Tutorial Rucio part 1 (basics)

Software week

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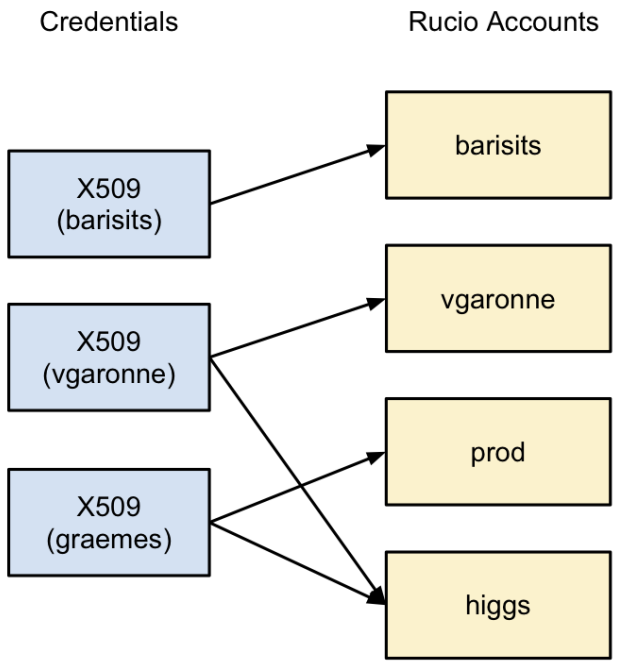
Introduction

- In this tutorial you will learn about :
  - Rucio concepts (account, scope, RSE, rules).
  - How to setup Rucio.
  - How to do some basic operations like listing dids, uploading/downloading files/datasets.
- The second part of the tutorial will talk about more advanced features/Rucio UI.
- Disclaimer : This is the first real Rucio Tutorial. Feedbacks are more than welcome (you can send them on rucio-dev@cern.ch) or use JIRA for feature requests and/or bug reports.

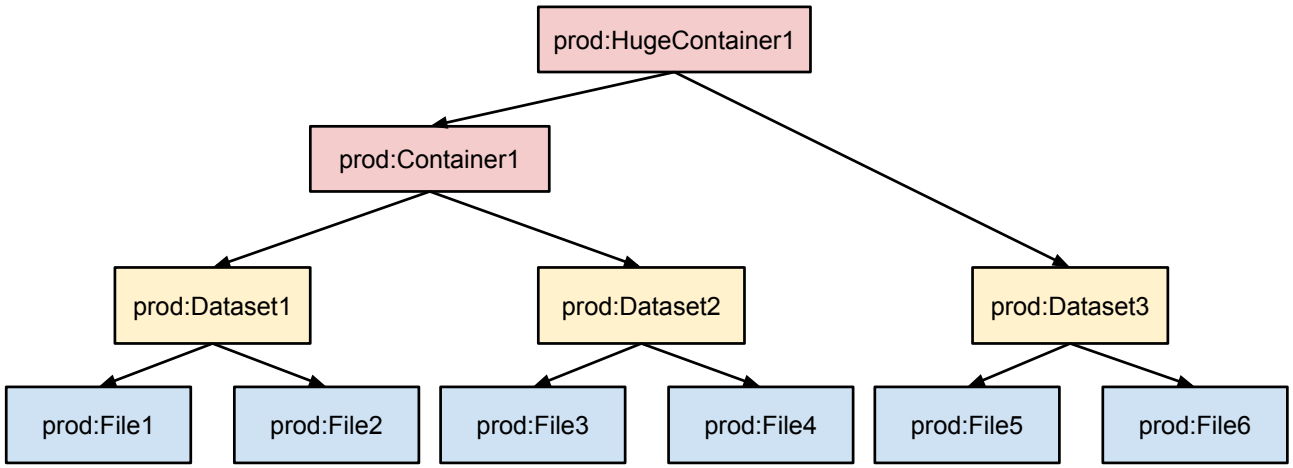
Rucio concepts

- Rucio account :
  - It can represent users (e.g. jdoe), groups (higgs), activities (tier0).
  - Quota, permissions tunable and associated to one account.
  - One can connect to a Rucio account using x509 certificate/proxy, kerberos, userpass.
  - One credential can be used to map to different accounts.



Rucio concepts

- Rucio namespace :
  - 3 types of Data Identifiers (DIDs) : File, Datasets, Containers. Allows multiple hierarchy level for containers (only one level in DQ2).
  - All Data Identifier are identified by a scope and a name. A name is unique within a scope but can be used in other scopes (vs uniqness of the name in the whole DQ2 namespace).



Rucio concepts

- Rucio Storage Elements (RSE) :
  - Abstraction for storage end-point.
  - Can be grouped in various ways with tags (e.g. tier=1, cloud=DE).
- Replication rules :
  - Describe how a Data Identifier must be replicated on a list of Rucio Storage Elements.
  - e.g. : Make 2 replicas of dataset data12_8TeV:mydatasetname on tier=1&disk=1.
  - Rucio will create the minimum number of replicas to optimise storage space, minimise the number of transfers and automate data distribution.
- Subscriptions :
  - Replication policies based on Data Identifiers metadata, for Data Identifiers that will be produced in the future.
  - e.g. : Make 2 replicas of datasets with scope=data12_8TeV and datatype=AOD on tier=1&disk=1.

How to setup the Rucio clients

- The recommended way to setup Rucio is via ATLAS Local Root Base :

```
# export ATLAS_LOCAL_ROOT_BASE=/cvmfs/atlas.cern.ch/repo/ATLASLocalRootBase
# alias setupATLAS='source $ATLAS_LOCAL_ROOT_BASE/user/atlasLocalSetup.sh'
# setupATLAS
# helpMe
...
rucio
  HowTo:
    http://rucio.cern.ch/client_howto.html
  WebUI:
    https://rucio-ui.cern.ch
  Help (eGroup - see forum description in links for usage):
    https://groups.cern.ch/group/hn-atlas-dist-analysis-help/default.aspx
...
# localSetupRucioClients
Info: Set RUCIO_AUTH_TYPE to x509_proxy
Do you want to set the RUCIO_ACCOUNT to serfon (y/n)?y
To avoid this question, you should set the environment variable RUCIO_ACCOUNT
or have a valid grid proxy
Info: Set RUCIO_ACCOUNT to serfon
```

- All ATLAS users having a zp account have a Rucio account (the same name as the zp account) and their DN is mapped to this account.

Let's start

- Setup Rucio via CVMFS and create a VOMS proxy.

```
# voms-proxy-init --voms atlas
```

- After setting up Rucio :

```
# rucio
usage: rucio [-h] [--version] [--verbose] [-H ADDRESS] [--auth_host ADDRESS]
             [-a ACCOUNT] [-S AUTH_STRATEGY] [-T TIMEOUT] [-u USERNAME]
             [-pwd PASSWORD] [--certificate CERTIFICATE]
             [--ca-certificate CA_CERTIFICATE]
...
# rucio ping
0.2.13
```

- What is returned is the version of Rucio installed on the server. You can try some other commands :

```
# rucio whoami
status     : ACTIVE
account    : rucio01
account_type : USER
created_at : 2013-09-13T13:13:20
suspended_at : None
updated_at : 2013-09-13T13:13:20
deleted_at : None
```

- Remark : rucio supports tab completion.

Reminder about some new concepts in Rucio

- Scope is a new concept in Rucio which is used to partition the namespace. Each user account has one default scope, e.g. user.jdoe for account jdoe.
- To list available scopes :

```
# rucio list-scopes
mock
user.petrtas
user.lydiaf
user.phillip
user.ctroncon
...
```

- As you can see, one scope has already been created for you : user.<account>

Reminder about some new concepts in Rucio

- In Rucio, the files, datasets and containers are defined as Data IDdentifiers (or DIDs).
- All DIDs are created within a scope and identified by the concatenation of the scope and the DID name separated by a colon (e.g. user.jdoe:test.root where user.jdoe is the scope and test.root is the DID name).
- Each data identifier name is unique within a scope, but 2 data identifiers can have the same name in different scopes (e.g. user.jdoe:myfile.root and user.janedoe:myfile.root)
- When you query DIDs matching a certain pattern or metadata you must always specify a scope.

How to list DIDs

- To list the DIDs in one scope :

```
# rucio list-dids tests:*
tests:test.container.cedric
tests:tests.container.cedric
tests:step14.33738.457cac2c.recon.ESD.753
tests:step14.64361.a1ff2cc7.recon.ESD.811
tests:step14.24777.7de4d74b.recon.ESD.499
tests:step14.61531.d7630dd3.recon.ESD.926
tests:step14.9838.453a5f56.recon.ESD.662
tests:step14.65917.3d6dac3c.recon.ESD.856
tests:step14.70414.26536bd5.recon.ESD.114
tests:step14.22872.5d1415ec.recon.ESD.701
```

- What is returned is the list of all datasets or containers in scope tests. You can refine your selection with the filter option, e.g. :

```
# rucio list-dids  tests:step14.33738* --filter type=dataset,datatype=ESD
tests:step14.33738.457cac2c.recon.ESD.753
tests:step14.33738.02d14bd3.recon.ESD.335
tests:step14.33738.8c3f64fe.recon.ESD.175
```

How to list DIDs contents

- To list the file content of a dataset/container :

```
# rucio list-files user.serfon:user.serfon.test.1234.31052013.214
user.serfon:file1.beaf170153b34b12b86b8a667848747d 1048576 984522ab 67438C3A824543A69F8B5760110E2D1B
user.serfon:file2.beaf170153b34b12b86b8a667848747d 1048576 bc1fa25c EDDD1881C21F4F879782DAA283D322E3
user.serfon:file3.beaf170153b34b12b86b8a667848747d 1048576 e96e80c0 5546F012383A4AA29C2ACD03055A396E
```

- To list the content of a dataset/container :

```
# rucio list-content user.serfon:user.serfon.test.1234.31052013.214
user.serfon:user.serfon.test.1234.31052013.212 [CONTAINER]
user.serfon:user.serfon.test.1234.31052013.215 [CONTAINER]
```

- As you see in Rucio containers can contain containers and the name doesn't need a trailing "/". To list the full content hierarchy :

```
# rucio list-dids --recursive  user.serfon:user.serfon.test.1234.31052013.214
|    |- user.serfon:user.serfon.test.1234.31052013.212 [CONTAINER]
|    |    |- user.serfon:user.serfon.test.24092014.1 [DATASET]
|    |    |- user.serfon:user.serfon.test.25092014.1 [DATASET]
|    |    |- user.serfon:user.serfon.test.26092014.1 [DATASET]
|    |    |    |- user.serfon:file1.beaf170153b34b12b86b8a667848747d [FILE]
|    |    |    |- user.serfon:file2.beaf170153b34b12b86b8a667848747d [FILE]
|    |    |    |- user.serfon:file3.beaf170153b34b12b86b8a667848747d [FILE]
|    |- user.serfon:user.serfon.test.1234.31052013.215 [CONTAINER]
```

How to get some metadata

- To list the DID metadata :

```
# rucio get-metadata
 data_test:data_test.00250001.calibration_DcmDummyProcessor.daq.RAW._lb0000._SFO-5._0001.data
campaign: None
updated_at: 2015-01-30 20:51:37
is_new: None
is_open: None
guid: e657bff1aea8e411b4450030489eba28
availability: AVAILABLE
deleted_at: None
panda_id: None
provenance: None
accessed_at: None
version: None
scope: data_test
hidden: False
md5: None
events: 2444
adler32: 06f2f6c2
...
```

- One can see new metadata (e.g. events) that were not supported by DQ2.

RSEs

- All former DQ2 endpoints are now available in Rucio as Rucio Storage Element (RSE) :

```
# rucio list-rses
AGLT2_CALIBDISK
AGLT2_DATADISK
AGLT2_LOCALGROUPDISK
AGLT2_PERF-MUONS
AGLT2_PHYS-HIGGS
AGLT2_PHYS-SM
...
```

- Some attributes can be associated to these RSEs by privileged users. You can list them :

```
# rucio list-rse-attributes LRZ-LMU_DATADISK
DETIER2S: True
ftstesting: https://fts3-pilot.cern.ch:8446
ALL: True
LRZ-LMU_DATADISK: True
DETIER2DS: True
physgroup: None
spacetoken: ATLASDATADISK
fts: https://fts3.cern.ch:8446,https://lcgfts3.gridpp.rl.ac.uk:8446,https://fts.usatlas.bnl.gov:8446
site: LRZ-LMU
...
```

RSEs

- The RSE attributes can be used to build RSE expressions. RSE expressions are a combination of keys/values
- The list-rse command can also be used to evaluate RSE expressions :

```
# rucio list-rses --expression "tier=2&cloud=DE&spacetoken=ATLASLOCALGROUPDISK"
LRZ-LMU_LOCALGROUPDISK
DESY-HH_LOCALGROUPDISK
CYFRONET-LCG2_LOCALGROUPDISK
FMPHI-UNIBA_LOCALGROUPDISK
HEPHY-UIBK_LOCALGROUPDISK
DESY-ZN_LOCALGROUPDISK
IEPSAS-KOSICE_LOCALGROUPDISK
UNI-FREIBURG_LOCALGROUPDISK
WUPPERTALPROD_LOCALGROUPDISK
GOEGRID_LOCALGROUPDISK
PRAGUELCG2_LOCALGROUPDISK
MPPMU_LOCALGROUPDISK
CSCS-LCG2_LOCALGROUPDISK
```

- RSE expression can be used when you set a rule (see later).

Listing the replicas of a DID

- Two commands :
  - To list the dataset replicas : list-dataset-replicas :

```
# rucio list-dataset-replicas data13_8TeV:data13_8TeV.00218048.express_express.merge.HIST.r5108_p1620
Dataset data13_8TeV:data13_8TeV.00218048.express_express.merge.HIST.r5108_p1620_tid01387999_00
RSE                                     Found  Total
FZK-LCG2_DATADISK                           12     12
```

  - To list the file replicas : list-file-replicas :

```
# rucio list-file-replicas tests:step14.21039.fc6fb258.recon.ESD.16
Scope Name Filesize adler32 Replicas
tests   ESD.0c8fb44832ac4a70b4dc108fa0933b3e    1048576 4cacbf6d        CERN-PROD-RUCIOTEST_DATADISK
https://lxbse15c06.cern.ch:443/eos/atlas/atlasdatadisk/ruciotest/rucio/tests/4d/da/
ESD.0c8fb44832ac4a70b4dc108fa0933b3e
tests   ESD.58409ecaf2854080a8ed6bbba2a1349d    1048576 88b11fbb        CERN-PROD-RUCIOTEST_DATADISK
https://lxbse15c06.cern.ch:443/eos/atlas/atlasdatadisk/ruciotest/rucio/tests/4d/b4/
ESD.58409ecaf2854080a8ed6bbba2a1349d
...
```

- list-dataset-replicas works only on datasets or containers, list-file-replicas on all DIDs (i.e. files, datasets, containers).

To list rules

- As explained in the introduction a rule can be used to transfer and/or to prevent a dataset from being deleted.
- To list the rules on one DID :

```
# rucio list-rules data_test:data_test.00250001.calibration_DcmDummyProcessor.daq.RAW
ID (account) SCOPE:NAME: STATE [LOCKS_OK/REPLICATING/STUCK], RSE_EXPRESSION, COPIES
================================================================================
5fcfb542af5e4b3187a721e0dde7d5ac (tzero)
data_test:data_test.00250001.calibration_DcmDummyProcessor.daq.RAW: OK[2/0/0],
"CERN-PROD_TZDISK", 1
9fa7923546cc47d0abcc5f47dae2f0f6 (tzero)
data_test:data_test.00250001.calibration_DcmDummyProcessor.daq.RAW: REPLICATING[1/1/0],
"CERN-PROD_RAW", 1
```

- Each rule is associated to an account and identified by a ID (UUID).
- The rule can have different states : OK, REPLICATING, STUCK, SUSPENDED.
- The LOCK_OK/REPLICATING/STUCK show how many files are the different states.

To list rules

- If you know a file name, you can check which rule is applied to it, e.g.:

```
# rucio list-rules --file
data_test:data_test.00250001.calibration_DcmDummyProcessor.daq.RAW._lb0000._SFO-5._0001.data
ID (account) SCOPE:NAME: STATE [LOCKS_OK/REPLICATING/STUCK], RSE_EXPRESSION, COPIES
================================================================================
5fcfb542af5e4b3187a721e0dde7d5ac (tzero)
data_test:data_test.00250001.calibration_DcmDummyProcessor.daq.RAW: OK[2/0/0],
"CERN-PROD_TZDISK", 1
9fa7923546cc47d0abcc5f47dae2f0f6 (tzero)
data_test:data_test.00250001.calibration_DcmDummyProcessor.daq.RAW: REPLICATING[1/1/0],
"CERN-PROD_RAW", 1
```

- You will show in the next part of the tutorial how to use the Rucio UI to monitor rules.

Rule operations

- Now let's create a rule :

```
# rucio add-rule data_test:data_test.00250001.calibration_DcmDummyProcessor.daq.RAW
--grouping DATASET 1 "CERN-PROD_SCRATCHDISK"
d6910238ea2445a2b00c457865458dc3
```

- What is returned is the rule id.
- Input parameters:
  - The –grouping option define what must be the replication unit (FILE, DATASET, CONTAINER).
  - The 1 means, one copy.
  - The last parameter is the RSE expression i.e. either a single site or an expression (e.g. "tier=2&cloud=DE").

Rule operations

- If you know the rule id, you can get rule info :

```
# rucio rule-info d6910238ea2445a2b00c457865458dc3
Id:                          d6910238ea2445a2b00c457865458dc3
Account:                     root
Scope:                       data_test
Name:                        data_test.00250001.calibration_DcmDummyProcessor.daq.RAW
RSE Expression:              CERN-PROD_SCRATCHDISK
Copies:                      1
State:                       REPLICATING
Locks OK/REPLICATING/STUCK: 0/2/0
```

- When you set a rule, you are charged for it. You can list your account usage like this :

```
# rucio list-account-usage serfon
RSE: usage (bytes), limit (bytes), quota_left (bytes)
=====================================================
WUPPERTALPROD_LOCALGROUPDISK: 144282349860, inf, inf
LRZ-LMU_LOCALGROUPDISK: 25253938286, inf, inf
MPPMU_LOCALGROUPDISK: 2564252263, inf, inf
```

- As you can see there are no quota set yet (they are set to infinity). It will change soon.
- Then if you want to delete the rule you created :

```
# rucio delete-rule d6910238ea2445a2b00c457865458dc3
```

Download

- The equivalent of dq2-get is rucio download :

```
# rucio  download  mc14_13TeV:AOD.04606956._004946.pool.root.1
2015-02-02 14:05:33,334 INFO [Starting download for mc14_13TeV:AOD.04606956._004946.pool.root.1]
[++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
File downloaded. Will be validated
File validated
2015-02-02 14:07:00,329 INFO [File mc14_13TeV:AOD.04606956._004946.pool.root.1 successfully downloade
2015-02-02 14:07:00,330 INFO [Download operation for mc14_13TeV:AOD.04606956._004946.pool.root.1 done
---------------------------------
Download summary
---------------------------------
Download summary
----------------------------------------
DID mc14_13TeV:AOD.04606956._004946.pool.root.1
Downloaded files :                          1
Files already found locally :               0
Files that cannot be downloaded :           0
```

- rucio download takes as parameter any DIDs (files, dataset, containers).
- It select the protocol with the highest priority associated to the site as defined in AGIS (either SRM, HTTP, Xrootd).

Download

- In the previous example, the dataset was downloaded from BNL-OSG2_DATADISK using WebDAV.
- You can force the source and/or the protocol to be used, e.g. :

```
# rucio download mc14_13TeV:AOD.04606956._004946.pool.root.1 --protocol srm --rse IN2P3-CC_DATADISK
2015-02-02 18:50:07,473 INFO [Starting download for mc14_13TeV:AOD.04606956._004946.pool.root.1]
File downloaded. Will be validated
File validated
2015-02-02 18:50:28,400 INFO [File mc14_13TeV:AOD.04606956._004946.pool.root.1 successfully downloade
2015-02-02 18:50:28,401 INFO [Download operation for mc14_13TeV:AOD.04606956._004946.pool.root.1 done
---------------------------------
Download summary
---------------------------------------
DID mc14_13TeV:AOD.04606956._004946.pool.root.1
Downloaded files :                          1
Files already found locally :               0
Files that cannot be downloaded :           0
```

Upload

- Last but not least, if you want to upload a dataset, you can use rucio upload.

```
# rucio upload --scope tests --rse IN2P3-CC_SCRATCHDISK ruciotest/
user.serfon:test.rucio.upload.030022015.3
2015-02-03 18:15:36,346 INFO [Dataset successfully created]
2015-02-03 18:15:36,411 INFO [Adding replicas in Rucio catalog]
2015-02-03 18:15:36,560 INFO [Replicas successfully added]
2015-02-03 18:15:39,962 INFO [File tests:file1.20292d82ce0746fa8a13426d1e693d43 successfully uploaded
2015-02-03 18:15:40,015 INFO [Adding replicas in Rucio catalog]
2015-02-03 18:15:40,075 INFO [Replicas successfully added]
2015-02-03 18:15:44,584 INFO [File tests:file2.20292d82ce0746fa8a13426d1e693d43 successfully uploaded
2015-02-03 18:15:44,658 INFO [Adding replicas in Rucio catalog]
2015-02-03 18:15:44,802 INFO [Replicas successfully added]
2015-02-03 18:15:49,196 INFO [File tests:file3.20292d82ce0746fa8a13426d1e693d43 successfully uploaded
2015-02-03 18:15:49,692 INFO [Will update the file replicas states]
2015-02-03 18:15:49,784 INFO [File replicas states successfully updated]
Completed in 14.3133 sec.

# rucio list-rules  user.serfon:test.rucio.upload.030022015.3
ID (account) SCOPE:NAME: STATE [LOCKS_OK/REPLICATING/STUCK], RSE_EXPRESSION, COPIES
================================================================================
440a315dfddd4e98bf9b16cc2ce4be87 (root) user.serfon:test.rucio.upload.030022015.3:
 OK[3/0/0], "IN2P3-CC_SCRATCHDISK", 1
```

Conclusion

- More infos can be found on Rucio HOWTO
- Once again, please provide feedback if you see some missing functionalities/bugs.
- We have rapid release cycles (every 2 weeks), so you don't have to wait too long for new features.
- Plan is to have a golden release (1.0.0) for the CLI by the end of this month.