10 TB and with reasonable lifetime <6 months
- What is a STUCK rule?
  - A rule is STUCK if some files cannot be transferred after 3 attempts. Stuck rules are reattempted. If some files continuously fail to be transferred, the rule will go to SUSPENDED after some time



# Getting Help

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- General HOWTO, FAQ:  
<https://twiki.cern.ch/twiki/bin/view/AtlasComputing/RucioClientsHowTo>
- 1st level support provided by DAST:  
[hn-atlas-dist-analysis-help@cern.ch](mailto:hn-atlas-dist-analysis-help@cern.ch)
  - Can solve most of your problems.
  - In the rare case they cannot help you, they escalate to 2nd level support (DDM operation team)
- In case of bugs in the code, in the WebUI (not transfer errors!!) or feature requests, please open an issue:  
<https://github.com/rucio/rucio/issues>
- Rucio is an open source project. If you want to contribute, you are welcome. Just contact [atlas-adc-rucio-dev@cern.ch](mailto:atlas-adc-rucio-dev@cern.ch) (we have qualification tasks).