LHCbDIRAC Documentation

Release v7

LHCbDIRAC Project.

Sep 06, 2019

Contents

The LHCbDIRAC project is the LHCb Grid solution. LHCbDIRAC is DIRAC extension.

DIRAC forms a layer between a particular community and various compute resources to allow optimized, transparent and reliable usage. LHCbDIRAC specializes DIRAC for LHCb.

- DIRAC documentation: http://dirac.readthedocs.io/en/latest/index.html
- DIRAC hosted repository: https://github.com/DIRACGrid

LHCbDIRAC is the LHCb extension to DIRAC:

- LHCbDIRAC hosted repository: https://gitlab.cern.ch/lhcb-dirac

CHAPTER 1

Developers Guide

1.1 Guide for developing LHCbDIRAC (and DIRAC, for LHCb developers)

A short, but hopefully comprehensive guide on developing in LHCbDIRAC, referencing DIRAC development model. For what are DIRAC and LHCbDIRAC doing, look elsewhere.

LHCbDIRAC is a DIRAC extension. This means that LHCbDIRAC cannot leave independently from DIRAC. There are a number of DIRAC extensions, maintained by various communities worldwide, and LHCbDIRAC is the most important out there, and the one that receives the most support by DIRAC itself. But it also means that DIRAC and LHCbDIRAC (as all the other DIRAC extensions) have different release cycles and versioning, adopts different version control systems, use different tracking systems, and that the code conventions may slightly differ.

DIRAC can also have other extensions, independent from a VO. All these are hosted at github.

1.1.1 Pre-requisites

Within this section we just look at what is necessary to know before looking at the code.

Releases

Naming

Both DIRAC and LHCbDIRAC follow the same naming conventions for releases, inherithed by the LHCb convention:

vMrNpt

where:

- **M** stands for *major version*, or simply *version*
- **N** stands for *minor version*, or simply *release*

- **t** stands for *patch version*, or simply *patch*

with a special *pre-release* naming convention: **-preX**.

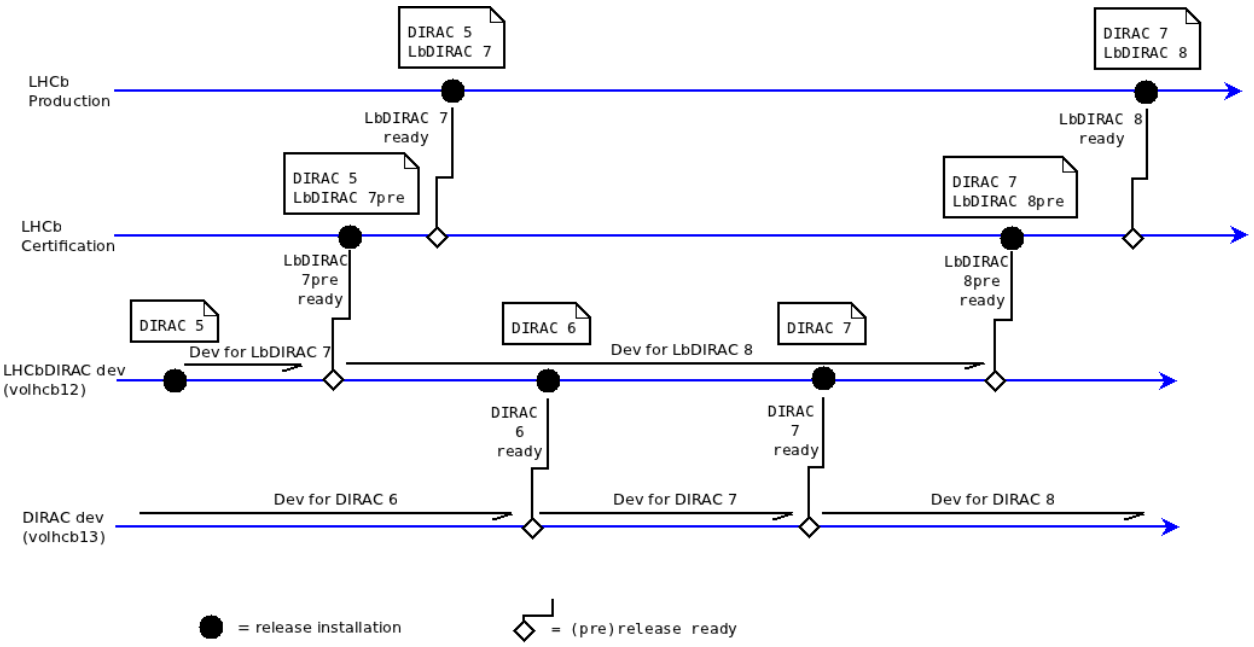
This will be clear with some examples:

- **v6r2p0** is the version 6, release 2, patch 0
- **v7r5p13** is the version 7, release 5, patch 13
- **v8r1-pre2** is the second pre-release of version 8, release 1

There are no pre-releases for patches.

Release cycle

When developing LHCbDIRAC, we need to consider that every LHCbDIRAC is developed on top of a DIRAC release. The following picture explaines the model.



So, for example. there might be 2 or more LHCbDIRAC releases based on top of the same DIRAC release. Every LHCbDIRAC developers has to know which release of DIRAC its development is for. The major version of both DIRAC and LHCbDIRAC changes rarely, let's say evry 2 years. The minor version changes more frequently in LHCbDIRAC with respect to DIRAC, but there is no strict advancement scheduling for none of the 2.

A pre-release is a release candidate that goes through a certification process.

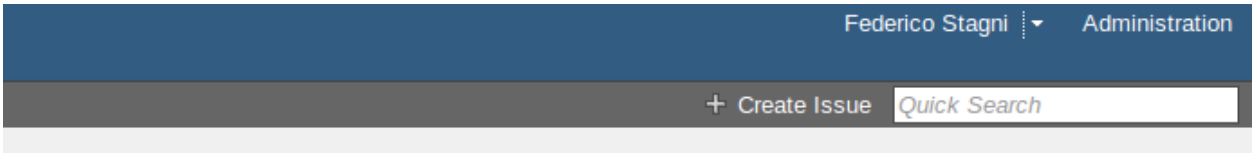
Version Control

LHCbDIRAC version control is based on GIT. GIT is a very popular distributed revision control system. The reader is supposed to be familiar with the way such systems work. The code is hosted in the CERN GitLab.

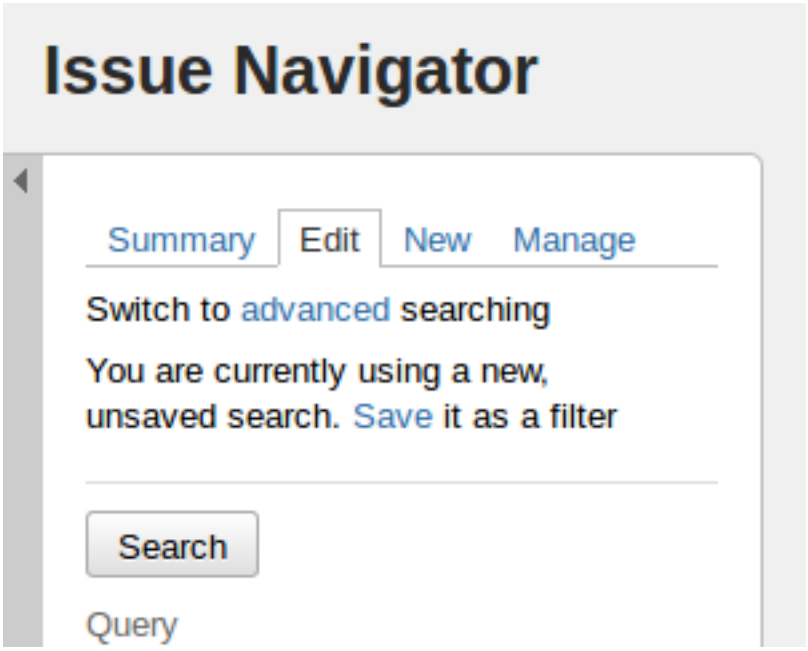
Tracking systems

The tracking system used for LHCbDIRAC is jira. Jira is a fundamental tool for LHCbDIRAC, and its use is mandatory. Every development should be tracked there. Jira is a very powerfool tool, but requires some time to master. Few notes/links:

- The *official documentation* is here. You might also be interested in watching the first ~15 minutes of this video.
- Issuing a new bug/task/story/etc. (there are many possible choices) is easy, just look at the top right of the screen:



- Remember to put a "component" when you make a new issue
- When you make a new research in the issue navigator, you can save the search: it will become useful later



Developer tools

You are free to choose the editor or IDE you prefer. I know Emacs is a great tool, and someone can't just leave without it. And that also vim is great. Eclipse with pydev is another good choice. Other possibilities include PyCharm (IntelliJIDEA) and atom

1.2 Developing DIRAC and LHCbDIRAC

Developing the code is not just about editing. You also want to "run" something, usually for testing purposes. The DIRAC way of developing can be found here and it applies also to LHCbDIRAC. Please follow carefully especially what's there

In general, if you are developing LHCbDIRAC, you should consider that:

- everything that applies to DIRAC development, also applies to LHCbDIRAC development, so, follow carefully the links above
- every LHCbDIRAC release has a strong dependency with a DIRAC release. See https://gitlab.cern.ch/lhcb-dirac/LHCbDIRAC/blob/master/CONTRIBUTING.md for more info.

1.3 HOW TOs

1.4 Browsing the code running in production

If you want to browse the DIRAC (and LHCbDIRAC) code running in production you'll first of all have to know which version is installed. Announcements of new deployments are done via the LHCb operations eLog. The code is also always installed in the CVMFS release area (*$LHCb_release_area/DIRAC/DIRAC_vX5rYpZ/DIRAC*) but you can normally use git to switch from one to another.

1.5 I developed something, I want it in the next release

Just open a merge request to the devel branch of LHCbDirac: all the releases (minor and major) are created branching from this branch.

1.6 Asking for a LHCbDIRAC patch

Just open a merge request to the master branch of LHCbDirac. If in a hurry, drop an e-mail to the lhcb-dirac mailing list.

CHAPTER 2

Administrator Guide

This page is the work in progress. See more material here soon !

2.1 LHCbDIRAC Releases

The following procedure applies fully to LHCbDIRAC production releases, like patches. For pre-releases (AKA certification releases, there are some minor changes to consider).

2.1.1 Prerequisites

The release manager needs to:

- be aware of the LHCbDIRAC repository structure and branching as highlighted in the contribution guide.
- have forked LHCbDIRAC on GitLab as a "personal project" (called "origin" from now on)
- have cloned origin locally
- have added https://gitlab.cern.ch/lhcb-dirac/LHCbDIRAC as "upstream" repository to the local clone
- have push access to the master branch of "upstream" (being part of the project "owners")
- have DIRAC installed
- have been grated write access to <webService>
- have "lhcb_admin" or "diracAdmin" role.
- have a Proxy

The release manager of LHCbDIRAC has the triple role of:

1. creating the release
2. making basic verifications
3. deploying it in production

2.1.2 1. Creating the release

Unless otherwise specified, (patch) releases of LHCbDIRAC are usually done "on top" of the latest production release of DIRAC. The following of this guide assumes the above is true.

Creating a release of LHCbDIRAC means creating a tarball that contains the release code. This is done in 3 steps:

1. Merging "Merge Requests"
2. Propagating to the devel branch (for patches)
3. Creating the release tarball, add uploading it to the LHCb web service

But before:

Pre

Verify what is the last tag of DIRAC:

```
# it should be in this list:
git describe --tags $(git rev-list --tags --max-count=10)
```

A tarball containing it is should be already uploaded here

You may also look inside the .cfg file for the DIRAC release you're looking for: it will contain an "Externals" version number, that should also be a tarball uploaded in the same location as above.

If all the above is ok, we can start creating the LHCbDIRAC release.

Merging "Merge Requests"

Merge Requests (MR) that are targeted to the master branch and that have been approved by a reviewer are ready to be merged

If there are no MRs, or none ready: please skip to the "update the CHANGELOG" subsection.

Otherwise, simply click the "Accept merge request" button for each of them.

If you are making a Major release please merge devel to master follow the instruction: *Basic instruction how to merge the devel branch into master (NOT for PATCH release)*.

Then, from the LHCbDIRAC local fork you need to update some files:

```
# if you start from scratch otherwise skip the first 2 commands
mkdir $(date +20%y%m%d) && cd $(date +20%y%m%d)
git clone https://gitlab.cern.ch/lhcb-dirac/LHCbDIRAC.git
cd LHCbDIRAC
git remote rename origin upstream
# update your "local" upstream/master branch
git fetch upstream
# create a "newMaster" branch which from the upstream/master branch
git checkout -b newMaster upstream/master
# determine the tag you're going to create by checking what was the last one from the␣
↪following list (add 1 to the "p"):
git describe --tags $(git rev-list --tags --max-count=5)
# Update the version in the __init__ file:
vim LHCbDIRAC/__init__.py
# Update the version in the releases.cfg file:
vim LHCbDIRAC/releases.cfg
```

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```
# Update the version in the Dockerfile file:
vim container/lhcbdirac/Dockerfile
# For updating the CHANGELOG, get what's changed since the last tag
t=$(git describe --abbrev=0 --tags); git --no-pager log ${t}..HEAD --no-merges --
↪pretty=format:'* %s';
# copy the output, add it to the CHANGELOG (please also add the DIRAC version)
vim CHANGELOG # please, remove comments like "fix" or "pylint" or "typo"...
git add -A && git commit -av -m "<YourNewTag>"
```

Time to tag and push:

```
# make the tag
git tag -a <YourNewTag> -m <YourNewTag>
# push "newMaster" to upstream/master
git push --tags upstream newMaster:master
# delete your local newMaster
git checkout upstream/master
git branch -d newMaster
```

Remember: you can use "git status" at any point in time to make sure what's the current status.

Propagate to the devel branch

Now, you need to make sure that what's merged in master is propagated to the devel branch. From the local fork:

```
# get the updates (this never hurts!)
git fetch upstream
# create a "newDevel" branch which from the upstream/devel branch
git checkout -b newDevel upstream/devel
# merge in newDevel the content of upstream/master
git merge upstream/master
```

The last operation may result in potential conflicts. If happens, you'll need to manually update the conflicting files (see e.g. this guide). As a general rule, prefer the master fixes to the "HEAD" (devel) fixes. Remember to add and commit once fixed. Note: For porting the LHCbDIRAC.init.py from master to devel, we prefer the HEAD version (only for this file!!!)

Plase fix the conflict if some files are conflicting. Do not forget to to execute the following:

```
git add -A && git commit -m " message"
```

Conflicts or not, you'll need to push back to upstream:

```
# push "newDevel" to upstream/devel
git push upstream newDevel:devel
# delete your local newDevel
git checkout upstream/devel
git branch -d newDevel
# keep your repo up-to-date
git fetch upstream
```

Creating the release tarball, add uploading it to the LHCb web service

Automatic procedure

When a new git tag is pushed to the repository, a gitlab-ci job takes care of testing, creating the tarball, uploading it to the web service, and to build the docker image. You can check it in the pipeline page of the repository (https://gitlab.cern.ch/lhcb-dirac/LHCbDIRAC/pipelines).

It may happen that the pipeline fails. There are various reasons for that, but normally, it is just a timeout on the runner side, so just restart the job from the pipeline web interface. If it repeatedly fails building the tarball, try the manual procedure described bellow to understand.

Manual procedure

This should a priori not be used anymore. If the pipeline fails, you should rather investigate why.

Login on lxplus, run

```
source /cvmfs/lhcb.cern.ch/lib/lhcb/LHCBDIRAC/lhcbdirac

git archive --remote ssh://git@gitlab.cern.ch:8443/lhcb-dirac/LHCbDIRAC.git devel␣
↪LHCbDIRAC/releases.cfg  | tar -x -v -f - --transform 's|^LHCbDIRAC/||' LHCbDIRAC/
↪releases.cfg

dirac-distribution -r v8r3p1 -l LHCb -C file:///`pwd`/releases.cfg (this may take␣
↪some time)
```

Don't forget to read the last line of the previous command to copy the generated files at the right place. The format is something like:

```
( cd /tmp/joel/tmpxg8UuvDiracDist ; tar -cf - *.tar.gz *.md5 *.cfg ) | ssh␣
↪lhcbprod@lxplus.cern.ch 'cd /afs/cern.ch/lhcb/distribution/DIRAC3/tars &&  tar -xvf␣
↪- && ls *.tar.gz > tars.list'
```

And just copy/paste/execute it.

If you do not have access to lhcbprod, you can use your user name.

2.1.3 2. Making basic verifications

Once the tarball is done and uploaded, the release manager is asked to make basic verifications, to see if the release has been correctly created.

2.1. GitLab-CI pipelines

Within GitLab-CI, at https://gitlab.cern.ch/lhcb-dirac/LHCbDIRAC/pipelines we run simple "unit" tests.

These pipelines will: run pylint (errors only), run all the unit tests found in the system, assess the coverage. If the GitLab-CI pipelines are successful, we can check the system tests.

2.2. Jenkins "integration" tests

At this link you'll find some Jenkins Jobs ready to be started. Please start the following Jenkins jobs and verify their output.

1. LHCbIntegration_SLC6

This is a lengthy test of the LHCbDIRAC server installation and interaction with services. Please just check if the result does not show in an "unstable" status.

2. LHCbPilot3_pipeline

This job will run several payloads in a pipeline, using pilot 3 on CERNVM3 nodes. Please just check if the result does not show in an "unstable" status.

3. LHCbPilot3_CVM4_pipeline

This job will run several payloads in a pipeline, using pilot 3 on CERNVM4 nodes. Some of the tests run in the pipeline will, for now, fail. The reason is that some tests try to run SLC5 binaries on a CentOS7-based distibution, which will fail. Some of the tests in the pipeline will anyway suceed.

2.1.4 3. Advertise the new release

Before you start the release you must write an Elog entry 1 hour before you start the deployment. You have to select Production and Release tick boxes.

When the intervention is over you must notify the users (reply to the Elog message).

2.1.5 4. Deploying the release

Deploying a release means deploying it for the various installations:

```
* client
* server
* pilot
```

release for client

Open a JIRA task: https://its.cern.ch/jira/projects/LHCBDEP.

- JIRA task: Summary:LHCbDirac vArBpC; Description: Please release LHCbDirac by following the instructions:

  https://lhcb-dirac.readthedocs.io/en/latest/AdministratorGuide/Installation/make_release.html#new-procedure-for-installing-on-cvmfs-lhcb

Once the client has been deployed, you should setup the correct environment (source /cvmfs/lhcb.cern.ch/lib/lhcb/LHCBDIRAC

- Minimal test: https://gitlab.cern.ch/lhcb-dirac/LHCbDIRAC/blob/master/tests/System/Client/basic-imports_client.py
- Bigger (certification like) test: https://gitlab.cern.ch/lhcb-dirac/LHCbDIRAC/blob/master/tests/System/Client/client_test.sh

Procedure for installing on cvmfs-lhcbdev

You should member of the e-group lhcb-cvmfs-librarians. you login to aivoadm.cern.ch and you follow the sequence:

```
ssh cvmfs-lhcbdev
sudo -i -u cvlhcbdev
lbcvmfsinteractive.sh -m "install vArB-preC"
(wait to get the prompt back)
cd /cvmfs/lhcbdev.cern.ch/lib/lhcb/LHCBDIRAC/
cvmfs_server transaction lhcbdev.cern.ch
export DIRAC=/cvmfs/lhcbdev.cern.ch/lib/lhcb/LHCBDIRAC/vDrE-preF (vDrE-preF is the␣
↪previous installation)
source bashrc
dirac-install -v -r vArB-preC -t server -l LHCb -e LHCb --createLink
rm /cvmfs/lhcbdev.cern.ch/lib/lhcb/LHCBDIRAC/pro
source lhcbdirac vArB-preC
pip install --trusted-host files.pythonhosted.org --trusted-host pypi.org --upgrade␣
↪pip
pip install --trusted-host files.pythonhosted.org --trusted-host pypi.org ipython
<deploy the test directory if it is needed>
mkdir tmp
cd tmp/
mkdir LHCbDIRAC
cd LHCbDIRAC/
git init
git remote add -f upstream https://:@gitlab.cern.ch:8443/lhcb-dirac/LHCbDIRAC.git
git config core.sparsecheckout true
echo tests/ >> .git/info/sparse-checkout
git pull upstream devel
rm -rf .git/
cd ../../
cp -r tmp/LHCbDIRAC/tests/ v9r3-pre20/LHCbDIRAC/
rm -rf tmp/
<end of tests directory deployment>
cd /
cvmfs_server publish lhcbdev.cern.ch
exit
exit
```

new procedure for installing on cvmfs-lhcb

Only members of the e-group lhcb-cvmfs-librarians have the karma to make releases on CVMFS. The version to be deployed is vArBpC. Login on aivoadm.cern.ch and follow the sequence:

```
ssh cvmfs-lhcb
sudo -i -u cvlhcb
cd /cvmfs/lhcb.cern.ch/lib/lhcb/LHCBDIRAC/
cvmfs_server transaction lhcb.cern.ch
source lhcbdirac pro (pro is the actual version)
export DIRAC=/cvmfs/lhcb.cern.ch/lib/lhcb/LHCBDIRAC/pro
dirac-install -v -r vArBpC -t server -l LHCb -e LHCb --createLink
source lhcbdirac vArBpC
pip install --trusted-host files.pythonhosted.org --trusted-host pypi.org --upgrade␣
↪pip
pip install --trusted-host files.pythonhosted.org --trusted-host pypi.org ipython
cd /
cvmfs_server publish lhcb.cern.ch
exit
exit
```

Server

Using the web portal:

- You cannot do all the machines at once. Select a bunch of them (between 5 and 10). Fill in the version number and click update.
- Repeate until you have them all.
- Start again selecting them by block, but this time, click on "restart" to restart the components.

To install it on the VOBOXes from lxplus:

```
lhcb-proxy-init -g lhcb_admin
dirac-admin-sysadmin-cli --host lbvoboxXYZ.cern.ch
> update LHCbDIRAC v9r3p3
> restart *
```

The recommended way is the following:

```
ssh lxplus
mkdir -p DiracInstall && cd  DiracInstall
curl https://gitlab.cern.ch/lhcb-dirac/LHCbDIRAC/raw/devel/dist-tools/create_vobox_
↪update.py -O
python create_vobox_update.py vArBpC
```

This command will create 6 files called "vobox_update_MyLetter" then you can run in 6 windows the recipe for one single machine like that:

```
ssh lxplus
cd  DiracInstall ; source /cvmfs/lhcb.cern.ch/lib/lhcb/LHCBDIRAC/lhcbdirac ; lhcb-
↪proxy-init -g lhcb_admin; dirac-admin-sysadmin-cli
      and from the prompt ::
         [host] : execfile vobox_update_MyLetter
         [host] : quit
```

Note:

It is normal if you see the following errors:

```
--> Executing restart Framework SystemAdministrator
[ERROR] Exception while reading from peer: (-1, 'Unexpected EOF')
```

In case of failure you have to update the machine by hand. Example of a typical failure:

```
--> Executing update v9r3p3
Software update can take a while, please wait ...
[ERROR] Failed to update the software
Timeout (240 seconds) for '['dirac-install', '-r', 'v9r3p3', '-t', 'server', '-e',
↪'LHCb', '-e', 'LHCb', '/opt/dirac/etc/dirac.cfg']' call
```

Login to the failing machine, become dirac, execute manually the update, and restart everything. For example:

```
ssh lbvobox11
sudo su - dirac
dirac-install -r v9r3p3 -t server -e LHCb -e LHCb /opt/dirac/etc/dirac.cfg
lhcb-restart-agent-service
runsvctrl t startup/Framework_SystemAdministrator/
```

Specify that this error can be ignored (but should be fixed !):

```
2016-05-17 12:00:00 UTC dirac-install [ERROR] Requirements installation script /opt/
↪dirac/versions/v8r2p42_1463486162/scripts/dirac-externals-requirements failed.␣
↪Check /opt/dirac/versions/v8r2p42_1463486162/scripts/dirac-externals-requirements.
↪err
```

WebPortal

When the web portal machine is updated then you have to compile the WebApp:

```
ssh lhcb-portal-dirac.cern.ch
sudo su - dirac
#  (for example: dirac-install -r v9r3p3 -t server -l LHCb -e LHCb,LHCbWeb,
↪WebAppDIRAC /opt/dirac/etc/dirac.cfg)
dirac-install -r VERSIONTOBEINSTALLED -t server -l LHCb -e LHCb,LHCbWeb,WebAppDIRAC /
↪opt/dirac/etc/dirac.cfg
```

When the compilation is finished:

```
lhcb-restart-agent-service
runsvctrl t startup/Framework_SystemAdministrator/
```

TODO

When the machines are updated, then you have to go through all the components and check the errors. There are two possibiliti

1. Use the Web portal (SystemAdministrator)
2. Command line:

```
for h in $(grep 'set host' vobox_update_* | awk {'print $NF'}); do echo "show␣
↪errors" | dirac-admin-sysadmin-cli -H $h; done | less
```

Pilot

Update the pilot version from the CS, keeping 2 pilot versions, for example:

/Operation/LHCb-Production/Pilot/Version = v9r3p3, v9r3p2

The newer version should be the first in the list

for checking and updating the pilot version. Note that you'll need a proxy that can write in the CS (i.e. lhcb-admin). This script will make sure that the pilot version is update BOTH in the CS and in the json file used by pilots started in the vacuum.

Basic instruction how to merge the devel branch into master (NOT for PATCH release)

Our developer model is to keep only two branches: master and devel. When we make a major release, we have to merge devel to master. Before the merging, create a new branch based on master using the web interface of GitLab. This is for safety: save the in a new branch, named e.g. "v9r1" the last commit done for "v9r1" branch.

After, you can merge devel to master (the following does it in a new directory, for safety):

```
mkdir $(date +20%y%m%d) && cd $(date +20%y%m%d)
git clone ssh://git@gitlab.cern.ch:7999/lhcb-dirac/LHCbDIRAC.git
cd LHCbDIRAC
git remote rename origin upstream
git fetch upstream
git checkout -b newMaster upstream/master
git merge upstream/devel
git push upstream newMaster:master
```

After when you merged devel to master, the 2 branches will be strictly equivalent. You can make the tag for the new release starting from the master branch. You have to merge devel to master for LHCbWebDIRAC as well:

```
mkdir $(date +20%y%m%d) && cd $(date +20%y%m%d)
git clone ssh://git@gitlab.cern.ch:7999/lhcb-dirac/LHCbWebDIRAC.git
cd LHCbWebDIRAC/
git remote rename origin upstream
git fetch upstream
git checkout -b newMaster upstream/master
git merge upstream/devel
git push upstream newMaster:master
```

When it is ready you can create the final tag for the new release.

2.1.6 5. Mesos cluster

Mesos is currently only used for the certification. In order to push a new version on the Mesos cluster, 3 steps are needed:

- Build the new image
- Push it the lhcbdirac gitlab repository
- Update the version of the running containers

Automatic procedure

The first two steps should be automatically done by the gitlab-ci of the LHCbDIRAC repository. The last step will be taken care of by the gitlab-ci of the MesosClusterConf repository (https://gitlab.cern.ch/lhcb-dirac/MesosClusterConf) For a simple version upgrade, edit directly on the gitlab web page the file clusterConfiguration.json and replace the "version" attribute with what you want. Of course add a meaningful commit message.

Manual procedure

This should in principle not happen. Remember that any manual change of the mesos cluster will be erased next time the gitlab-ci of the MesosClusterConf repository will run. However, you can do all the above step manually.

All these functionalities have been wrapped up in a script (dirac-docker-mgmt), available on all the lbmesosadm* machines (01, 02)

The next steps are the following:

```
# build the new image
# this will download the necessary files, and build
# the image localy
dirac-docker-mgmt.py -v v8r5 --build
```

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```
# Push it to the remote lhcbdirac registry
# Your credentials for gitlab will be asked
dirac-docker-mgmt.py -v v8r5 --release

# Update the version of the running containers
# The services and number of instances running
# will be preserved
dirac-docker-mgmt.py -v v8r5 --deploy
```

2.2 Renewal of certificate for ONLINE machine

Login as lhcbprod on **lbdirac.cern.ch** and generate the certificate request

```
openssl req -new -subj /CN=lbdirac.cern.ch -out newcsr.csr -nodes -sha1
```

Open in your browser the page http://ca.cern.ch cut the content of *newcsr.csr* (created in the previous step) in the web page and click on the submit button. Save the Base 64 encoded certificate as a file *newcert.cer*. Copy this file to lbdirac.cern.ch. Then convert the certificate in the correct format.

```
openssl pkcs12 -export -inkey privkey.pem -in newcert.cer -out myCertificate.pks (You␣
↪will have to type the PEM password you typed in the previous step. Type also an␣
↪export password, and don't forget it. Your certificate in PKCS12 format is ready in␣
↪file myCertificate.pks, you can delete the other files.)
openssl pkcs12 -in myCertificate.pks -clcerts -nokeys -out hostcert.pem
openssl pkcs12 -in myCertificate.pks -nocerts -out hostkey.pem.passwd
openssl rsa -in hostkey.pem.passwd -out hostkey.pem (remove the password)
```

If you want to test that the new host certificate is valid without any password, just do

```
dirac-proxy-init -C <cert> -K <key>
```

2.3 ONLINE steps

2.3.1 Installation of LHCbDirac

The machine running the transfers from the pit is lbdirac, and is in the online network. This machine runs:

- A complete RMS: ReqManager (url: RequestManagement/onlineGateway), a ReqProxy (known only from inside) and a RequestExecutingAgent
- The RAWIntegrity system: the RAWIntegrityHandler and RAWIntegrityAgent

A special catalog is defined in the local configuration in order to keep track of the files transfered:

```
RAWIntegrity
{
  AccessType = Read-Write
  Status = Active
}
```

We also have two special configuration for StorageElements:

```
# Setting it to NULL to transfer without
# checking the checksum, since it is already done by
# the DataMover and the RAWIntegrityAgent
# It should avoid the double read on the local disk
ChecksumType=NULL
# Setting this to True is dangerous...
# If we have a SRM_FILE_BUSY, we remove the file
# But we have enough safety net for the transfers from the pit
SRMBusyFilesExist = True
```

Finally, you need to overwrite the URLS of the RMS to make sure that they use the internal RMS:

```
URLs
{
  ReqManager = dips://lbdirac.cern.ch:9140/RequestManagement/ReqManager
  ReqProxyURLs = dips://lbdirac.cern.ch:9161/RequestManagement/ReqProxy
}
```

2.3.2 Installation/update of LHCbDirac version

Instructions to install or update a new version of LHCbDirac

```
ssh lhcbprod@lbgw.cern.ch
ssh store06
cd /sw/dirac/run2
source /sw/dirac/run2/bashrc
dirac-install -v -r vArBpC -t server -l LHCb -e LHCb
rm /sw/dirac/run2/pro ; ln -s versions/vArBpC_hhhhhh pro
cd /sw/dirac/run2/pro


foreach i (`ls`)
if -l $i then
  echo $i
  rm $i
  ln -s ../../$i
endif
end
```

2.3.3 Workflow

The DataMover is the Online code responsible for the interraction with the BKK (register the run, the files, set the replica flag), to request the physical transfers, and to remove the file of the Online storage when properly transfered.

The doc is visible here: https://lbdokuwiki.cern.ch/online_user:rundb_onlinetoofflinedataflow

The DataMover registers the Run and the files it already knows about in the BKK. Then it creates for each file a request with a PutAndRegister operation. The target SE is CERN-RAW, the Catalog is RAWIntegrity. The RequestExecutingAgent will execute the copy from the local online storage to CERN-RAW, and register it in the RAWIntegrity DB.

The RAWIntegrityAgent looks at all the files in the DB that are in status 'Active'.

For each of them, it will check if the file is already on tape, and if so, compare the checksum.

If the checksum is incorrect, the file remains in status 'Active', and will require manual intervention. If the checksum is correct, we attempt to register the file in the DFC only.

If the registration fails, the file goes into 'Copied' status in the DB, c If the registration works, we attempt to remove the file from the Online storage. This removal Request sends a signal to the DataMover, which will mark the file for removal (garbage collection), and the replica flag to yes in the BKK.

If the removal fails, the file status is set to 'Registered' in the DB, and will be reattempted from there at the next loop. If the removal works, the file is set to 'Done' in the DB.

2.3.4 HLTFram

The Productions, Monte Carlo or Other, are run under the ONLINE account lhcbprod. Under its home directory, a subdirectory called production contains all the scripts and tools to start the agent launch by PVSS. PVSS called the script */home/lhcbprod/production/launch_agent.sh*. which will call the DIRAC Pilot (*/home/lhcbprod/production/dirac-pilot-3.sh*). The code for the Pilot itself is store in */home/lhcbprod/production/Pilot3*. The content of this directory is updated every day by a cron run on the machine cron01 as lhcbprod. The script which update it is */home/lhcbprod/production/dirac-pilot3-cron.sh*.

2.4 Bookkeeping

2.4.1 LHCbBookkeeping database administration

This document contains all the information needed to manage the Bookkeeping Oracle database.

Login to the database

We are using 3 database accounts:

1. LHCB_DIRACBOOKKEEPING_users (reader account)
2. LHCB_DIRACBOOKKEEPING_server (write account)
3. LHCB_DIRACBOOKKEEPING (main account)

The main account is always locked. Every time when you want to use it you have to unlock.

Before login to the production db, you have to unlock the database:

https://cern.ch/service-db-actionmanagement

Important: you must only unlock the following account: lhcbr lhcb_diracbookkeeping

You have two ways to login:

1. using sqldeveloper

   ConnectionName: give a name

   UserName: LHCB_DIRACBOOKKEEPING

   Password: xxxx

   Hostname: itrac50087-v.cern.ch

   Port: 10121

   Service name: lhcb_diracbookkeeping.cern.ch

   You can retreive the information using the tns.ora. You can found it:

vi $TNS_ADMIN/phydb/tnsnames.phydb.ora

You have to search to LHCB_DIRACBOOKKEEPING and after you will found the Service name and Hostname

2. using sqlplus

   source /afs/cern.ch/project/oracle/script/setoraenv.sh

   setoraenv -s 12101

   sqlplus LHCB_DIRACBOOKKEEPING/password@LHCB_DIRACBOOKKEEPING

Compile oracle stored procedure

In order to compile the stored procedure you need the sql file: https://gitlab.cern.ch/lhcb-dirac/LHCbDIRAC/blob/master/LHCbDIRAC/BookkeepingSystem/DB/oracle_schema_storedprocedures.sql

You can find it in the tar.gz file in the release in case you want to update the prodction db.

NOTE: I recommend to use the stored procedure, which is in the tar.gz.

1. Login the database using sqlplus
2. in the termineal execute @/home/user/oracle_schema_storedprocedures.sql
3. commit;

In case of error you have to use 'show errors' command

In case of a schema change, you can find the command that needs to be executed: https://gitlab.cern.ch/lhcb-dirac/LHCbDIRAC/blob/master/LHCbDIRAC/BookkeepingSystem/DB/oracle_schema_commands.sql

Discover slow queries in the db

Note: If you are not familiar with Oracle better to send a mail to phydb.support@cern.ch mailing list. You can write we have problem with the database the queries are very slow. IT/DB expert will find the slow queries and will probaly tell what is the problem and try to solve.

https://cern.ch/session-manager is a portal provided by IT/DB where you can logon and find the running query. You can find the query which is running very long. You can get the execution plan and also can take the query and run in sqlplus. So you can compare the execution plan which is in the web and in sqlplus.

Login to the session manager:

You have a reader and writer account. All the select queries are running in the reader account.

Login form:

UserName: LHCB_DIRACBOOKKEEPING_users

Password: pass

Database: LHCBR

How to identify problematic queries:

You can find the queries which takes very long using https://cern.ch/session-manager, but it maybe normal. You can check the execution plan in the following way.

1. Login to sqlplus (you have to use the main owner account)
2. set autot traceo

3. set timing on
4. set linesize 1000
5. execute the qurey

After when the query will finish then you will have the execution plan and you will have the real execution time as well. I propose to look the following parameters:

```
Cost (%CPU) , consistent gets, physical reads
```

For example:

```
Elapsed: 00:00:00.12
Execution Plan
----------------------------------------------------------
Plan hash value: 3340191443
-------------------------------------------------------------------------------------------------
↪--------------------------------
| Id  | Operation              | Name      | Rows  | Bytes | Cost (%CPU)| Time     |␣
↪Pstart| Pstop |
-------------------------------------------------------------------------------------------------
↪--------------------------------
|   0 | SELECT STATEMENT          |           |  4960 |  2232K| 21217   (1)| 00:00:01␣
↪|       |      |
|   1 |  NESTED LOOPS             |           |       |       |       |          |      |
|   2 |   NESTED LOOPS            |           |  4960 |  2232K| 21217   (1)| 00:00:01␣
↪|       |      |
|   3 |    PARTITION RANGE ALL          |           |  4897 |  1219K|  1619   (1)|␣
↪00:00:01 |     1 |  20 |
|   4 |     TABLE ACCESS BY LOCAL INDEX ROWID| JOBS      |  4897 |  1219K|  1619   ␣
↪(1)| 00:00:01 |     1 |  20 |
|*  5 |      INDEX RANGE SCAN           | PROD_CONFIG  |  4897 |       |  88   (0)|␣
↪00:00:01 |     1 |  20 |
|   6 |    PARTITION RANGE ITERATOR        |           |   1 |       |   3   (0)|␣
↪00:00:01 |   KEY | KEY |
|*  7 |     INDEX RANGE SCAN         | JOBS_REP_VIS |     1 |       |   3   (0)|␣
↪00:00:01 |   KEY | KEY |
|   8 |   TABLE ACCESS BY LOCAL INDEX ROWID  | FILES     |   1 | 206 |   4   (0)|␣
↪00:00:01 |     1 |   1 |
-------------------------------------------------------------------------------------------------
↪--------------------------------
Predicate Information (identified by operation id):
---------------------------------------------------
 5 - access("J"."PRODUCTION"=51073)
 7 - access("J"."JOBID"="F"."JOBID" AND "F"."GOTREPLICA"='Yes')
Statistics
----------------------------------------------------------
 46  recursive calls
  0  db block gets
508  consistent gets
 46  physical reads
   1452  redo size
  56603  bytes sent via SQL*Net to client
640  bytes received via SQL*Net from client
 10  SQL*Net roundtrips to/from client
  1  sorts (memory)
  0  sorts (disk)
131  rows processed
```

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```
Problems:
    - the cost is a big number.
    - the consistent gets is very high
    - physical reads are very high
```

Note:

- You may have query which needs to read lot of data. In this case the consistent gets and physical reads are very high numbers. In that example if the consistent gets and physical reads are very high for example more than 10k we have problem. This is because the query only returned 131 rows.
- TABLE ACCESS FULL is not good. You have to make sure that the query uses an index. This is not always true.
- parallel execution you have to make sure if the query is running parallel, the processes does not send to much data between each other. If you run a query parallel and the consistent gets is very high then you have a problem. Contact to oracle IT/DB if you do not know what to do...
- CARTESIAN join: If you see that word in the execution plan, the query is wrong.

2.4.2 Steps in the Bookkeeping database

Steps are used to process/produce data. The steps are used by the Production Management system and work flow. The steps are stored in the steps table which has the following columns:

```
STEPID
STEPNAME
APPLICATIONNAME
APPLICATIONVERSION
OPTIONFILES
DDDB
CONDDB
EXTRAPACKAGES
INSERTTIMESTAMPS
VISIBLE
INPUTFILETYPES
OUTPUTFILETYPES
PROCESSINGPASS
USABLE
DQTAG
OPTIONSFORMAT
ISMULTICORE
SYSTEMCONFIG
MCTCK
```

The steps table has 3 triggers:

```
STEP_INSERT: This trigger is used to replace NULL, None to an empty string.
steps_before_insert: It checks that the processing pass contains a '/'.
step_update: The steps which are already used can not be modified.
```

Modifying steps

We may want to modify an already used steps. A step can be modified if the trigger is disabled. The following commands has to be performed in order to modify a step:

```
alter trigger step_update disable;
update steps set stepname='Reco16Smog for 2015 pA', processingpass='Reco16Smog' where␣
↪stepid=129609; --an alternative is to used the StepManager page
alter trigger step_update enable;
```

2.4.3 Processing pass in the Bookkeeping

The processing pass is a collection of steps. The processing pass is stored in the processing table:

```
ID
ParentID
Name
```

The following example illustrates how to create a step:

```
select max(id)+1 from processing;
select * from processing where name='Real Data';
insert into processing(id,parentid, name)values(1915,12,'Reco16Smog');
```

In this example we have created the following processing pass: /Real Data/Reco16Smog

The following query can be used to check the step:

```
SELECT * FROM (SELECT distinct SYS_CONNECT_BY_PATH(name, '/') Path, id ID
     FROM processing v   START WITH id in (select distinct id from processing where␣
↪name='Real Data')
CONNECT BY NOCYCLE PRIOR  id=parentid) v   where v.path='/Real Data/Reco16Smog';
```

If we know the processing id, we can use the following query to found out the processing pass:

```
SELECT v.id,v.path FROM (SELECT distinct  LEVEL-1 Pathlen, SYS_CONNECT_BY_PATH(name,
↪'/') Path, id
  FROM processing
  WHERE LEVEL > 0 and id=1915
  CONNECT BY PRIOR id=parentid order by Pathlen desc) v where rownum<=1;
```

2.4.4 Bookkeeping down time

The following services/agent needs to be stopped before the deep down time (SystemAdministrator can be used in order to manage the services):

```
RMS:
        RequestExecutingAgent
                check it really stops (may take long time)
TS:
        BookkeepingWatchAgent
        TransformationAgent - Reco, DM, MergePlus (this to be checked). This was not␣
↪stopped the latest deep downtime
        TransformationCleaningAgent
```

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```
        MCSimulationTestingAgent
PMS:
        ProductionStatusAgent
        RequestTrackingAgent
DMS:
        PopularityAgent
StorageHistoryAgents(s)
```

Just before the intervention stop all Bookkeeping services.

2.4.5 Automatic updating of the productionoutputfiles

Create an oracle periodic job:

```
BEGIN
  DBMS_SCHEDULER.CREATE_JOB (
     job_name             => 'produpdatejob',
     job_type             => 'PLSQL_BLOCK',
     job_action           => 'BEGIN BKUTILITIES.updateProdOutputFiles(); END;',
     repeat_interval      => 'FREQ=MINUTELY; interval=10',
     start_date           => systimestamp,
     enabled              =>  TRUE
     );
  END;
  /
```

For monitoring:

```
select JOB_NAME, STATE, LAST_START_DATE, LAST_RUN_DURATION, NEXT_RUN_DATE, RUN_COUNT,␣
↪FAILURE_COUNT from USER_SCHEDULER_JOBS;
```

Debugging the produpdatejob in case of failure:

- sqlplus LHCB_DIRACBOOKKEEPING/xxxxx@LHCB_DIRACBOOKKEEPING
- set serveroutput on
- exec BKUTILITIES.updateProdOutputFiles();

You will see the problematic production, which you will need to fix. For example: If the production is 22719, you can use the following queries for debug:

```
SELECT j.production,J.STEPID, f.eventtypeid, f.filetypeid, f.gotreplica, f.
↪visibilityflag
        FROM jobs j, files f WHERE
                j.jobid = f.jobid AND
                j.production=22719 and
                f.gotreplica IS NOT NULL and
                f.filetypeid NOT IN(9,17) GROUP BY j.production, J.STEPID, f.
↪eventtypeid, f.filetypeid, f.gotreplica, f.visibilityflag Order by f.gotreplica,f.
↪visibilityflag asc;

select * from files f, jobs j where
                j.jobid = f.jobid AND
                j.production=22719 and
                f.gotreplica IS NOT NULL and
```

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```
    f.eventtypeid is NULL and
                f.filetypeid NOT IN(9,17);

update files set eventtypeid=90000000 where fileid in (select f.fileid from files f,␣
↪jobs j where  j.jobid = f.jobid AND
j.production=22719 and
f.gotreplica IS NOT NULL and
f.eventtypeid is NULL and
f.filetypeid NOT IN(9,17));

commit;
```

2.4.6 Managing partitions

jobs and *files* tables are partitioned. *jobs* table RANGE-HASH partitioned by *production* and *configurationid*. *files* table RANGE partitioned by *jobid*.

jobs table partitions

The last partitions called *prodlast* and *runlast*. The maximum value of the *prodlast* partition is MAXVALUE. This may require to split, if we see performance degradation. This can happen if two many rows (*jobs*) belong to this partition. The recommended way to split the partition is to declare a down time, because when the partition split then the non partitioned indexes become invalid. The non partitioned indexes needs to be recreated, which will block writing to the DB. The procedure for splitting the *prodlast* partition:

```
select max(production) from jobs PARTITION(prodlast) where production!=99998;
ALTER TABLE jobs SPLIT PARTITION prodlast AT (xxxxx) INTO (PARTITION prodXXX,␣
↪PARTITION prodlast);
```

One of the possibility is to split the *prodlast* using the last production, which can be retrieved using the following query above. *xxxxx* is the result of the query. *prodXXX* is the last partition+1. For example:

```
select max(production) from jobs PARTITION(prodlast) where production!=99998;
```

which result is 83013

```
ALTER TABLE jobs SPLIT PARTITION prodlast AT (83013) INTO (PARTITION prod4, PARTITION␣
↪prodlast);
```

Rebuild the non partitioned indexes:

```
ALTER INDEX SYS_C00302478 REBUILD;
ALTER INDEX JOB_NAME_UNIQUE REBUILD;
```

files table partitions

This table is RANGE partitioned by *jobid*, which can reach the maximum value of the existing partition. It this happen, the following error will appear:

```
2018-07-30 01:12:00 UTC dirac-jobexec/UploadOutputData ERROR: Could not send␣
↪Bookkeeping XML file to server:
Unable to create file /lhcb/MC/2015/SIM/00075280/0000/00075280_00009971_1.sim !␣
↪ERROR: Excution failed.: (
ORA-14400: inserted partition key does not map to any partition
ORA-06512: at "LHCB_DIRACBOOKKEEPING.BOOKKEEPINGORACLEDB", line 976
ORA-06512: at line 1
```

In order to fix the issue a new partition has to be created:

```
alter table files add PARTITION SECT_0620M  VALUES LESS THAN (620000000);
```

2.4.7 Database monitoring

Various queries are available in the BookkeepingSystem/DB/monitoring.sql file. They can be used for discovering problems such as database locks, broken oracle jobs, sessions, used indexes, etc.

2.4.8 ProductionOutputFiles table

The table contains data used for speeding up some queries. This table contains aggregated data used by the BkQuery. The queries are very fast because it does not require join of the two main tables *files* and *jobs*. The table is filled when a production is created. The addProduction method add all necessary info for this table. The table contains the following columns:

```
Production
Stepid
EventtypeId
FileTypeId
Visible
GotReplica
```

The *visible* and *GotReplica* columns can be changed when all files are removed from a production, or when a file is set to invisible (i.e. when the files are archived, they are not supposed to be used by the users.) be used by the users). In order to update this table, the following stored procedure is used:

```
BKUTILITIES.updateProdOutputFiles
```

This method updates the productions with *visible* and *gotreplica* flags that have changed in the last 3 days. The procedure is run by an Oracle job. It is scheduled every 10 minutes. More details in the *LHCbBookkeeping database administration* document.

2.4.9 Fill ProductionOutputFiles table

The productionoutputfiles table is used for removing the materialized views (MV). It is introduced June 2017. This document is describes about how the table propagated with some meaningful data.

Note: This document can be useful if we want to know what changes applied to the db. Before we created a table for keeping track about the migration.

```
create table prods as select distinct production from jobs where production not in␣
↪(select production from productionoutputfiles);
```

- **This table contains all productions, which are not in the productionoutputfiles table. The productions which are entered a** already in this table

```
alter table prods add processed char(1) default 'N' null;
```

- In order to keep which productions are inserted to the productionoutputfiles table.

```
alter table prods add stepid char(1) default 'N' null;
```

- The all jobs which belong to this prod does not have stepid.

```
alter table prods add problematic char(1) default 'N' null;
```

- Duplicated steps in the stepscontainer table.

The migration started with the runs (production<0) and with the prods.processed='N':

```
declare
    begin
    FOR stcont in (select distinct ss.production from stepscontainer ss where ss.
↪production in (select p.production from prods p where p.processed='N' and p.
↪production<0)) LOOP
      DBMS_OUTPUT.put_line (stcont.production);
      FOR st in (select s.stepid, step from steps s, stepscontainer st where st.
↪stepid=s.stepid and st.production=stcont.production order by step) LOOP
        FOR f in (select distinct j.stepid,ft.name, f.eventtypeid, ft.filetypeid, f.
↪visibilityflag from jobs j, files f, filetypes ft
                      where ft.filetypeid=f.filetypeid and f.jobid=j.jobid and
                      j.production=stcont.production and j.stepid=st.stepid and f.
↪filetypeid not in (9,17) and eventtypeid is not null) LOOP
          DBMS_OUTPUT.put_line (stcont.production||'->'||st.stepid||'->'||f.
↪filetypeid||'->'||f.visibilityflag||'->'||f.eventtypeid);
          BOOKKEEPINGORACLEDB.insertProdnOutputFtypes(stcont.production, st.stepid, f.
↪filetypeid, f.visibilityflag,f.eventtypeid);
          update prods set processed='Y' where production=stcont.production;
        END LOOP;
      END LOOP;
      commit;
    END LOOP;
    END;
    /
    END LOOP;
    END;
    /
```

After I have noticed we have jobs without stepid. In order to fix this issue executed the following commands:

```
create table stepscontainer_2018_09_20 as select * from stepscontainer;
```

- this is used for backup, because the duplicated entries will be deleted...

To fill the stepid for the non processed runs:

```
declare
found number;
prname varchar2(256);
prversion varchar2(256);
prev_name varchar2(256);
```

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```
prev_version varchar2(256);
rep number;
begin
FOR stcont in (select p.production from prods p where p.processed='N' and p.production
↪<0) LOOP
  found:=0;
  select count(*) into found from jobs where production=stcont.production and stepid␣
↪is null;
  if found>0 then
    prev_name:=null;
    prev_version:=null;
    for sts in (select stepid, step from stepscontainer where production=stcont.
↪production order by step) LOOP
      DBMS_OUTPUT.put_line ('Stepid'||sts.stepid||'Prod'||stcont.production);
      select applicationname, applicationversion into prname,prversion from steps␣
↪where stepid=sts.stepid;
      if prev_name is null and prev_version is null then
        prev_name:=prname;
        prev_version:=prversion;
        --DBMS_OUTPUT.put_line ('Update:'|| stcont.production);
        update jobs set stepid=sts.stepid where programname=prname and␣
↪programversion=prversion and production=stcont.production;
        update prods set stepid='Y' where production=stcont.production;
      elsif prev_name=prname and prev_version=prversion then
         DBMS_OUTPUT.put_line ('Problematic:'|| stcont.production);
         delete stepscontainer where production=stcont.production and stepid=sts.
↪stepid;
         update prods set problematic='Y' where production=stcont.production;
      else
        --DBMS_OUTPUT.put_line ('Update:'|| stcont.production);
        update jobs set stepid=sts.stepid where programname=prname and␣
↪programversion=prversion and production=stcont.production;
        update prods set stepid='Y' where production=stcont.production;
        prev_name:=prname;
        prev_version:=prversion;
      END if;
    END LOOP
    commit;
  END if;
END LOOP;
END;
/
```

After executing this procedure 21309 productions are fixed:

```
select count(*) from prods where stepid='Y' and production<0;
```

Now we can add these productions to the productionoutputfiles table:

Check how many runs are processed:

```
select count(*) from prods where processed='Y' and production<0;
```

the result is 14026 Check all the runs which are not processed:

```
select count(*) from prods where stepid='Y' and processed='N' and production
↪<0; result is 21308
```

Note: 21309!=21308 because I did a test before executing the procedure.

```
declare
begin
FOR stcont in (select distinct ss.production from stepscontainer ss where ss.
↪production in (select p.production from prods p where stepid='Y' and p.processed='N
↪' and p.production<0)) LOOP
  DBMS_OUTPUT.put_line (stcont.production);
  FOR st in (select s.stepid, step from steps s, stepscontainer st where st.stepid=s.
↪stepid and st.production=stcont.production order by step) LOOP
    FOR f in (select distinct j.stepid,ft.name, f.eventtypeid, ft.filetypeid, f.
↪visibilityflag from jobs j, files f, filetypes ft
                  where ft.filetypeid=f.filetypeid and f.jobid=j.jobid and
                  j.production=stcont.production and j.stepid=st.stepid and f.
↪filetypeid not in (9,17) and eventtypeid is not null) LOOP
      DBMS_OUTPUT.put_line (stcont.production||'->'||st.stepid||'->'||f.filetypeid||'-
↪>'||f.visibilityflag||'->'||f.eventtypeid);
      BOOKKEEPINGORACLEDB.insertProdnOutputFtypes(stcont.production, st.stepid, f.
↪filetypeid, f.visibilityflag,f.eventtypeid);
      update prods set processed='Y' where production=stcont.production;
    END LOOP;
  END LOOP;
  commit;
END LOOP;
END;
/
END LOOP;
END;
/
```

```
select count(*) from prods where stepid='Y' and processed='N' and production<0;
```

the result is 260. Checking one of the production -22595: this run does not has associated files.

The following script is used to fix the 260 problematic runs:

```
DECLARE
nbfiles number;
BEGIN
for prod in (select production from prods where stepid='Y' and processed='N' and␣
↪production<0)
LOOP
   select count(*) into nbfiles from jobs j, files f where j.jobid=f.jobid and j.
↪production=prod.production and j.production<0;
   if nbfiles = 0 then
     DBMS_OUTPUT.put_line ('DELETE:'|| prod.production);
     delete runstatus where runnumber=-1 * prod.production;
     delete jobs where production<0 and production=prod.production;
     delete productionscontainer where production=prod.production;
     delete stepscontainer where production=prod.production;
     update prods set processed='Y' where production=prod.production;
     commit;
   END IF;
END LOOP;
END;
/
```

After checking the result:

```
SQL> select production from prods where stepid='Y' and processed='N' and production<0;

PRODUCTION
----------
    -9
```

After this fix we check how many runs are not in the productionoutputfiles table:

```
SQL> select count(*) from prods p where p.processed='N' and p.production<0;

COUNT(*)
----------
   155
```

After checking the runs, we noticed the stepid is okay, but the runs do not have any files. For fixing:

```
DECLARE
nbfiles number;
BEGIN
for prod in (select production from prods where processed='N' and production<0)
LOOP
   select count(*) into nbfiles from jobs j, files f where j.jobid=f.jobid and j.
↪production=prod.production and j.production<0;
   if nbfiles = 0 then
     DBMS_OUTPUT.put_line ('DELETE:'|| prod.production);
     delete runstatus where runnumber=-1 * prod.production;
     delete jobs where production<0 and production=prod.production;
     delete productionscontainer where production=prod.production;
     delete stepscontainer where production=prod.production;
     update prods set processed='Y' where production=prod.production;
     commit;
   END IF;
END LOOP;
END;
/
```

We can check how many runs are remained:

```
SQL> select * from prods p where p.processed='N' and p.production<0;

PRODUCTION P S P
---------- - - -
-42854 N N N
    -9 N Y N
```

-9 can be deleted:

```
SQL> select count(*) from jobs j, files f where j.jobid=f.jobid and j.production=-9␣
↪and f.gotreplica='Yes';

COUNT(*)
----------
     0
```

The runs are almost fixed:

```
SQL> select * from prods p where p.processed='N' and p.production<0;

PRODUCTION P S P
---------- - - -
-42854 N N N
```

Fixing the productions which are not in the stepscontainer:

```
declare
stepid number;
stnum number;
begin
for prod in (select p.production from prods p where p.processed='N' and p.production>
↪0 and p.production not in (select distinct ss.production from stepscontainer ss))
LOOP
  stnum:=0;
  FOR jprod in (select j.programName, j.programVersion, f.filetypeid, ft.name, f.
↪visibilityflag, f.eventtypeid from jobs j, files f, filetypes ft where ft.
↪filetypeid=f.filetypeid and j.jobid=f.jobid and j.production=prod.production and j.
↪stepid is null and f.filetypeid not in (9,17) and f.eventtypeid is not null group␣
↪by j.programName, j.programVersion, f.filetypeid, ft.name, f.visibilityflag, f.
↪eventtypeid
   Order by( CASE j.PROGRAMNAME WHEN 'Gauss' THEN '1' WHEN 'Boole' THEN '2' WHEN
↪'Moore' THEN '3' WHEN 'Brunel' THEN '4' WHEN 'Davinci' THEN '5' WHEN 'LHCb' THEN '6
↪' ELSE '7' END))
  LOOP
    stnum:=stnum+1;
     DBMS_OUTPUT.put_line ('Production:'||prod.production||'  applicationname:'||␣
↪jprod.programname||'  APPLICATIONVERSION:'||jprod.programversion||stnum);
    select count(*) into stepid from steps s, table(s.outputfiletypes) o where s.
↪applicationname=jprod.programname and s.APPLICATIONVERSION=jprod.programversion and␣
↪o.name=jprod.name and o.visible=jprod.visibilityflag and ROWNUM<2;
    if stepid>0 then
      select s.STEPID into stepid from steps s, table(s.outputfiletypes) o where s.
↪applicationname=jprod.programname and s.APPLICATIONVERSION=jprod.programversion and␣
↪o.name=jprod.name and o.visible=jprod.visibilityflag and ROWNUM<2;
      --DBMS_OUTPUT.put_line ('Stepid:'|| stepid);
      BOOKKEEPINGORACLEDB.insertProdnOutputFtypes(prod.production, stepid, jprod.
↪filetypeid, jprod.visibilityflag,jprod.eventtypeid);
      update prods set processed='Y', stepid='Y' where production=prod.production;
      update jobs j set j.stepid=stepid where j.production=prod.production and j.
↪programname=jprod.programname and j.programversion=jprod.programversion;
      BOOKKEEPINGORACLEDB.insertStepsContainer(prod.production,stepid,stnum);
    else
      select count(*) into stepid from steps s, table(s.outputfiletypes) o where s.
↪applicationname=jprod.programname and s.APPLICATIONVERSION=jprod.programversion and␣
↪o.name=jprod.name and ROWNUM<2;
      if stepid > 0 then
        select s.stepid into stepid from steps s, table(s.outputfiletypes) o where s.
↪applicationname=jprod.programname and s.APPLICATIONVERSION=jprod.programversion and␣
↪o.name=jprod.name and ROWNUM<2;
        BOOKKEEPINGORACLEDB.insertProdnOutputFtypes(prod.production, stepid, jprod.
↪filetypeid, jprod.visibilityflag,jprod.eventtypeid);
        update prods set processed='Y', stepid='Y' where production=prod.production;
        update jobs j set j.stepid=stepid where j.production=prod.production and j.
↪programname=jprod.programname and j.programversion=jprod.programversion;
        BOOKKEEPINGORACLEDB.insertStepsContainer(prod.production,stepid,stnum);
```

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```
      else
        --DBMS_OUTPUT.put_line ('insert');
        SELECT applications_index_seq.nextval into stepid from dual;
        insert into steps(stepid,applicationName,applicationversion,␣
↪processingpass)values(stepid,jprod.programname,jprod.programversion,'FixedStep');
        BOOKKEEPINGORACLEDB.insertProdnOutputFtypes(prod.production, stepid, jprod.
↪filetypeid, jprod.visibilityflag,jprod.eventtypeid);
        update prods set processed='Y', stepid='Y' where production=prod.production;
        update jobs j set j.stepid=stepid where j.production=prod.production and j.
↪programname=jprod.programname and j.programversion=jprod.programversion;
        BOOKKEEPINGORACLEDB.insertStepsContainer(prod.production,stepid,stnum);
      END IF;
    END IF;
    commit;
  END LOOP;
END LOOP;
END;
/
```

NOTE: The files which do not have event type it is not added to the productionoutputfiles...

```
SQL> select * from prods p where p.processed='N' and p.production>0 and p.production␣
↪not in (select distinct ss.production from stepscontainer ss);

PRODUCTION P S P
---------- - - -
 52192 N N N
```

Added to the productionoutputfile:

```
exec BOOKKEEPINGORACLEDB.insertProdnOutputFtypes(52192, 128808, 88, 'Y',11114044);
exec BOOKKEEPINGORACLEDB.insertProdnOutputFtypes(52192, 129669, 121, 'Y',11114044);
```

Fix the remained productions:

```
declare
nb number;
begin
FOR stcont in (select distinct ss.production from stepscontainer ss where ss.
↪production in (select p.production from prods p where p.processed='N' and p.
↪production>0)) LOOP
  DBMS_OUTPUT.put_line (stcont.production);
  FOR st in (select s.stepid, step from steps s, stepscontainer st where st.stepid=s.
↪stepid and st.production=stcont.production order by step) LOOP
    select count(*) into nb from jobs j, files f, filetypes ft where ft.filetypeid=f.
↪filetypeid and f.jobid=j.jobid and j.production=stcont.production and j.stepid=st.
↪stepid and f.filetypeid not in (9,17) and eventtypeid is not null;
    if nb=0 then
      update jobs set stepid=st.stepid where production=stcont.production;
      commit;
    END IF;
    FOR f in (select distinct j.stepid,ft.name, f.eventtypeid, ft.filetypeid, f.
↪visibilityflag from jobs j, files f, filetypes ft
                  where ft.filetypeid=f.filetypeid and f.jobid=j.jobid and
                  j.production=stcont.production and j.stepid=st.stepid and f.
↪filetypeid not in (9,17) and eventtypeid is not null) LOOP
        DBMS_OUTPUT.put_line (stcont.production||'->'||st.stepid||'->'||f.filetypeid||
↪'->'||f.visibilityflag||'->'||f.eventtypeid);
```

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```
        BOOKKEEPINGORACLEDB.insertProdnOutputFtypes(stcont.production, st.stepid, f.
↪filetypeid, f.visibilityflag,f.eventtypeid);
        update prods set processed='Y' where production=stcont.production;
    END LOOP;
  END LOOP;
  commit;
END LOOP;
END;
/
```

```
select * from prods where processed='N';

PRODUCTION P S P
---------- - - -
 24179 N N N
-42854 N N N
```

Two production are problematic. The eventtypeid is null for 24179. -42854 is not yet deleted...

2.4.10 Consistency checks

We run some consistent checks in order to make sure the productionoutputfiles table correctly filled.

```
declare
counter number;
nb number;
begin
counter:=0;
for p in (select production,EVENTTYPEID,FILETYPEID, programname, programversion,␣
↪simid, daqperiodid from prodview)LOOP
   if p.simid>0 then
    select count(*) into nb from productionoutputfiles prod, productionscontainer ct,␣
↪steps s where ct.production=prod.production and
     prod.production=p.production and prod.filetypeid=p.filetypeid and prod.
↪eventtypeid=p.eventtypeid and prod.gotreplica='Yes' and prod.Visible='Y' and
     ct.simid=p.simid and s.stepid=prod.stepid and s.applicationname=p.programname␣
↪and s.applicationversion=p.programversion;
    else
     select count(*) into nb from productionoutputfiles prod, productionscontainer ct,
↪ steps s where ct.production=prod.production and
     prod.production=p.production and prod.filetypeid=p.filetypeid and prod.
↪eventtypeid=p.eventtypeid and prod.gotreplica='Yes' and prod.Visible='Y' and
     ct.daqperiodid=p.daqperiodid and s.stepid=prod.stepid and s.applicationname=p.
↪programname and s.applicationversion=p.programversion;
   end if;
   if nb=0 then
    DBMS_OUTPUT.put_line (nb||' '||p.production||'  '||p.EVENTTYPEID||' '||p.
↪FILETYPEID);
    counter:=counter+1;
   end if;
   if nb>1 then
    DBMS_OUTPUT.put_line ('DOUBLE:'||nb||' '||p.production||'  '||p.EVENTTYPEID||'
↪'||p.FILETYPEID);
   END IF;
END LOOP;
```

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```
DBMS_OUTPUT.put_line ('COUNTER:'||counter);
END;
/
```

1035 production found.

The following script is used to fix the productions which are wrong in the productionoutputfiles tabe.

```
declare
        counter number;
        nb number;
        begin
        counter:=0;
        for p in (select production,EVENTTYPEID,FILETYPEID, programname,␣
↪programversion, simid, daqperiodid from prodview)
    LOOP
   if p.simid>0 then
    select count(*) into nb from productionoutputfiles prod, productionscontainer ct,␣
↪steps s where ct.production=prod.production and
     prod.production=p.production and prod.filetypeid=p.filetypeid and prod.
↪eventtypeid=p.eventtypeid and prod.gotreplica='Yes' and prod.Visible='Y' and
     ct.simid=p.simid and s.stepid=prod.stepid;
    else
     select count(*) into nb from productionoutputfiles prod, productionscontainer ct,
↪ steps s where ct.production=prod.production and
     prod.production=p.production and prod.filetypeid=p.filetypeid and prod.
↪eventtypeid=p.eventtypeid and prod.gotreplica='Yes' and prod.Visible='Y' and
     ct.daqperiodid=p.daqperiodid and s.stepid=prod.stepid;
   end if;
   if nb=0 then
    for dat in (select j.production, J.STEPID, f.eventtypeid, f.filetypeid, f.
↪gotreplica, f.visibilityflag from
        jobs j, files f where j.jobid=f.jobid and j.production=p.production and f.
↪filetypeid not in (9,17) and
        f.eventtypeid is not null GROUP BY j.production, j.stepid, f.eventtypeid, f.
↪filetypeid, f.gotreplica, f.visibilityflag Order by f.gotreplica,f.visibilityflag␣
↪asc)
    LOOP
     select count(*) into nb from productionoutputfiles where production=dat.
↪production and
        stepid=dat.stepid and filetypeid=dat.filetypeid and visible=dat.
↪visibilityflag and
        eventtypeid=dat.eventtypeid and gotreplica=dat.gotreplica;
     if nb=0 then
        DBMS_OUTPUT.put_line (nb||' '||p.production||'  '||p.EVENTTYPEID||' '||p.
↪FILETYPEID);
        select count(*) into nb from productionoutputfiles where production=dat.
↪production and
        stepid=dat.stepid and filetypeid=dat.filetypeid and visible=dat.
↪visibilityflag and
        eventtypeid=dat.eventtypeid;
        if nb=0 then
            INSERT INTO productionoutputfiles(production, stepid, filetypeid, visible,
↪ eventtypeid,gotreplica)VALUES(dat.production,dat.stepid, dat.filetypeid, dat.
↪visibilityflag,dat.eventtypeid, dat.gotreplica);
        else
            update productionoutputfiles set gotreplica=dat.gotreplica where␣
↪production=dat.production and
```

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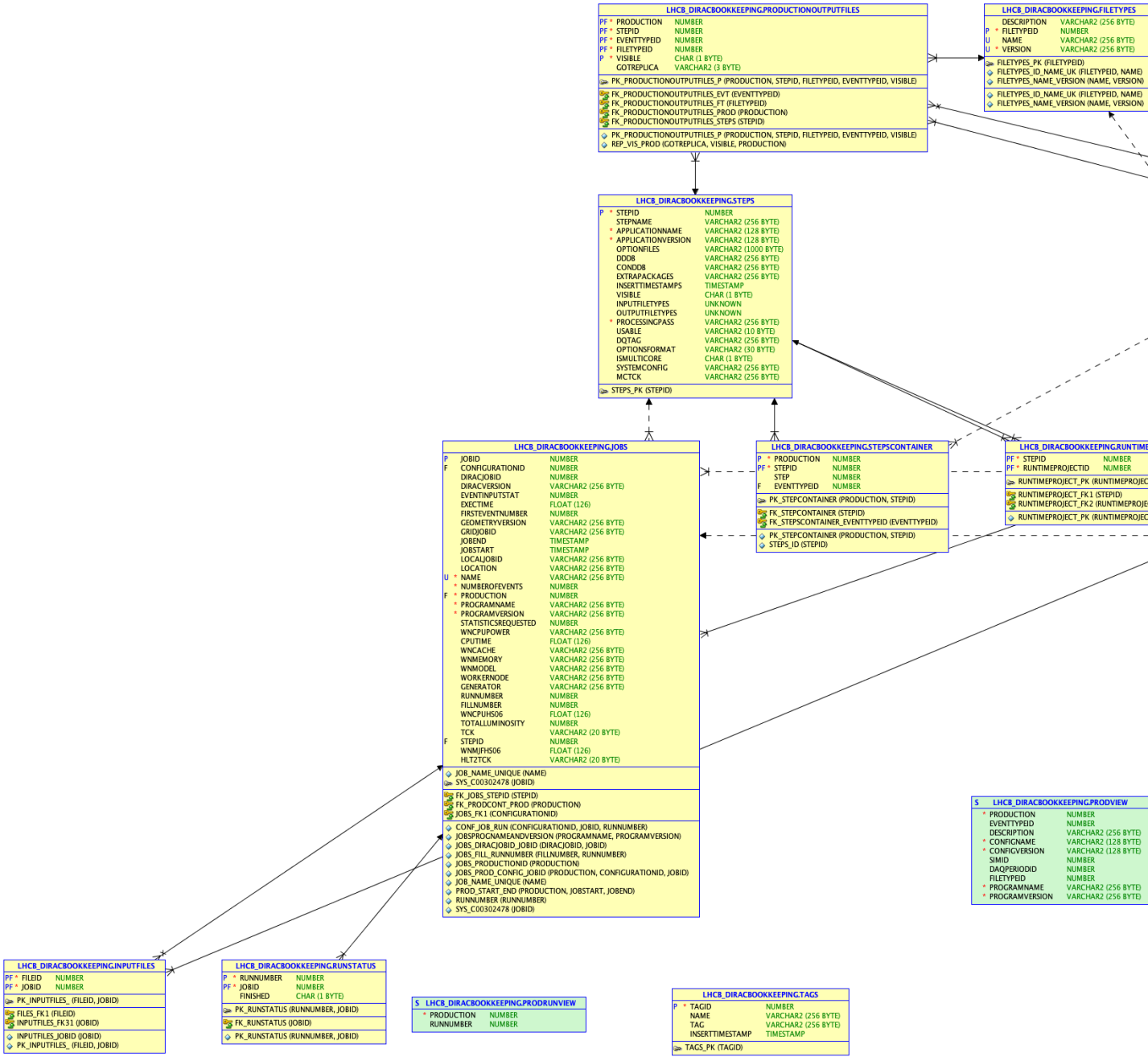
```
        stepid=dat.stepid and filetypeid=dat.filetypeid and visible=dat.
↪visibilityflag and
        eventtypeid=dat.eventtypeid;
        END IF;
        counter:=counter+1;
     end if;
    END LOOP;
   end if;
   if nb>1 then
    DBMS_OUTPUT.put_line ('DOUBLE:'||nb||' '||p.production||'  '||p.EVENTTYPEID||'
↪'||p.FILETYPEID);
   END IF;
END LOOP;
DBMS_OUTPUT.put_line ('COUNTER:'||counter);
END;
/
```

2.4.11 Bookkeeping database schema



The schema can be recreated using the following files:

```
LHCbDIRAC/BookkeepingSystem/DB/database_schema.sql

LHCbDIRAC/BookkeepingSystem/DB/oracle_utilities_stored_procedures.sql

LHCbDIRAC/BookkeepingSystem/DB/oracle_schema_storedprocedures.sql

LHCbDIRAC/BookkeepingSystem/DB/admin_tools.sql
```

Note: The fist and last file does not need to be executed. If you want to start with an empty database, you have to use them.

2.5 Data distribution

2.5.1 Policy

Archive

The default option is at *Operations/<Setup>/TransformationPlugins/Archive2SEs*. it can be overwritten in each plugin. The choice is done randomly.

DST broadcast

The broadcast done by LHCbDSTBroadcast plugin is done according to the free space

2.5.2 RAW files processing and distribution

The RAW files all have a copy at CERN, and are then distributed across the Tier1. The processing is shared between CERN and the Tier1.

The selection of the site for copying the data and the site where the data will be processed (so called *RunDestination*) is done by the *RAWReplication* plugin. To do so, it uses shares that are defined in *Operations/<Setup>/Shares*

Selection of a Tier1 for the data distribution

The quota are defined in *Operations/<Setup>/Shares/RAW*.

Since CERN has a copy of every file, it does not appear in the quota.

In practice, the absolute values are meaningless, what matters is their relative values. The total is normalized to a 100 in the code.

When choosing where a run will be copied, we look at the current status of the distribution, based on the run duration. The site which is the furthest from its objectives is selected.

Selection of a Tier1 for the data processing

Once a Tier1 has been selected to copy the RAW file, one needs to select a site where the data will be processed: either CERN or the Tier1 where the data is: the *RunDestination*. Note that the destination is chosen per Run, and will stay as is: all the production will process the run at the same location.

This is done using *Operations/<Setup>/Shares/CPUforRAW*. There, the values are independent: they should be between 0 and 1, and represents the fraction of data it will process compared to CERN. So if the value is 0.8, it means 80% of the data copied to that site will be processed at that site, and the 20 other percent at CERN.

This share is used by the processing plugin *DataProcessing*. The equivalent exists when reprocessing (plugin *DataReprocessing*): *Operations/<Setup>/Shares/CPUforReprocessing*

Change of values in the shares

Note: if a change is to be made after a transformation has already distributed a lot of files, it is better to start a new transformation.

The principle goes as follow, but is obviously better done with an Excel sheet.

From Rebus (https://gstat-wlcg.cern.ch/apps/pledges/resources/), we take for each T1 the CPUPledge (in MHS06) and the TapePledge (PB). We deduce easily the CPUPledgePercent and TapePledgePercent.

From the StorageUsageSummary, we get the CurrentTapeUsage (e.g. dirac-dms-storage-usage-summary –LCG –Site LCG.CERN.cern)

We then have:

```
AdditionalTape = TapePledge - CurrentTape
```

From which we deduce AdditionalTapePercent.

We then compute the ratio:

```
CPU / NewTape = CPUPledgePercent / AdditionalTapePercent
```

It represents the increase of CPU pledge vs the increase of Tape with respect to the total.

We then chose a certain percentage of data which is going to be processed at CERN. Say 20%. We then get:

```
CPUShare = CPUPledgePercent*(1-0.2)
```

The next step is to assign a CPUFraction (in [0:1]) by hand following this guideline: the lower the CPU/Tape ratio, the lower the fraction processed "locally".

The final step is to compute:

```
RAWShare = CPUShare/CPUFraction
```

It represents the percentage of data to be copied to the given T1.

Obviously, since we have an extra constraint, we have to give a degree of freedom. We normally give it to RAL with the following:

```
RALRAWShare = 100% - Sum(OtherShares)
RALCPUFraction = RALCpuShare / RALRAWShare
```

CPUFraction corresponds to *Operations/<Setup>/Shares/CPUforRAW*

RAWShare corresponds to *Operations/<Setup>/Shares/RAW*

2.5.3 MonteCarlo distribution

The distribution of MC relies on the *LHCbMCDstBroadcast* plugin. In order to know what to replicate, we use a wildcard in the bookkeeping query, and for each of the individual path, we start a transformation. To be sure not to start several time the same, we use the *–Unique* option.

The difficulty is to know for which year and which sim version to start. Gloria or Vladimir can tell you...

In order to list the BK paths that are going to be replicated:

```
for year in 2011 2012 2015 2016;
do
  for sim in Sim09b Sim09c;
  do
    dirac-dms-add-transformation --List --BK=/MC/$year//$sim/...Reco...;
  done;
done


List of processing passes for BK path /MC/2011//Sim09b/...Reco...

/Sim09b/Reco14c
/Sim09b/Reco14c/Stripping21r1NoPrescalingFlagged
/Sim09b/Trig0x40760037/Reco14c
/Sim09b/Trig0x40760037/Reco14c/Stripping20r1Filtered
/Sim09b/Trig0x40760037/Reco14c/Stripping20r1NoPrescalingFlagged
/Sim09b/Trig0x40760037/Reco14c/Stripping21r1Filtered
/Sim09b/Trig0x40760037/Reco14c/Stripping21r1NoPrescalingFlagged
/Sim09b/Trig0x40760037/Reco14c/Stripping21r1p1Filtered
/Sim09b/Trig0x40760037/Reco14c/Stripping21r1p1NoPrescalingFlagged
```

In order to actually start these replications:

```
for year in 2011 2012 2015 2016;
do
  for sim in Sim09b Sim09c;
  do
    dirac-dms-add-transformation --Plugin LHCbMCDSTBroadcastRandom --BK=/MC/$year//
↪$sim/...Reco... --Unique --Start;
  done;
done
```

2.5.4 Standing Transformations

it is useful to have some transformations always at hand where you can just add a few files. Here are a few:

```
# Replicate files to freezer
dirac-dms-add-transformation --Plugin ReplicateDataset --Destination CERN-FREEZER-EOS␣
↪--Name 'Replicate-to-Freezer-2018' --Force

# Replicate to local buffer
dirac-dms-add-transformation --Plugin=ReplicateToLocalSE --Dest=Tier1-Buffer --Name
↪'Replicate-to-local-Buffer-2018' --Force


# Replicate to RAW
dirac-dms-add-transformation --Plugin=ReplicateDataset --Dest=CERN-RAW --Name
↪'Replicate-to-CERN-RAW-2018' --Force
dirac-dms-add-transformation --Plugin=ReplicateDataset --Dest=GRIDKA-RAW --Name
↪'Replicate-to-GRIDKA-RAW-2018' --Force
dirac-dms-add-transformation --Plugin=ReplicateDataset --Dest=RAL-RAW --Name
↪'Replicate-to-RAL-RAW-2018' --Force
dirac-dms-add-transformation --Plugin=ReplicateDataset --Dest=IN2P3-RAW --Name
↪'Replicate-to-IN2P3-RAW-2018' --Force
dirac-dms-add-transformation --Plugin=ReplicateDataset --Dest=CNAF-RAW --Name
↪'Replicate-to-CNAF-RAW-2018' --Force
```

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```
dirac-dms-add-transformation --Plugin=ReplicateDataset --Dest=RRCKI-RAW --Name
↪'Replicate-to-RRCKI-RAW-2018' --Force
dirac-dms-add-transformation --Plugin=ReplicateDataset --Dest=PIC-RAW --Name
↪'Replicate-to-PIC-RAW-2018' --Force


# Replicate to DST
dirac-dms-add-transformation --Plugin=ReplicateDataset --Dest=CERN-DST-EOS --Name
↪'Replicate-to-CERN-DST-EOS-2018' --Force
dirac-dms-add-transformation --Plugin=ReplicateDataset --Dest=GRIDKA-DST --Name
↪'Replicate-to-GRIDKA-DST-2018' --Force
dirac-dms-add-transformation --Plugin=ReplicateDataset --Dest=RAL-DST --Name
↪'Replicate-to-RAL-DST-2018' --Force
dirac-dms-add-transformation --Plugin=ReplicateDataset --Dest=IN2P3-DST --Name
↪'Replicate-to-IN2P3-DST-2018' --Force
dirac-dms-add-transformation --Plugin=ReplicateDataset --Dest=CNAF-DST --Name
↪'Replicate-to-CNAF-DST-2018' --Force
dirac-dms-add-transformation --Plugin=ReplicateDataset --Dest=RRCKI-DST --Name
↪'Replicate-to-RRCKI-DST-2018' --Force
dirac-dms-add-transformation --Plugin=ReplicateDataset --Dest=PIC-DST --Name
↪'Replicate-to-PIC-DST-2018' --Force


# Replicate to MC-DST
dirac-dms-add-transformation --Plugin=ReplicateDataset --Dest=CERN_MC-DST-EOS --Name
↪'Replicate-to-CERN_MC-DST-EOS-2018' --Force
dirac-dms-add-transformation --Plugin=ReplicateDataset --Dest=GRIDKA_MC-DST --Name
↪'Replicate-to-GRIDKA_MC-DST-2018' --Force
dirac-dms-add-transformation --Plugin=ReplicateDataset --Dest=RAL_MC-DST --Name
↪'Replicate-to-RAL_MC-DST-2018' --Force
dirac-dms-add-transformation --Plugin=ReplicateDataset --Dest=IN2P3_MC-DST --Name
↪'Replicate-to-IN2P3_MC-DST-2018' --Force
dirac-dms-add-transformation --Plugin=ReplicateDataset --Dest=CNAF_MC-DST --Name
↪'Replicate-to-CNAF_MC-DST-2018' --Force
dirac-dms-add-transformation --Plugin=ReplicateDataset --Dest=RRCKI_MC-DST --Name
↪'Replicate-to-RRCKI_MC-DST-2018' --Force
dirac-dms-add-transformation --Plugin=ReplicateDataset --Dest=PIC_MC-DST --Name
↪'Replicate-to-PIC_MC-DST-2018' --Force




# To reduce number of replicas, based on data popularity
dirac-dms-add-transformation --Plugin ReduceReplicas --Number 1 --Name 'Reduce-to-1-
↪replica-2018' --Force
dirac-dms-add-transformation --Plugin ReduceReplicas --Number 2 --Name 'Reduce-to-2-
↪replicas-2018' --Force
dirac-dms-add-transformation --Plugin ReduceReplicas --Number 3 --Name 'Reduce-to-3-
↪replicas-2018' --Force


# remove from Tier1-Buffer
dirac-dms-add-transformation --Plugin RemoveReplicas --From Tier1-Buffer --Name
↪'Remove-from-Tier1-Buffer-2018' --Force
dirac-dms-add-transformation --Plugin RemoveReplicas --From Tier1-DST --Name 'Remove-
↪from-Tier1-DST-2018' --Force
```

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```
# destroy dataset
dirac-dms-add-transformation --Plugin=DestroyDataset --Name 'Destroy-dataset-2018' --
↪Force
```

2.6 ReStripping

2.6.1 Pre-Staging

We do the prestaging of the RDST and the RAW files before a re-stripping campaign. Both files are staged on the BUFFER storage of the run destination. A rough estimation of the last exercise is that we can stage about 100TB a day.

The staging of these two can be launched with a single command:

```
dirac-dms-add-transformation --Start --BK=<BKPATH> --Runs=<RUNRANGES> --
↪Plugin=ReplicateWithAncestors --DQFlags=OK,UNCHECKED --Dest=Tier1-Buffer
```

For example

```
dirac-dms-add-transformation --Start --BK=/LHCb/Collision17//RealData/Reco17//RDST --
↪Runs=191782:193500 --Plugin=ReplicateWithAncestors --DQFlags=OK,UNCHECKED --
↪Dest=Tier1-Buffer
```

In practice, the transformation plugin only knows about the RDST, and then adds the ancestors to the tasks.

Important parameters

A few operation parameters can be used to tune the staging. They are in *Operations/<setup>/TransformationPlugins/ReplicateWithAncestors*

TargetFilesAtDestination

This number sets an upper limit to the number of files allowed in total per **directory**. We look at the LFNs in the transformation, and take the directory of level 4 (in that case */lhcb/LHCb/Collision17/RDST*).

In order to know how many files are on an SE, we look into the StorageUsageDB for that specific directory.

Each SE has a share which is the TargetFilesAtDestination divided by the RAWShare of this site. The number of files in the SE should not be greater than this Share.

Since the StorageUsageDB is refreshed only once a day, we add the number of files Processed and Assigned in the last 12 hours to get a better estimate.

Example of logs in the TransformationAgent:

```
(V) [NoThread] [-9999] Get storage usage for directories /lhcb/LHCb/Collision16/RDST
(V) [NoThread] [-9999] Current storage usage per SE:
(V) [NoThread] [-9999]     CERN-BUFFER: 2
(V) [NoThread] [-9999]     CNAF-BUFFER: 41702
(V) [NoThread] [-9999]      RAL-BUFFER: 29
(V) [NoThread] [-9999]    RRCKI-BUFFER: 16
(V) [NoThread] [-9999] Shares per SE for 400000 files:
```

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```
(V) [NoThread] [-9999]     CERN-BUFFER: 79888.0
(V) [NoThread] [-9999]     CNAF-BUFFER: 57600.0
(V) [NoThread] [-9999]   GRIDKA-BUFFER: 52920.0
(V) [NoThread] [-9999]    IN2P3-BUFFER: 37080.0
(V) [NoThread] [-9999]      PIC-BUFFER: 19840.0
(V) [NoThread] [-9999]      RAL-BUFFER: 93152.0
(V) [NoThread] [-9999]    RRCKI-BUFFER: 26400.0
(V) [NoThread] [-9999]     SARA-BUFFER: 33120.0
(V) [NoThread] [-9999] Number of files Assigned or recently Processed (12 hours):
(V) [NoThread] [-9999]     CERN-BUFFER: 0
(V) [NoThread] [-9999]     CNAF-BUFFER: 15897
(V) [NoThread] [-9999]   GRIDKA-BUFFER: 0
(V) [NoThread] [-9999]    IN2P3-BUFFER: 0
(V) [NoThread] [-9999]      PIC-BUFFER: 0
(V) [NoThread] [-9999]      RAL-BUFFER: 0
(V) [NoThread] [-9999]    RRCKI-BUFFER: 0
(V) [NoThread] [-9999]     SARA-BUFFER: 0
[NoThread] [-9999] Maximum number of files per SE:
[NoThread] [-9999]     CERN-BUFFER: 79886
[NoThread] [-9999]     CNAF-BUFFER: 0
[NoThread] [-9999]   GRIDKA-BUFFER: 52919
[NoThread] [-9999]    IN2P3-BUFFER: 37080
[NoThread] [-9999]      PIC-BUFFER: 19840
[NoThread] [-9999]      RAL-BUFFER: 93122
[NoThread] [-9999]    RRCKI-BUFFER: 26383
[NoThread] [-9999]     SARA-BUFFER: 33120
```

MinFreeSpace

This is a water mark, in TB, and per SE. The information is taken from <CacheFeederAgent> Note that it is not very smart: if when we check, we are below the watermark, we do not create tasks. if we are above, we create them all, even if we will be well bellow after ! It is just a safeguard

2.6.2 Input Removal

Once a given RDST has been processed, it can be removed from BUFFER, as well as the associated raw file. This can be done with a single transformation:

```
dirac-dms-add-transformation --Plugin=RemoveReplicasWithAncestors --FromSE=Tier1-
↪Buffer --BK=<BKPATH> --ProcessingPass=PROCESSINGPASS> --DQFlags=OK,UNCHECKED --Runs=
↪<RUNRANGES> --Start
```

For example

```
dirac-dms-add-transformation --Plugin=RemoveReplicasWithAncestors --FromSE=Tier1-
↪Buffer --BK=/LHCb/Collision17/Beam6500GeV-VeloClosed-MagDown/RealData/Reco17//RDST -
↪-ProcessingPass=Stripping29r2 --DQFlags=OK,UNCHECKED --Runs=199386:200000 --Start
```

A few important points:

- the BKPath must contain the condition because that his what is used to find the production in which we check the descendants
- the processing pass is the output of the production

- Although not strictly needed, it is good practice to have one removal transformation per production, with the same run ranges.
- the production manager should extend the run ranges of both the production and the removal transformation

2.6.3 Output Replication

In the current computing model, the output is replicated on an archive and at a second DST storage. This is done using the LHCbDSTBroadcast plugin

```
dirac-dms-add-transformation --Plugin=LHCbDSTBroadcast --BK=<BKPATH> --Except
↪<USELESSSTREAM> --Start
```

For example

```
dirac-dms-add-transformation --Plugin=LHCbDSTBroadcast --BK=/LHCb/Collision15//
↪RealData/Reco15a/Stripping24r1//ALL.DST,ALL.MDST --Except CALIBRATION.DST --Start
```

Typical useless streams are normally *CALIBRATION.DST* and *MDST.DST*

2.6.4 Productions check

The productions need to be checked for consistency and from the Datamanagement point of view.

For the DataManagement, please see *DM checks at the end of Stripping* and *DM checks at the end of Merging*.

Also, some files might need to be cleaned manually because they were flagged bad during the production, see *Files unused in productions*.

2.7 Productions flushing

2.7.1 Flushing a transformation

Transformations normally have grouping factors: total size of the input files, number of files, etc. There are cases when the grouping conditions cannot be reached, for example if there are not enough files in the run to reach the threshold defined. In that case, the transformation can be *flushed*, meaning create tasks anyway with whatever is there.

The flushing is a manual operation that only has an impact on the files present at the moment of triggering it, meaning that if new files arrive later, they will accumulate again: a transformation does not stay in "flush mode".

2.7.2 Flushing a run in a transformation

Many transformations have a grouping by Run on top of a running by size/files. The same as described previously can happen: within a given run, the grouping conditions cannot be reached. In that case, it is possible to flush the run. There are two major differences compared to flushing a transformation:

1. Flushing a run is definitive
2. The procedure *can* be automatic

1. Flushing a run is definitive

Once a run is set to flush, it will stay in this state. This means that if new files arrive after flushing the run, they will not be accumulated, and a new task will be create for each and every file that arrives. This is not what you want normally. You can check here how to make sure that you can manually flush a run in the Merging: *Flushing runs*

2. Automatic run flushing for Merging

The principle always consists in going back to the RAW files of a run, and making sure that all of them have descendants in the current production. In practice, we count the number of RAW ancestors of the files in the production, and compare it with the number of RAW files declared in the BKK. These two numbers must match. This count is done by stream.

The only runs that are considered for flushing are the runs marked as 'finished' in the bookkeeping.

However, it might happen that a run does not get flushed. This normally shows an issue at the Stripping level. Consider the following example, with a Run that contains 3 raw files:

RAW file	RDST file	Stripping output
A.RAW	A.RDST	A.stream1, A.stream2, A.stream3
B.RAW	B.RDST	B.stream2, B.stream3, B.stream4
C.RAW	C.RDST	C.stream3, c.stream4

So, when looking at the ancestors per stream, we find:

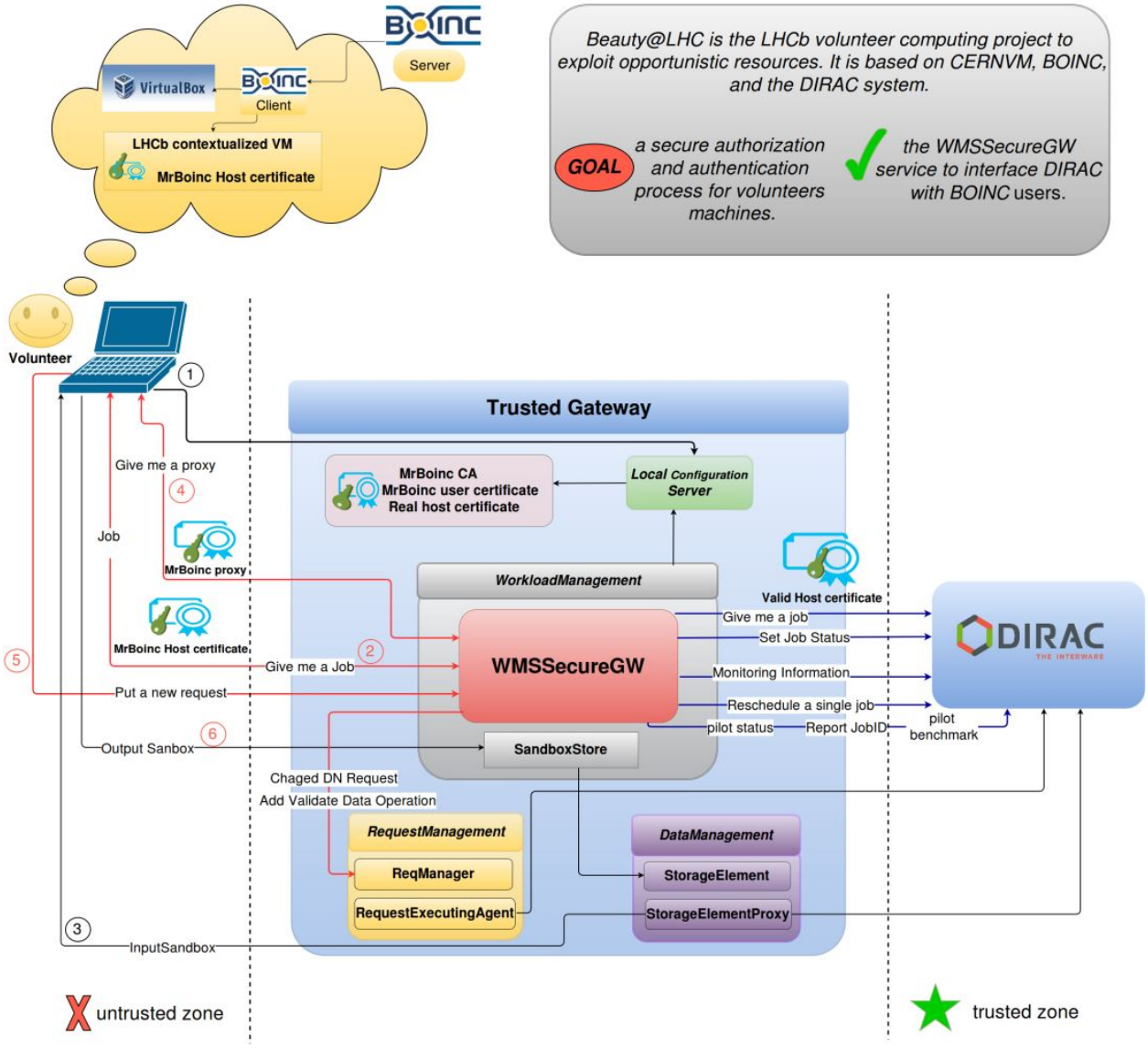
Stream	Nb of RAW ancestors
stream1	1
stream2	2
stream3	3
stream4	2

In that case, the flushing of the run will be triggered by stream3, since it finds the 3 ancestors. However, if in the stripping production, one file is never stripped because problematic, no stream will ever have all the raw files as ancestors, and the run will never be flushed. Hence, the run status in the merging is a good way to check the stripping :-)

Note that the script transformation-debug is more clever that the plugin, and can warn of such situations.

2.8 DIRAC on BOINC

2.8.1 Design of the system



Generic principle:

Two worlds, the trusted one (real Dirac system) and the untrusted one (Boinc client). The security relies on the gateway. In the untrusted world, we use only self sign certificates from a local CA. The BOINC gateway has two dirac configuration files: one for the trusted world, one for the untrusted world which is the one that is served by the local CS and that the jobs will see.

In the BOINC Gateway there are the following components:

- **DataManagement:**
  - StorageElement to upload the output of the Job

  - StorageElementProxy to fetch the input sandbox

- **RequestManagement:**
  - After the job execution, to forward to the trusted world the data after carefully checking it
- SandboxStore for the outputSandbox, which uses the local StorageElement
- **Configuration server:**
  - running the BOINC setup.
  - define all the URLs of all the systems to WMSSecureGW
- **WMSSecureGW:**
  - accept calls targeted at all systems (WMS, Monitoring, RMS, Accounting, etc) and redirect them to the trusted world.

The BOINC users only (almost, see below) talk to the WMSSecureGW, which redirects all the calls to the trusted world, using real host certificate. From the BOINC user perspective, it is just like they are talking to the real system.

Steps for running a job:

0. The machine boots with a MrBOINC host certificate integrated in the image
1. The machine starts a pilot that contacts the BOINC configuration server.
2. The pilot asks for a job to the WMSSecureGW, which will ask one to the trusted world, and return it
3. The pilot download the InputSandbox through a call to the StorageElementProxy (How is the authentication done ?)
4. The pilot asks for a proxy to the WMSSecureGW. It will receive a MrBoinc proxy.
5. After the job has finished, the job will upload the output to the StorageElement on the BOINC gateway (as failover) and send a RMS Request to the WMSSecureGW (see details in gw setup)
6. The output sandbox is uploaded to the BOINC gateway

The Request will be executed by the local RequestExecutingAgent, which will transfer all the output data to the trusted world.

Authentication and Authorization

Input sandbox download

The download goes through a StorageElementProxy. This means that if the real Sandbox SE is a dirac service, we will use the host certificate of the boinc gateway. This is the only case that can work. If the SE were an outside service (eos, anything else), we would use the MrBoinc proxy, and then fail.

Output data upload

The data is uploaded as MrBOINC to the BOINC-SE. The final copy to the real system will be done using the DN inserted to perform the replication request (see below).

Request modification

When a request is done, it is intercepted by the WMSSecureGW, which changes the ownerDN and add a first Operation which is WMSSecureOutput. For the time being, the ownerDN is always the one defined in *Operations/<setup>/BoincShifter/ProductionManager*. This should however change and be based on the actual job (see todo)

2.8.2 Configuration of the system

There are in facts two distinct configurations:

- The configuration used by the services and agents running on the gateway
- The configuration used by the jobs

Template files are available for you to use.

Configuration of services and agents

This configuration corresponds to the local configuration of the gateway as a vobox: the traditional dirac.cfg. An example of such file can be found `here`.

First of all, because the components on the gateway will interact with the real system, this configuration file has to refer to the real CS and the setup used should be the same as the one the jobs will run it (so in fact, your production setup normally).

Systems

Even if all the services and agents definition could be left in the central CS if standard, we rather recommend to redefine them locally to have a self contained configuration file. For a list of components, please see *here*.

We strongly recommend to define a database section totally different from the production one.

As for the URLs, you do not need to define most of them as the calls should go directly to the real system, however there are a few exceptions:

- *Framework/BoincProxyManager*: This URL should point at your local proxy manager. The reason is that the jobs will contact the WMSSecureGW to get a proxy. And this gateway will in fact query *Framework/BoincProxyManager* to retrieve the MrBoinc Proxy, and not *Framework/ProxyManager* not to leak any real proxy.
- *RequestManagement/ReqManager*: This URL should point at your local ReqManager. The reason is that any request that the job will try to put will go through the gateway, which will modify it slightly (see REFERENCE TO REQUEST MODIFICATION), and then forward it to the local ReqManager, to be executed by the local RequestExecutingAgent. No request from a BOINC Job should ever reach the central system.
- *RequestManagement/ReqProxyURLs*: this needs to be redefined to the local ReqProxy, otherwise the requests might enter the real system if they go through a central ReqProxy.

RequestExecutingAgent

There is a special Operation to define in the RequestExecutingAgent: *WMSSecureOutputData*. It can point to any module you like. This Operation will be inserted in the first position whenever a job puts a Request. Typically, it is a safety operation, where you can check anything you like (provenance, nature of the output data, etc).

StorageElementProxy

The StorageElementProxy will try getting the MrBoinc proxy when the job asks for the input sandbox. So for this service, we need to redefine the ProxyManager as pointing to the WMSSecureGW.

ReqProxy

The ReqProxy must go through the WMSSecureGW in order to upload the request with the right ownerDN otherwise it will come up with MrBoincUser. So for this service, we need to redefine the ReqManager as pointing to the WMSSecureGW.

Operations

To make sure to override anything that could be defined in the central CS, we need to put it in the setup specific section, not in the *Defaults* one.

- *BoincShifter/ProductionManager*: This is used by the WMSSecureGW to reassign the ownership of the requests coming from BOINC jobs. This will hopefully disappear in a future version.
- *BoincShifter/BoincShifter*: This is used by the WMSSecureGW to return the MrBoinc user proxy. The user and group should match what you define in Operations

Resources

StorageElements

Here you need to only define BOINC-SE as your local storage element. Technically, you could avoid it because it must be defined anyway in the real CS. All the access must be set to Active.

Registry

The DefaultGroup should be boinc_users.

Users

Only MrBoinc needs to be defined. The DN is the one of the user certificate you self generated (see *Create/Renew the MrBoinc User certificate and proxy*)

CAUTION: not sure now, probably need to redefine all the shifter users.

Groups

The groups are not merged with the central CS, but replaced. You should define a boinc_users group, with NormalUser as property, and add only MrBoinc in it.

Hosts

MrBoincHost should be defined as the certificate shipped with the VM image

Configuration for the jobs

This configuration is served to the jobs by the Configuration server running on the gateway. It basically just defines what the job needs in order to run.

The setup used should be the same as the real one (like LHCb-Certification), but you have to redefine the setup as using a different instance for each system (like boincInstance)

Systems

We only define the URLs, and all of them must point toe the WMSSecureGW. There is currently one exception: the DataStore, which is not handle by the WMSSecureGW.

LocalSite

This is your BOINC site name. It has to be consistend with what goes in the central CS (see bellow)

Operations

CAUTION: check which protocol really need modification * DataManagement: The protocol lists (RegistrationProtocols, ThirdPartyProtocols, WriteProtocols, AccessProtocols) need to be redefined in order to include 'proxy' * ResourceStatus/Config: disable RSS all together. * Services/Catalogs: define the catalogs you want to use.

Resources

- FileCatalog: define the catalogs you want to use.
- Sites: only the BOINC site is needed
- StorageElement: all the SEs a job might need to write to or read from. Most of the definition can be fake, but they need to be there. What matters is that the configuration of BOINC-SE, which is used as failover, is correct.
- StorageElementGroups: all the groups that might potentially be used by your jobs. Important is to redefine the failover as BOINC-SE
- Computing: this gives the OS compatibility. Take it from your real system. Hopefuly, pilot3 will get ride of that.

Configuration to put in the central CS

Some changes are needed on your real system to have jobs flowing in BOINC.

In order to have the matcher send jobs to BOINC, you need to define the site just like in the BOINC-Conf.cfg:

```
Resources
{
  Sites
  {
    BOINC
    {
      BOINC.World.org
      {
```

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```
        CE = Boinc-World-CE.org
        CEs
        {
          Boinc-World-CE.org
          {
            CEType = Boinc
            Queues
            {
              MaxCPUTime = 100000
              Boinc.World.Queue
              {
                MaxCPUTime = 100000
              }
            }
          }
          # This special CE is for sending test jobs with a special tag
          Boinc-World-TestCE.org
          {
            CEType = Boinc
            Tag = BoincTestJobs
            Queues
            {
              MaxCPUTime = 100000
              Boinc.World.TestQueue
              {
                MaxCPUTime = 100000
              }
            }
          }
        }
      }
    }
  }
}
```

You might also want to define some running limits (typically, at the moment, you only want MC running there):

```
Operations
{
  <Setup>
  {
    JobScheduling
    {
      RunningLimit
      {
        BOINC.World.org
        {
          JobType
          {
            User = 0
            MCSimulation = 500
          }
        }
      }
    }
  }
}
```

You have to define the BOINC SE, just like it is in the gateway dirac.cfg, without the file protocol. The reason is that the REA of the gateway will have RSS enabled, so RSS must know this SE. Define an always banned RSS rule for it, so RSS does not bother trying to test it:

```
Operations
{
  <Setup>
  {
    ResourceStatus
    {
      Policies
      {
        Ban_BOINC_SE
        {
          policyType = AlwaysBanned
          matchParams
          {
            name = BOINC-SE
            statusType = ReadAccess
            statusType += WriteAccess
            statusType += CheckAccess
            elementType = StorageElement
          }
        }
      }
    }
  }
}
```

2.8.3 Gateway setup

Certificate handling

First of all, a real certificate, trusted by your real system must be present on this machine. This is the one that will be used by the services and agents running on it. However, the untrusted world runs with self signed certificates. So we need to have our own CA.

Generate the CA certs

see https://jamielinux.com/docs/openssl-certificate-authority/index.html for detailed guide.

Work into `/path/to/boincCertificate` and there:

```
mkdir -p ca/newcerts ca/certs ca/crl
touch ca/index.txt
echo 1000 > ca/serial
echo 1000 > ca/crlnumber
```

Create the `openssl_config_ca.cnf` file (see below) in the `ca/` directory. You might need to edit it some path in the file.

Create the CA key

```
cd ca
# Type one of the two command below
openssl genrsa -aes256 -out ca.key.pem 4096     # for encrypted key
openssl genrsa -out ca.key.pem 4096             # for unencrypted key

chmod 400 ca.key.pem
```

Create the CA root certificate

```
openssl req -config openssl_config_ca.cnf  -key ca.key.pem  -new -x509 -days 7300 -
↪sha256 -extensions v3_ca -out ca.cert.pem
```

On the gateway machine, the CA certificate should be copied (*sym-link*) (`ca.cert.pem`) in `/etc/grid-security/certificates`. And the index hash link should be created

```
caHash=$(openssl x509 -in ca.cert.pem -noout -hash)
ln -s /etc/grid-security/certificates/ca.cert.pem /etc/grid-security/certificates/"
↪$caHash".0
```

Create/Renew the MrBoinc User certificate and proxy

Then we need a user certificate (MrBoinc User) self-signed by our own CA to be used in the untrusted world to obtain a MrBoinc user proxy.

Work into `/path/to/boincCertificate` and there:

```
mkdir MrBoinc
```

Create/use the `openssl_config_user.cnf` file (see below) in the `MrBoinc/` directory.

Create the MrBoinc User private key

```
openssl genrsa -out MrBoinc/userkey.pem 4096
chmod 400 MrBoinc/userkey.pem
```

Generate the certificate request

```
openssl req -config MrBoinc/openssl_config_user.cnf -key MrBoinc/userkey.pem  -new -
↪out MrBoinc/request.csr.pem
```

Create the MrBoinc User certificate, valid for 375 days

```
openssl ca -config ca/openssl_config_ca.cnf \
     -extensions usr_cert \
     -in MrBoinc/request.csr.pem \
     -out MrBoinc/usercert.pem
```

The MrBoinc user certificate must be then saved on the gateway machine under `~/.globus`.

MrBoinc Proxy generation

From the gateway machine, become the dirac user, and source the bashrc. Then:

```
lhcb-proxy-init \
   -o '/Systems/Framework/<your Setup>/URLs/ProxyManager=dips://<your gw machine>
↪:9152/Framework/ProxyManager'\
   -o '/DIRAC/Configuration/Servers=dips://<your gw machine>:9135/Configuration/Server
↪'\
   -U
#e.g.
lhcb-proxy-init \
 -o '/Systems/Framework/Certification/URLs/ProxyManager=dips://lbboinccertif.cern.
↪ch:9152/Framework/ProxyManager'\
 -o '/DIRAC/Configuration/Servers=dips://lbboinccertif.cern.ch:9135/Configuration/
↪Server'\
 -U
```

MrBoinc Proxy generation (DEPRECATED)

This procedure must be done after the gateway is setup

1. From lxplus: Ban the BOINC site
   - `lb-run LHCbDirac/prod bash --norc`
   - `lhcb-proxy-init -g lhcb_admin`
   - `dirac-admin-ban-site BOINC.World.org "boinc_proxy_renewal"`
2. From lbvobox46: you need to upload the new proxy in the proxydb of lbvobox46. As dirac user, do
   - `lhcb-proxy-init -o /Systems/Framework/Production/URLs/ProxyManager="dips://lbvobox46.cern.ch:9152/Framework/ProxyManager" -o /DIRAC/Configuration/Servers="dips://lbvobox46.cern.ch:9135/Configuration/Server" -g lhcb_pilot -v 1500:00 -U`
3. Allow the site from lxplus
   - `dirac-admin-allow-site BOINC.World.org "boinc_proxy_updated"`

2.8.4 Gateway DIRAC Installation

Just follow what is described in the documentation: http://dirac.readthedocs.io/en/latest/AdministratorGuide/InstallingDIRACService/index.html#install-primary-server

Use the install.cfg provied in the cfgTemplates

Then turn every component off in order to edit by hand the configuration files:

```
runsvctrl d startup/*
```

Use the provided configuration files

Take the dirac.cfg and BOINC-conf.cfg in the template, and adapt them. Remember that the dirac.cfg is used only by agents and services, and overwrites or adds little on top of the central CS. The BOINC-Conf.cfg is what is served to the BOINC VMs.

The advantage of using these templates is that it is much easier and faster. But hopefuly, they will stay up to date...

Generate the dirac.cfg (in progress...)

Move content of the BOINCCert.cfg to dirac.cfg : * all of Registry * remove website part * copy all the system definition

In dirac.cfg: * replace boincInstance with the real instance you want to map to (boincInstance -> certification) * replace DIRAC/Configuration/Servers with the real server * LocalSite: name the gateway * Registry: add MrBoincHost (after generating it) * DIRAC/Security/UseServerCertificate = True * In the URLs, ProxyManager -> BoincProxyManager

Edit the file:

- add the primary server URL
- change the setup to point to your real system and not local one
- run generateRunitEnv
- create the database by hand (ReqDB, proxyDB, sandboxstoreDB)
- Edit dirac.cfg

2.8.5 BOINC Image

The client side interaction is handled by CERN IT (Laurence Field atm). I am not sure how their whole system works, but the main point is that the client ends up booting an image: * contextualized by a user_data file which basically just specify the cvmfs path to use, and contain the MrBoincHost certificate and key (see below) * Start a pilot bootstrap script available here: https://gitlab.cern.ch/vc/vm/raw/master/bin/lhcb-pilot

2.8.6 Generate the MrBoinc host certificate

This certificate/key needs to be given to IT to add in the contextualization file.

Work into `/path/to/boincCertificate` and there:

```
mkdir MrBoincHost
```

Create the `openssl_config_host.cnf` file in the `MrBoincHost/` directory:

```
# Generate the key
openssl genrsa -out MrBoincHost/hostkey.pem 4096
chmod 400 MrBoincHost/hostkey.pem

# Create the request
openssl req -config MrBoincHost/openssl_config_host.cnf -key MrBoincHost/hostkey.pem ␣
↪-new -sha256 -out MrBoincHost/request.csr.pem

# Sign it
openssl ca -config ca/openssl_config_ca.cnf \
     -extensions server_cert \
```

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```
    -in MrBoincHost/request.csr.pem \
    -out MrBoincHost/hostcert.pem
```

This self-signed host certificate (MrBoinc Host) must then be saved on any BOINC VM in `/etc/grid-security`. Do not forget to add it to the list of trusted host for ProxyDelegation in the dirac.cfg of the gateway

2.8.7 Test

The BOINCDirac repository is here: https://github.com/DIRACGrid/BoincDIRAC

This is *generic*, right now (04/2017) is not used by LHCb. All the code used by LHCB is within LHCbDIRAC.

- VM creation and contextualization files (lhcb_pilot, create_image): https://gitlab.cern.ch/vc/vm/tree/master/bin
- Pilot v3 (the one used in VMs) code repository: https://github.com/DIRACGrid/Pilot

Start a pilot on VM to test the BOINC gateway service:

1. MrBoinc Host certificate under `/etc/grid-security` needed (or somewhere else)
2. Get the pilot files:

```
curl --insecure -L -O https://lhcb-portal-dirac.cern.ch/pilot/pilot.json
curl --insecure -L -O https://lhcb-portal-dirac.cern.ch/pilot/pilotTools.
↪py
curl --insecure -L -O https://lhcb-portal-dirac.cern.ch/pilot/
↪pilotCommands.py
curl --insecure -L -O https://lhcb-portal-dirac.cern.ch/pilot/
↪LHCbPilotCommands.py
curl --insecure -L -O https://lhcb-portal-dirac.cern.ch/pilot/dirac-
↪pilot.py
curl --insecure -L -O https://lhcb-portal-dirac.cern.ch/pilot/dirac-
↪install.py
```

4. Define the environment variables needed:

```
export X509_CERT_DIR=/cvmfs/lhcb.cern.ch/etc/grid-security/certificates/
export X509_VOMS_DIR=/cvmfs/lhcb.cern.ch/etc/grid-security/vomsdir
```

3. start the pilot with:

```
#run the dirac-pilot script
python ./dirac-pilot.py \
 --debug \
 --setup=<YOUR SETUP (LHCb-Certification)> \
 --pilotCFGFile=pilot.json \
 -l LHCb \
 -o LbRunOnly \
 --Name=<YOUR CE NAME (BOINCCert-World-CE.org) \
 --Queue=<YOUR QUEUE NAME (BoincCert.World.Queue)> \
 --MaxCycles=1 \
 --name=<YOUR BOINC SITE (BOINCCert.World.org)> \
 --cert \
 --certLocation=<CERTIFICATE LOCATION (/etc/grid-security/) \
 --commandExtensions LHCbPilot \
 --configurationServer <YOUR BOINC CONFIG SERVER (dips://lbboinccertif.
↪cern.ch:9135/Configuration/Server)>
```

2.8.8 TO-DO

Stalled jobs

In the current setup:

- The VM is running for a set amount of time (currently 24 hours)
- The JobAgent has no limit on its number of cycles

BOINC will kill the VM at the end of the set time, and any job that was running at the time will stall.

Some possible solutions are:

1) Put a limit of one cycle on the JobAgent, and shutdown the VM at the end of this cycle. This will end the BOINC task, and a new one will begin.
2) Make use of the planned $MACHINEFEATURES and $JOBFEAUTURES to signal that we have 24 hours of computing available and let the jobs adapt.

InputData

If we need input data, there is currently no way: the real storages are define so that the upload fail and we create a request. The downloading would need to go throught a proxy. Maybe we could have a read only proxy, and the result would be the same as for the sandbox?

SandboxStore

At the moment, the output sandbox are not used at all. They are uplaoded on the BOINC gateway, and stay there forever. We can: * not upload them (point to WMSSecureGW and always return S_OK) * forward them (either directly (not good) or by adding an extra step in the SecureOutput)

StorageElement

The disk often fills up because things are not cleaned.

Find the files and sort them by date:

```
find -type f -printf '%a %p\n'| sort -k1
```

Find files older than 60 days and sort:

```
find -mtime +60 -type f -printf '%a %p\n' | sort -k1
```

We can assume that after being there 60 days, they will not be touched anymore...

To remove, append to your find command:

```
-exec rm {} \;
```

Alternative (quicker find):

```
find -mtime +60 -type f -print0 | xargs -0 ls -lt
```

to keep only the path, append::

awk -F' ' '{print $9}'

to remove, append to the previous::

xargs rm -f

Accounting

BOINC credits

The BOINC accounting system is active and grants credits to the volunteers based on the time the VM ran and their CPU power.

This is not in most cases the actual work done on DIRAC jobs. This is maybe not an issue, as it still credit volunteers for the time they give us (after all, it's our problem if we don't use it).

Note that BOINC only gives credit at the end of a succesfull run. This has two constraints:

- VMs must have a set run time
- A failed or cancelled VM run on BOINC side will not grant credits, regardless of what happened inside the VM (eg. successful jobs)

An alternate method of granting credits on the run exist but is considered deprecated by the BOINC developers. Having this credit system enabled is pretty much mandatory to attract people within the BOINC community, especially the competitive minded volunteers.

LHCb accounting

Volunteers accounting

The Test4Theory project uses a second accounting method, based on the number of event produced. While not a good metric in our case as all events are not the same, a similar system could be implemented.

Currently, BOINC VMs hostname are set to boinc[host id]. This enables a basic job accounting, since the hostname will appear in the parameters of the jobs. Philippe Charpentier made a script to select jobs based on this: `WorkloadManagementSystem/scripts/dirac-wms-get-wn.py`. Because the hostname is not a primary key, this is slow. A web interface could be made available to volunteers to access this information.

Alternative? Use a noSQL db to store ~json~ data with job parameters (yet another accounting)

New VM contextualization / merge BOINC-specific changes ?

Quite a lot of BOINC-specific additions have been introduced in the contextualization and would need to be properly merged in the new contextualization. They currently reside in a branch at: http://svnweb.cern.ch/world/wsvn/dirac/LHCbVMDIRAC/branches/LHCbVMDIRAC_v0_BOINC_branch/.

Web page

The project web page is pretty much just the default BOINC page, this would probably need some additions.

Security aspects

The VM is now accessible as boinc:boinc:boinc. See the amiconfig file.

The certificate is in the image that is created. Use the SSH contextualization?

WMSSecureGW development

Some developments are clearly needed

- Do something sensible in the SecureOutput operation
- Set the owner DN to the real owner of the job, not the shifter
- Keep a mapping of "boincID <-> JobID" if possible

Other stuff

Laurence said that we could submit directly to his HTCondor, so we would not need anymore his intervention. Much better. We would need a MrBoinc pilot proxy, and a MrBoinc user proxy (could technicaly be the same) And then a site director on the BOINC gateway Luca should do that, with the help of Andrew.

2.8.9 HOW-TO

Process Completed Jobs

From the gateway (`lbboinc01.cern.ch`) have a look at the requests

- `dirac-rms-request --Job <JobIDs>`
- check if output files are registered and/or do exists at SE with `dirac-dms-pfn-exists <LFNs>`
- check if output files that do not exists @CERN have descendants with (on lxplus) `dirac-bookkeeping-get-file-descendants --All --Depth=100 <LFNs>`
- **if files have already descendants**
  - update the job status to 'Done'
  - remove the files @BOINC-SE-01 if needed with `dirac-dms-remove-files -o "/DIRAC/Security/UseServerCertificate=No" <LFN>`, using a valid Proxy (must be in `/tmp/x509up_uNNNNN` and exported to the env `export X509_USER_PROXY=/tmp/x509up_uNNNNN`)
- **if files are @CERN**
  - update the job status to 'Done'
  - DO NOT REMOVE the files!
- **if files have neither descendants nor are @CERN nor @BOINC-SE**
  - KILL the job
- dispose the LOG files properly (simply remove them if still registered @BOINC)

Remove files (triggered by Vlad)

From lbboinc01.cern.ch

- double check if files are registered in the FC and/or do exists at the SE with `dirac-dms-lfn-replicas <LFNs>` and/or `dirac-dms-pfn-exists <LFNs>`
- if files do not exists (anymore) @CERN-BUFFER, double check if they have descendants with (on lxplus) `dirac-bookkeeping-get-file-descendants --All --Depth=100 <LFNs>`
- double check the status of the Job(s) and update it accordingly
- if everything is ok, then

Using a valid Proxy (must be in `/tmp/x509up_uNNNNN` and exported to the env `export X509_USER_PROXY=/tmp/x509up_uNNNNN`):

- `dirac-dms-remove-files -o "/DIRAC/Security/UseServerCertificate=No" <LFN>`

this will remove file(s) both from SE and catalog.

If the file(s) is not registered in the catalog but exists on SE (or for checking if it does exist in the SE)

- use the script `remove-LFN-from-SE.py`

remove-LFN-from-SE.py

```
from DIRAC.Core.Base.Script import parseCommandLine
parseCommandLine()
from DIRAC.Resources.Storage.StorageElement import StorageElement
se = StorageElement('BOINC-SE-01')
lfns = [<list of LFNs>]
#se.exists(lfns)
#se.removeFile(lfns)
```

2.9 HowTo

2.9.1 HowTo

Productions

These advices can be applied to all sort of productions.

Hospital

When?

When all files have been processed except some that cannot make it due to either excessive CPU or memory (e.g. at IN2P3 jobs stalled)

How?

In the CS: /Operations/LHCb-Production/Hospital set 2 options: HospitalSite: for example CLOUD.CERN.cern (or any other site without strict limitations) Transformations: list of productions to be processed at the hospital queue

Then:

reset the files Unused. They will be brokered to the designated hospital site, wherever the input data is.

Example:

```
[localhost] ~ $ dirac-transformation-debug 71500 --Status MaxReset --Info jobs
 Transformation 71500 (Active) of type DataStripping (plugin ByRunWithFlush,␣
↪GroupSize: 1) in Real Data/Reco17/Stripping29r2
BKQuery: {'StartRun': 199386L, 'ConfigName': 'LHCb', 'EndRun': 200350L, 'EventType':␣
↪90000000L, 'FileType': 'RDST', 'ProcessingPass': 'Real Data/Reco17', 'Visible': 'Yes
↪', 'DataQualityFlag': ['OK', 'UNCHECKED'], 'ConfigVersion':
'Collision17', 'DataTakingConditions': 'Beam6500GeV-VeloClosed-MagDown'}

2 files found with status ['MaxReset']


 1 LFNs: ['/lhcb/LHCb/Collision17/RDST/00066581/0004/00066581_00043347_1.rdst'] :␣
↪Status of corresponding 5 jobs (sorted):
Jobs: 200059983, 200171070, 200415532, 201337455, 201397489
Sites (CPU): LCG.IN2P3.fr (3609 s), LCG.IN2P3.fr (3635 s), LCG.IN2P3.fr (3626 s), LCG.
↪IN2P3.fr (3617 s), LCG.IN2P3.fr (3649 s)
  5 jobs terminated with status: Failed; Job stalled: pilot not running; DaVinci step␣
↪1
      1 jobs stalled with last line: (LCG.IN2P3.fr) EventSelector     SUCCESS Reading␣
↪Event record 3001. Record number within stream 1: 3001
      1 jobs stalled with last line: (LCG.IN2P3.fr) EventSelector     SUCCESS Reading␣
↪Event record 4001. Record number within stream 1: 4001
      2 jobs stalled with last line: (LCG.IN2P3.fr) EventSelector     SUCCESS Reading␣
↪Event record 5001. Record number within stream 1: 5001
      1 jobs stalled with last line: (LCG.IN2P3.fr) EventSelector     SUCCESS Reading␣
↪Event record 3001. Record number within stream 1: 3001

 1 LFNs: ['/lhcb/LHCb/Collision17/RDST/00066581/0007/00066581_00074330_1.rdst'] :␣
↪Status of corresponding 7 jobs (sorted):
Jobs: 200339756, 200636702, 200762354, 200913317, 200945856, 201337457, 201397490
Sites (CPU): LCG.IN2P3.fr (32 s), LCG.IN2P3.fr (44 s), LCG.IN2P3.fr (46 s), LCG.IN2P3.
↪fr (45 s), LCG.IN2P3.fr (44 s), LCG.IN2P3.fr (3362 s), LCG.IN2P3.fr (38 s)
  7 jobs terminated with status: Failed; Job stalled: pilot not running; DaVinci step␣
↪1
      1 jobs stalled with last line: (LCG.IN2P3.fr) dirac-jobexec INFO: DIRAC JobID␣
↪200339756 is running at site LCG.IN2P3.fr
      1 jobs stalled with last line: (LCG.IN2P3.fr) dirac-jobexec/Subprocess VERBOSE:␣
↪systemCall: ['lb-run', '--use-grid', '-c', 'best', '--use=AppConfig v3r [...]
      1 jobs stalled with last line: (LCG.IN2P3.fr) dirac-jobexec/Subprocess VERBOSE:␣
↪systemCall: ['lb-run', '--use-grid', '-c', 'best', '--use=AppConfig v3r [...]
      1 jobs stalled with last line: (LCG.IN2P3.fr) dirac-jobexec/Subprocess VERBOSE:␣
↪systemCall: ['lb-run', '--use-grid', '-c', 'best', '--use=AppConfig v3r [...]
      1 jobs stalled with last line: (LCG.IN2P3.fr) dirac-jobexec/Subprocess VERBOSE:␣
↪systemCall: ['lb-run', '--use-grid', '-c', 'best', '--use=AppConfig v3r [...]
```

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```
     1 jobs stalled with last line: (LCG.IN2P3.fr) EventSelector     SUCCESS Reading␣
↪Event record 2001. Record number within stream 1: 2001
     1 jobs stalled with last line: (LCG.IN2P3.fr) dirac-jobexec/Subprocess VERBOSE:␣
↪systemCall: ['lb-run', '--use-grid', '-c', 'best', '--use=AppConfig v3r [...]
```

So 2 files have to be hospitalised. Reset them Unused:

```
[localhost] ~ $ dirac-transformation-reset-files 71500 --Status MaxReset
2 files were set Unused in transformation 71500
```

Stripping

DM checks at the end of Stripping

The procedure is very similar to the Merging production: *DM checks at the end of Merging*

Troubleshooting

files Assigned with no jobs.

The first action to take is always to check the descendants. Then several cases may arise.

Jobs killed, data upload failing

This can be seen from the log files. In that case, we clean whatever the old job managed to produce, and we re-strip the input files

```
[lxplus079] ~ $ grep InFCNotInBK CheckDescendantsResults_70268.txt | dirac-dms-check-
↪fc2bkk --FixFC
Got 16 LFNs
Checking replicas for 16 files : found 16 files with replicas and 0 without in 0.2␣
↪seconds
Getting 16 files metadata from BK : completed in 0.1 seconds
>>>>
16 files are in the FC but have replica = NO in BK
====== Now checking 16 files from FC to SE ======
Checking replicas for 16 files : found 16 files with replicas and 0 without in 5.2␣
↪seconds
Get FC metadata for 16 files to be checked:  : completed in 0.1 seconds
Check existence and compare checksum file by file...
Getting checksum of 16 replicas in 2 SEs
0. At CERN-BUFFER (13 files) : completed in 2.1 seconds
1. At PIC-BUFFER (3 files) : completed in 1.3 seconds
Verifying checksum of 16 files
No files in FC not in BK -> OK!
No missing replicas at sites -> OK!
No replicas have a bad checksum -> OK!
All files exist and have a correct checksum -> OK!
====== Completed, 16 files are in the FC and SE but have replica = NO in BK ======
0 files are visible, 16 files are invisible
/lhcb/LHCb/Collision16/BHADRON.MDST/00070268/0006/00070268_00061489_1.Bhadron.mdst :␣
↪Visi N
```

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```
/lhcb/LHCb/Collision16/BHADRON.MDST/00070268/0006/00070268_00063156_1.Bhadron.mdst :␣
↪Visi N
/lhcb/LHCb/Collision16/BHADRONCOMPLETEEVENT.DST/00070268/0006/00070268_00063156_1.
↪BhadronCompleteEvent.dst : Visi N
/lhcb/LHCb/Collision16/CALIBRATION.DST/00070268/0006/00070268_00060532_1.Calibration.
↪dst : Visi N
/lhcb/LHCb/Collision16/CALIBRATION.DST/00070268/0006/00070268_00063183_1.Calibration.
↪dst : Visi N
/lhcb/LHCb/Collision16/CHARM.MDST/00070268/0006/00070268_00060532_1.Charm.mdst : Visi␣
↪N
/lhcb/LHCb/Collision16/CHARM.MDST/00070268/0006/00070268_00063156_1.Charm.mdst : Visi␣
↪N
/lhcb/LHCb/Collision16/CHARM.MDST/00070268/0006/00070268_00063183_1.Charm.mdst : Visi␣
↪N
/lhcb/LHCb/Collision16/CHARMCOMPLETEEVENT.DST/00070268/0006/00070268_00063156_1.
↪CharmCompleteEvent.dst : Visi N
/lhcb/LHCb/Collision16/CHARMCOMPLETEEVENT.DST/00070268/0006/00070268_00063183_1.
↪CharmCompleteEvent.dst : Visi N
/lhcb/LHCb/Collision16/EW.DST/00070268/0001/00070268_00016205_1.EW.dst : Visi N
/lhcb/LHCb/Collision16/EW.DST/00070268/0006/00070268_00061489_1.EW.dst : Visi N
/lhcb/LHCb/Collision16/EW.DST/00070268/0006/00070268_00063156_1.EW.dst : Visi N
/lhcb/LHCb/Collision16/FTAG.DST/00070268/0001/00070268_00016205_1.FTAG.dst : Visi N
/lhcb/LHCb/Collision16/LEPTONIC.MDST/00070268/0001/00070268_00016205_1.Leptonic.mdst␣
↪: Visi N
/lhcb/LHCb/Collision16/LEPTONIC.MDST/00070268/0006/00070268_00063156_1.Leptonic.mdst␣
↪: Visi N
Full list of files:    grep InFCButBKNo CheckFC2BK-1.txt
Going to fix them, by removing from the FC and storage
Removing 16 files : completed in 22.1 seconds
Successfully removed 16 files
<<<<
No files in FC not in BK -> OK!
```

RDST files should be reset Unused automatically by the DRA:

```
NotProcWithDesc /lhcb/LHCb/Collision16/RDST/00051872/0000/00051872_00004324_1.rdst
NotProcWithDesc /lhcb/LHCb/Collision16/RDST/00051872/0007/00051872_00073248_1.rdst
NotProcWithDesc /lhcb/LHCb/Collision16/RDST/00051872/0007/00051872_00075929_1.rdst
NotProcWithDesc /lhcb/LHCb/Collision16/RDST/00051872/0013/00051872_00134216_1.rdst
NotProcWithDesc /lhcb/LHCb/Collision16/RDST/00051872/0013/00051872_00138382_1.rdst
```

Merging

DM checks at the end of Merging

When the Merging productions for a given Stripping are over, there are a couple of situations that might arise:

1. Output file is registered in the FC but is not registered in the BKK
2. Output file is registered in the FC but does not have the replica flag = No
3. Output file is registered in the BKK but not in the FC

First case

Nothing can be done, we do not have all the info, we should just remove the file. If it is a debug file, it will be cleaned anyway when cleaning the DEBUG storage.

Second case

Either the file is at its final destination, and in that case the replica flag can just be toggled (*–FixBK* in dirac-dms-check-fc2bkk), or the file is in a failover. In the later case, it is enough to replicate the file to its run destination (dirac-dms-replicate-to-run-destination) and remove the replica on the failover storage.

Third case

If the file physically exists, the file can just be registered in the FC.

Examples

The 3rd case is noticeable only in the output replication transformation, because it will mark these files as MissingInFC. For the first two cases, the best is to use *dirac-dms-check-fc2bkk*.

For example

```
[LHCbDirac prod] diracos $ dirac-dms-check-fc2bkk --Prod 69080,69076,68774,68772
Processing production 69080
Getting files from 18 directories  : found 5348 files with replicas and 0 without in␣
↪13.9 seconds
Getting 5348 files metadata from BK : completed in 1.8 seconds
>>>>
1 files are in the FC but have replica = NO in BK
====== Now checking 1 files from FC to SE ======
Checking replicas for 1 files : found 1 files with replicas and 0 without in 1.1␣
↪seconds
Get FC metadata for 1 files to be checked:  : completed in 0.1 seconds
Check existence and compare checksum file by file...
Getting checksum of 1 replicas in 1 SEs
0. At RAL-DST (1 files) : completed in 1.7 seconds
Verifying checksum of 1 files
No files in FC not in BK -> OK!
No missing replicas at sites -> OK!
No replicas have a bad checksum -> OK!
All files exist and have a correct checksum -> OK!
====== Completed, 1 files are in the FC and SE but have replica = NO in BK ======
1 files are visible, 0 files are invisible
/lhcb/LHCb/Collision15/BHADRONCOMPLETEEVENT.DST/00069080/0000/00069080_00003151_1.
↪bhadroncompleteevent.dst :
Visi Y
Full list of files:    grep InFCButBKNo CheckFC2BK-2.txt
Use --FixBK to fix it (set the replica flag) or --FixFC (for removing from FC and␣
↪storage)
<<<<
No files in FC not in BK -> OK!
Processed production 69080
Processing production 69076
```

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```
Getting files from 18 directories  : found 5789 files with replicas and 0 without in␣
↪10.3 seconds
Getting 5789 files metadata from BK : completed in 2.9 seconds
No files in FC with replica = NO in BK -> OK!
No files in FC not in BK -> OK!
Processed production 69076
Processing production 68774
Getting files from 18 directories  : found 7510 files with replicas and 0 without in␣
↪12.7 seconds
Getting 7510 files metadata from BK : completed in 2.8 seconds
No files in FC with replica = NO in BK -> OK!
No files in FC not in BK -> OK!
Processed production 68774
Processing production 68772
Getting files from 18 directories  : found 10702 files with replicas and 0 without in␣
↪14.8 seconds
Getting 10702 files metadata from BK : completed in 4.2 seconds
No files in FC with replica = NO in BK -> OK!
>>>>
1 files are in the FC but are NOT in BK:
/lhcb/debug/Collision15/LEPTONIC.MDST/00068772/0000/00068772_00003806_1.leptonic.mdst
Full list of files:    grep InFCNotInBK CheckFC2BK-3.txt
Use --FixFC to fix it (remove from FC and storage)
<<<<



[LHCbDirac prod] diracos $ dirac-dms-check-fc2bkk --
LFN=/lhcb/LHCb/Collision15/BHADRONCOMPLETEEVENT.DST/00069080/0000/00069080_00003151_1.
↪bhadroncompleteevent.dst
--FixBK
Checking replicas for 1 files : found 1 files with replicas and 0 without in 0.3␣
↪seconds
Getting 1 files metadata from BK : completed in 0.0 seconds
>>>>
1 files are in the FC but have replica = NO in BK
====== Now checking 1 files from FC to SE ======
Checking replicas for 1 files : found 1 files with replicas and 0 without in 4.8␣
↪seconds
Get FC metadata for 1 files to be checked:  : completed in 0.4 seconds
Check existence and compare checksum file by file...
Getting checksum of 1 replicas in 1 SEs
0. At RAL-DST (1 files) : completed in 1.0 seconds
Verifying checksum of 1 files
No files in FC not in BK -> OK!
No missing replicas at sites -> OK!
No replicas have a bad checksum -> OK!
All files exist and have a correct checksum -> OK!
====== Completed, 1 files are in the FC and SE but have replica = NO in BK ======
1 files are visible, 0 files are invisible
/lhcb/LHCb/Collision15/BHADRONCOMPLETEEVENT.DST/00069080/0000/00069080_00003151_1.
↪bhadroncompleteevent.dst :
Visi Y
Full list of files:    grep InFCButBKNo CheckFC2BK-4.txt
Going to fix them, setting the replica flag
       Successfully added replica flag to 1 files
```

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```
<<<<
No files in FC not in BK -> OK!

[LHCbDirac prod] diracos $ dirac-dms-remove-files
/lhcb/debug/Collision15/LEPTONIC.MDST/00068772/0000/00068772_00003806_1.leptonic.mdst
Removing 1 files : completed in 8.1 seconds
Successfully removed 1 files
```

jobs failing during finalize

Problem:

If a Merge job fails during finalisation, its input files may not be removed... In addition its output files may be incorrectly uploaded or registered Therefore starting from the left non-merged files one may find anomalies and fix them. This requiers getting invisible files in the DataStripping productions and checking their descendants in the Merge production

Examples:

Get the descendants of the DataStripping production (here 69528) that still have replicas, and check their descendants in the Merging production (here 69529)

```
[localhost] ~ $ dirac-bookkeeping-get-files --Production 69528 --Visi No | dirac-
↪production-check-descendants 69529
Got 59 LFNs
Processing Merge production 69529
Looking for descendants of type ['EW.DST', 'BHADRON.MDST', 'SEMILEPTONIC.DST',
↪'DIMUON.DST', 'CALIBRATION.DST', 'FTAG.DST', 'CHARMCOMPLETEEVENT.DST',
↪'BHADRONCOMPLETEEVENT.DST', 'CHARM.MDST', 'LEPTONIC.MDST']
Getting files from the TransformationSystem...
Found 59 processed files and 0 non processed files (1.2 seconds)
Now getting daughters for 59 processed mothers in production 69529 (depth 1) :␣
↪completed in 5.9 seconds
Checking replicas for 2 files : found 2 files with replicas and 0 without in 0.4␣
↪seconds
Checking FC for 2 file found in FC and not in BK |
↪              |Checking replicas for 2 files (not in Failover) : found 0 files with␣
↪replicas and 0 without in 0.5 seconds
: found 2 in Failover in 0.5 seconds

Results:
2 descendants were found in Failover and have no replica flag in BK
All files:
/lhcb/LHCb/Collision16/DIMUON.DST/00069529/0001/00069529_00012853_1.dimuon.dst
/lhcb/LHCb/Collision16/BHADRONCOMPLETEEVENT.DST/00069529/0001/00069529_00012813_1.
↪bhadroncompleteevent.dst
You should check whether they are in a failover request by looking at their job␣
↪status and in the RMS...
To list them:     grep InFailover CheckDescendantsResults_69529-1.txt
2 unique daughters found with real descendants
No processed LFNs with multiple descendants found -> OK!
No processed LFNs without descendants found -> OK!
```

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```
No non processed LFNs with multiple descendants found -> OK!
No non processed LFNs with descendants found -> OK!
Complete list of files is in CheckDescendantsResults_69529-1.txt
Processed production 69529 in 9.4 seconds
```

After checking at the RMS whether they have matching Requests, and if so what happened to it, we can replicate them to final destination and then remove from Failover

```
[localhost] ~ $ grep InFailover CheckDescendantsResults_69529-1.txt | dirac-dms-
↪replicate-to-run-destination --RemoveSource --SE Tier1-DST
Got 2 LFNs
Replicating 2 files to CERN-DST-EOS
Successful :
    CERN-DST-EOS :
        /lhcb/LHCb/Collision16/BHADRONCOMPLETEEVENT.DST/00069529/0001/00069529_
↪00012813_1.bhadroncompleteevent.dst :
             register : 0.757441997528
            replicate : 655.287761927
        /lhcb/LHCb/Collision16/DIMUON.DST/00069529/0001/00069529_00012853_1.dimuon.
↪dst :
             register : 0.632274866104
            replicate : 46.3780457973
```

Finally, Check again and remove non-merged files

```
[localhost] ~ $ dirac-dms-remove-files --Last
Got 59 LFNs
Removing 59 files : completed in 103.1 seconds
59 files in status Processed in transformation 69529: status unchanged
Successfully removed 59 files
```

Flushing runs

When a file is problematic in the Stripping production, or if a RAW file was not processed in the Reco, the run cannot be flushed automatically (Number of ancestors != number of RAW in the run). We list the runs in the Stripping productions (here 71498) that have problematic files, and we flush them in the Merging (here 71499)

```
[localhost] ~ $ dirac-transformation-debug 71498 --Status Problematic --Info files |␣
↪dirac-bookkeeping-file-path --GroupBy RunNumber --Summary
--List
Got 29 LFNs
Successful :
    RunNumber 201413 : 1 files
    RunNumber 201423 : 1 files
    RunNumber 201467 : 1 files
    RunNumber 201602 : 1 files
    RunNumber 201643 : 1 files
    RunNumber 201647 : 1 files
    RunNumber 201664 : 1 files
    RunNumber 201719 : 1 files
    RunNumber 201745 : 2 files
    RunNumber 201749 : 1 files
    RunNumber 201822 : 1 files
    RunNumber 201833 : 1 files
```

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```
    RunNumber 201864 : 1 files
    RunNumber 201873 : 1 files
    RunNumber 201983 : 1 files
    RunNumber 202031 : 1 files
    RunNumber 202717 : 1 files
    RunNumber 202722 : 1 files
    RunNumber 202752 : 1 files
    RunNumber 202773 : 1 files
    RunNumber 202809 : 1 files
    RunNumber 202825 : 1 files
    RunNumber 202835 : 2 files
    RunNumber 202860 : 1 files
    RunNumber 202869 : 1 files
    RunNumber 202873 : 1 files
    RunNumber 202887 : 1 files

List of RunNumber values
201413,201423,201467,201602,201643,201647,201664,201719,201745,201749,201822,201833,
↪201864,201873,201983,202031,202717,202722,2027
52,202773,202809,202825,202835,202860,202869,202873,202887
```

Then flush the runs in the merging production

```
[localhost] ~ $ dirac-transformation-flush-runs 71499 --Runs
201413,201423,201467,201602,201643,201647,201664,201719,201745,201749,201822,201833,
↪201864,201873,201983,202031,202717,202722,2027
52,202773,202809,202825,202835,202860,202869,202873,202887
Runs being flushed in transformation 71499:
201413,201423,201467,201602,201643,201647,201664,201719,201745,201749,201822,201833,
↪201864,201873,201983,202031,202717,202722,2027
52,202773,202809,202825,202835,202860,202869,202873,202887
27 runs set to Flush in transformation 71499
```

Then, starting from the runs that are not flushed in the Merging, we can check if some RAW files do not have descendant

```
dirac-bookkeeping-run-files <runNumber> | grep FULL | dirac-bookkeeping-get-file-
↪descendants
```

The files that are marked as NotProcessed or NoDescendants are in runs that will need to be flushed by hand

Another way of understanding why a run is not flushed is by using dirac-transformation-debug. But this takes a looooong while

```
dirac-transformation-debug --Status=Unused --Info=flush <mergingProd>
```

2.9.2 DataManagement

Checking unfinished runs

The run is declared finished by the online data mover once all the files have been transfered. it is good to check from time to time that no runs are left behind:

We start from the Reconstruction production (here 67722)

```
[localhost] ~ $ dirac-bookkeeping-run-information --Prod 67722 --Info Finished --
↪ByValue
Found 347 runs
Successful :
      No : (36 runs) - 201402,201403,201640,201971,201972,202804,202805,202821,[.....␣
↪more that are active...]
```

You can also give a run range

```
[LHCbDirac prod] SRPM $ dirac-bookkeeping-run-information 205957:212325 --Information␣
↪Finished --ByValue
Successful :
     No : (1 runs) - 212325
    Yes : (2129 runs) - 205957,205958,[...]
```

A bit of cleaning

From StorageUsagePlot

From the StorageUsage plots, we can see that there are sometimes files left on BUFFER after a production has been finished.

To find them

```
[lxplus021] ~ $ dirac-dms-find-lfns --Path /lhcb/data/2015/RAW/SMOGPHY/LHCb/LEAD15/ --
↪SE Tier1-Buffer | dirac-dms-replica-stats
Got 3 LFNs
[...]
```

Very often, it is because the run has been flagged BAD. This can be checked as follows:

```
dirac-bookkeeping-file-path  --GroupBy dataqualityflag --Summary <LFNS>
```

We make sure they were not processed before removing them

```
[lxplus021] ~ $ dirac-bookkeeping-get-file-descendants --Last
Got 3 LFNs
Getting descendants for 3 files (depth 1) : completed in 0.3 seconds
NotProcessed :
    /lhcb/data/2015/RAW/SMOGPHY/LHCb/LEAD15/169028/169028_0000000546.raw
    /lhcb/data/2015/RAW/SMOGPHY/LHCb/LEAD15/169030/169030_0000000354.raw
    /lhcb/data/2015/RAW/SMOGPHY/LHCb/LEAD15/169034/169034_0000000323.raw
[lxplus021] ~ $ dirac-dms-remove-replicas --Last --SE Tier1-Buffer
Got 3 LFNs
Removing replicas : completed in 8.6 seconds
Successfully removed 3 replicas from IN2P3-BUFFER
```

Files unused in productions

If a run is flagged BAD during the processing, some files may have been added to a production, but then never get used. A very similar process can be done. In case of stripping, we can also go up to the parent files to remove the RA files from buffer:

```
[localhost] ~ $ dirac-transformation-debug 71500 --Status Unused --Info files | dirac-
↪bookkeeping-get-file-ancestors | dirac-dms-replica-stats
Getting ancestors for 41 files (depth 1) : completed in 12.0 seconds
Got 108 LFNs
Getting replicas for 108 LFNs : completed in 5.8 seconds
108 files found with replicas

Replica statistics:
  0 archive replicas: 108 files
---------------------
  0  other  replicas: 0 files
  1  other  replicas: 41 files
  2  other  replicas: 67 files
---------------------

SE statistics:
        CERN-RAW: 67 files
        CNAF-RAW: 67 files
       CNAF-RDST: 41 files

Sites statistics:
   LCG.CERN.cern: 67 files
     LCG.CNAF.it: 108 files
[localhost] ~ $ dirac-bookkeeping-file-path --Last --GroupBy dataqualityflag --Summary
Got 108 LFNs
Successful :
    DataqualityFlag BAD : 108 files
[localhost] ~ $ dirac-transformation-reset-files --New Removed --Last 71500
Got 108 LFNs
41 files were set Removed in transformation 71500
```

Files problematic in productions

When a file goes problematic in a production, it can be removed from buffer. If it is for the stripping, also its raw ancestor can be removed. Example for a Stripping (here, all the prods for a given Stripping)

```
[localhost] ~ $ dirac-transformation-debug 69077,69073,68675,68486,69079,69075,68773,
↪68771 --Status Problematic --Info files | dirac-dms-replica-stats
Got 28 LFNs
Getting replicas for 28 LFNs : completed in 4.7 seconds
28 files found with replicas

Replica statistics:
  0 archive replicas: 28 files
---------------------
  0  other  replicas: 0 files
  1  other  replicas: 0 files
  2  other  replicas: 28 files
---------------------
[...]


[localhost] ~ $ dirac-bookkeeping-get-file-ancestors --Last | dirac-dms-remove-
↪replicas --SE Tier1-Buffer
Getting ancestors for 28 files (depth 1) : completed in 6.5 seconds
```

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```
Got 56 LFNs
Removing replicas : completed in 228.5 seconds
Successfully removed 12 replicas from CERN-BUFFER
Successfully removed 2 replicas from SARA-BUFFER
Successfully removed 6 replicas from RRCKI-BUFFER
Successfully removed 4 replicas from GRIDKA-BUFFER
Successfully removed 8 replicas from IN2P3-BUFFER
Successfully removed 24 replicas from RAL-BUFFER
```

We can then set these files as Removed in the removal transformation (setting them Done would not be very clean...)

```
[localhost] ~ $ dirac-transformation-reset-files --NewStatus Removed --Last 69128,
↪69127,68831,68829
Got 56 LFNs
6 files were set Removed in transformation 69128
7 files were set Removed in transformation 69127
8 files were set Removed in transformation 68831
7 files were set Removed in transformation 68829
```

From DEBUG

Here we can just clean regularly what is in debug...

```
dirac-dms-list-directory --Dir /lhcb/debug/ --Rec --Days 7 --NoDirectories | dirac-
↪transformation-add-files Remove-all-replicas
```

2.9.3 Containers

LHCb applications are ran in a containerised environment by passing the `--allow-containers` argument to `lb-run`. Before activating this feature the `GaudiExecution/lbRunOptions` configuration option under `Operations` must be set to include this argument, e.g. `--siteroot=/cvmfs/lhcb.cern.ch/lib/ --allow-containers`.

Containerised LHCb applications can then be enabled or disabled at three levels of granularity. In order of preference these are: * For a single compute element by setting `/Resources/Sites/${SITE_TYPE}/${SITE}/CEs/${COMPUTE_ELEMENT}/AllowContainers` to `yes`. * For an entire site by setting `/Resources/Sites/${SITE_TYPE}/${SITE}/AllowContainers` to `yes`. * Globally by setting the `Operations` option `GaudiExecution/AllowContainers` to `yes`.

Currently `LbPlatformUtils` only supports Singularity however future releases may allow the `AllowContainers` option to be used to set which container technologies can be used.

2.10 LHCbDIRAC Logs

2.10.1 Job logs aka LogSE

The LogSE is used to store the log files from the production jobs. it is defined in */Operations/defaults/LogStorage/LogSE = LogSE-EOS*.

The content is exposed via the normal EOS protocols, but also via a CERN web service . Any member of the lhcb-geoc group can manage this web service. The reason for having this web service is to be able to use htaccess and php magic.

The aim of the php and htaccess magic is to transparently move from a log directory per job to one zip archive per job, and still expose the content the same way, allowing for easy browsing.

The *.htaccess*, *listzip.php* and *extract.php* are stored at the root of the logSE. The php scripts are shared with the Core soft team and available in this repo.

The *.htaccess* content is pasted bellow:

```
# Option mandatory for CERN website exploration to work
Options +Indexes

# Allows rewrite ruls
RewriteEngine On

# this is a clever trick to avoid RewriteBase
# see http://stackoverflow.com/a/21063276
# basically, {ENV:BASE} eval to the location of the htaccess
RewriteCond "%{REQUEST_URI}::$1" "^(.*?/)(.*)::\2$"
RewriteRule "^(.*)$" "-" [E=BASE:%1]


# These rules expect path that follows the convention
# <something>/LOG/<numbers>/<numbers>/<numbers>
# In practice, what we have is
# MC/2018/LOG/<prodNumber>/<first digits of the prod number>/<jobNumber>
# What we want to be able to do is to expose the exact same way the log files of a␣
↪job:
# * stored in a directory <jobNumber>
# * stored in a zip file <jobNumber.zip>, containing itself a <jumbNumber> directory

# Aim: list the zip file as if it was a directory
# If the URL targets is a non existing directory
RewriteCond "%{DOCUMENT_ROOT}/%{REQUEST_URI}" !-d
# if the url is if the form "<something>/LOG/<int>/<int>/<int>/ (Note the "/: at the␣
↪end)
# we redirect to "{ENV:BASE}/listzip.php?zip=<something>/LOG/<int>/<int>/<int>.zip
RewriteRule "^(.*/LOG/[0-9]+/[0-9]+/([0-9]+))/$" "%{ENV:BASE}listzip.php?zip=$1.zip"␣
↪[PT,B,L]

# Aim: extract artifacts from specific zip files
# If we have a URL targetting a non existing file
RewriteCond "%{DOCUMENT_ROOT}/%{REQUEST_URI}" !-f
# if the url is if the form "<something>/LOG/<int>/<int>/<int>/<a path>
# we redirect to "{ENV:BASE}/extract.php?zip=<something>/LOG/<int>/<int>/<int>.zip&
↪path=<int>/<a path>
RewriteRule "^(.*/LOG/[0-9]+/[0-9]+/([0-9]+))/(.+)" "%{ENV:BASE}extract.php?zip=$1.
↪zip&path=$2/$3" [PT,B,L]
```

2.10.2 Centralized logging

TL;DR

All the logs (up to the VERBOSE level) from the Agents and services are visible on *https://es-lhcb-dirac-logs.cern.ch/kibana/app/kibana*.

More details

Each and every component send their logs at the VERBOSE level in a message queue. This is configured using the message queue backend , and the queue is described in the MQServices resources

The logs are then consumed by a logstash server (*lblogs.cern.ch*), and forwarded to ElasticSearch. This is configured in the ai-puppet-hostgroup-volhcb repository.

Data storage

We are using Elasticsearch (ES) to store the data, which is provided by IT CERN centralized ES service. The ES configuration can be found in it-elasticsearch-project repositiry.

Data Visualization

Kibana is used to visualize the data, which is accessible in this link. To access the Kibana you have to be a member of lhcb-geoc egroup. There are predefined dash boards which you can access under Dash boards menu.

2.11 Message Queues for LHCb

The IT Message Queue service has setup two ActiveMQ brokers for us, configured the same way: *lhcb-test-mb* and *lhcb-mb*.

2.11.1 Queues and topics

This is the destinations that we are allowed:

```
/queue/lhcb.certification
/queue/lhcb.dirac.{path}
/queue/lhcb.jenkins
/queue/lhcb.test.{name}
/topic/lhcb.dirac.{path}
```

where *{path}* can be anything and *{name}* any word without dots.

2.11.2 Authentication & Authorizations

Authentication can be done via user name, or via host DN.

For convenience, we use a *dirac* user for every interaction. The IT guys have a list of our machines, but we have to ask them to update it every time we add a machine, so it is not very convenient.

2.11.3 Monitoring

We can see how are our queues doing on this monitoring link

cluster can be either *lhcb* or *lhcb-test*

2.12 Sandbox Store

Our Sandbox store is hosted on a VM (currently lbvobox110) and the files are stored on an external volume (currently mounted under */opt/dirac/storage*)

2.12.1 How To resize the sandbox store volume

Resize the sandbox volume since it is full. The normal procedure can be found here: https://clouddocs.web.cern.ch/clouddocs/details/working_with_volumes.html However, for historical reasons, we do not have a filesystem directly on the volume, but we have LVM. So the procedure goes as follow:

- stop all the services using the volume (SandboxStore, but potentially other system services)
- unmount the FS from lbvobox110
- Deactivate the logical volume
- unmount + resize the volume as per the doc
- tell lbvobox110 lvm to forget about what it knows
- remount the volume
- tell lvm to scan what it finds, resize the pv, and activate it
- resize the logical volume
- mount the file system
- resize the file system

I could/should have resized before mounting, it might have been faster. With the procedure bellow, expect a 1h resize time for 500GB.

Step by step:

```
# Unmount the FS
[root@lbvobox110 ~]# umount /opt/dirac/storage/


# Find the volume, detach it, and extend it
[chaen@lxplus097 ~]$ openstack volume list | grep sandbox
| 8ab0da8d-477b-459b-a4e4-5fd9c57f1241 | dirac-sandbox                | in-use | 1500␣
↪| Attached to lbvobox110
on /dev/vdc    |

[chaen@lxplus097 ~]$ nova volume-detach lbvobox110 8ab0da8d-477b-459b-a4e4-
↪5fd9c57f1241
[chaen@lxplus097 ~]$ cinder extend 8ab0da8d-477b-459b-a4e4-5fd9c57f1241 3000


# Deactivate the volume (CAUTION: this step was found to be missing, and was added␣
↪without being tested)
[root@lbvobox110 ~]# lvchange -a n /dev/VolGroup02/sandbox

# Tell lvm to forget everything
[root@lbvobox110 ~]# dmsetup remove /dev/VolGroup02/*


# reattach the volume
```

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```
[chaen@lxplus097 ~]$ nova volume-attach lbvobox110 8ab0da8d-477b-459b-a4e4-
↪5fd9c57f1241
+----------+--------------------------------------+
| Property | Value                                |
+----------+--------------------------------------+
| device   | /dev/vdc                             |
| id       | 8ab0da8d-477b-459b-a4e4-5fd9c57f1241 |
| serverId | a36daa82-3b6c-4018-b56d-fa5cfa376a76 |
| volumeId | 8ab0da8d-477b-459b-a4e4-5fd9c57f1241 |
+----------+--------------------------------------+


# Scan the physical volume, resize it, and extend the logical volume
[root@lbvobox110 ~]# pvscan

# NOTE: last time we did this procedure, the scan did not give us the size we␣
↪expected, so we
# had to manually resize it. Not clear why. In case it does not have the size you␣
↪want, do the following
[root@lbvobox110 ~]# pvresize /dev/vdc

[root@lbvobox110 ~]# lvextend -L2.92T /dev/VolGroup02/sandbox
  Rounding size to boundary between physical extents: 2.92 TiB.
  Size of logical volume VolGroup02/sandbox changed from 1.42 TiB (371200 extents) to␣
↪2.92 TiB (765461 extents).
  Logical volume sandbox successfully resized.

# Activate it
[root@lbvobox110 ~]# lvchange -a y /dev/VolGroup02/sandbox

# Mount the file system
[root@lbvobox110 ~]# mount /dev/VolGroup02/sandbox /opt/dirac/storage

# resize it
[root@lbvobox110 ~]# resize2fs /dev/VolGroup02/sandbox
resize2fs 1.41.12 (17-May-2010)
Filesystem at /dev/VolGroup02/sandbox is mounted on /opt/dirac/storage; on-line␣
↪resizing required
old desc_blocks = 91, new_desc_blocks = 187
Performing an on-line resize of /dev/VolGroup02/sandbox to 783832064 (4k) blocks.
```

2.13 Data Popularity

Whenever production data is accessed by a user job, we keep that information in order to estimate the popularity of the dataset

- Freeing disk space
- Making data set consistent in terms of number of replicas
- Produce plots for the RRB

2.13.1 Components

The popularity analysis relies on a lot of components

StorageUsageDB

Despite its name, that is where both the StorageUsageAgent and the PopularityAgent stores their data. It is exposed via the StorageUsageHandler and the DataUsageHandler

StorageUsageAgent

This agent scans the DFC and stores the size and number of files per directory and per StorageElement in the StorageUsageDB.

StorageHistoryAgent

This agent crawls the StorageUsageDB, convert each directory into a bookkeeping path and fill in the following accounting:

- Storage: space used/free per storage and/or directory
- Data storage: spaced used per bookkeeping path
- user storage: like Storage, but for user directories

DataUsageHandler

This service is called by the jobs to declare their use of a given directory. It is stored per directory and per day.

PopularityAgent

This agent goes through the StorageUsageDB and creates accounting entries for the popularity. It also caches the BK dictionary for each directory in the StorageUSageDB.

DataPop server

Yandex provided service that consumes our popularity CSV and make prediction on which dataset to remove. It is ran on our mesos cluster: https://lbmesosms02.cern.ch/marathon/ui/#/apps/%2Fdatapopserv

PopularityAnalysisAgent

This agents creates two files:

- one CSV containing a summary of the popularity (see *popularity.csv file*).
- one CSV, generated from the first one through the DataPop server

2.13.2 Popularity scanning

This file is produced by the PopularityAgent and stored on its work directory.

To produce the *popularity.csv* file, the scanning follows this algorithm:

- list all the directories of the DFC
- Convert each visible directory into a BK dictionary, getting the information from the StorageUsage (if it is cached), or from the BK itself

- For each directory:
  - Get the number of PFNs and size per SE from the StorageUsageDB
  - Get the day by day usage of the directories and group them by week from the DataUsage (which is the StorageUsageDB..)
- Sum the size and the number of files per:
  - directory
  - storage type (Archive, tape, disk)
  - StorageElement
  - Site
- Assigns the dataset to a given storage type (see bellow)

2.13.3 popularity.csv file

This file is the output of all the processing chain. The fields are the following:

- Name: full Bookkeeping path (e.g */LHCb/Collision11/Beam3500GeV-VeloClosed-MagDown/RealData/Reco14/Stripping20r1/90000000/SEMILEPTONIC.DST*)
- Configuration: Configuration part, so DataType + Activity (*/LHCb/Collision11*)
- ProcessingPass: guess... (*/RealData/Reco14/Stripping20r1*)
- FileType: guess again (*SEMILEPTONIC.DST*)
- Type: a number depending on the type of data:
  - 0: MC
  - 1: Real Data
  - 2: Dev simulation
  - 3: upgrade simulation
- Creation-week: "week number" when this file was created (see bellow for details) (e.g. *104680*)
- NbLFN: number of LFNs in the dataset
- LFNSize: size of the dataset in TB
- NbDisk: number of replicas on disk. Careful: if all LFNs have two replicas, you will have *NbDisk=2*NbLFN*.
- DiskSize: effective size on disk of the dataset in TB (also related to the number of replicas)
- NbTape: number of replicas on tape, which is not archive
- TapeSize: effective size on tape of the dataset in TB.
- NbArchived: number of replicas on Archive storage.
- ArchivedSize: effective size on Archive storage in TB
- CERN, CNAF,.. (all T1 sites): disk space used at the various sites.
- NbReplicas: average number of replicas on disk (*NbDisk/LFN*)
- NbArchReps: average nymber of replicas on Archive (*NbArchived/LFN*)
- Storage: one of the following:
  - Active: If the production creating this file is either idle, completed or active

  - Archived: if there are on disk copies, only archive
  - Tape: if dataset is on RAW or RDST
  - Disk: otherwise
- FirstUsage: first time the dataset was used (n "week number")
- LastUsage: last time the dataset was used (in "week number")
- Now: current week number
- 1, 2, etc: number of access since *k* weeks ago. Note that these numbers are cumulative, that means that what was accessed 1 week ago is also counted in what was included 2 weeks ago.

Week number

This allows to have an easy way to compare the age of datasets. It is defined as *year * 52 + week number*

2.13.4 Popularity Analysis

The analysis is performed based on an Excel spreadsheet available in the repository. This spreadsheet takes the raw data contained in the *popularity.csv file* and makes statistics on them.

Spreadsheet setup

For some obscure reason, the spreadsheet needs a bit of manual actions.

You first need to manually copy all the data from the popularity.csv file to the "Popularity data" tab of the spreadsheet, starting line 2. You can then extend the "Popularity Formulas" tab to the same number of lines. It would be nice if Excel was doing that automatically, but...

Spreadsheet content

The spreadsheet is divided into several tabs.

Popularity Data

Just a copy paste of the popularity.csv

Dataset statistics

The dataset statistics tab is a frequency table. The first column is the bin size, while all the others are the values inside the given bin.

The aim of this tab is to give a global overview of the number of replicas, archives, size, etc used per dataset

Popularity formulas

This tab crunches the popularity.csv data. It uses some value from other tabs as parameters. In particular:

- A1, name StorageType: type of storage we are doing statistics on. Normally, disk
- A2, named NbOfWeeks: taken from *PopularityPlots.L16*. It is the number of weeks on which we do our statistics

The fields are the following

- Disk: useless, place holder for A2
- Name: like popularity.csv
- Configuration: like popularity.csv
- ProcessingPass: like popularity.csv
- Storage: like popularity.csv
- NbLFN: like popularity.csv
- FileType: like popularity.csv
- Disk Real Data: DiskSize of popularity.csv if the dataset is real data
- Disk MC: DiskSize of popularity.csv if the dataset is MC or Dev
- Usage: takes the number of usage at NbOfWeeks from the popularity data
- Norm. Usage: defined as *Usage/NbLFN* if the *Storage* is *StorageType*, -1 otherwise
- AgeWeeks: What it says (*Now - creationWeek*), if the *Storage* is *StorageType*. -1 otherwise
- Age Real Data: same as *AgeWeeks* if the dataset is real data, but in years (so divided by 52)
- Age MC: same as *AgeWeeks* if the dataset is MC or Dev, but in years
- Last usage in weeks: number of weeks since it has not been used (*Now - LastUsage*). Caution ! LastUsage is a week number in the popularity data
- Usage span: Number of weeks during which the dataset was used
- Age at last Usage: in years, only if the *Storage* is *StorageType*, -1 otherwise
- Age at first usage: in years, only if the *Storage* is *StorageType*, -1 otherwise
- Age of unused datasets: in years, if the data was never used the last *NbOfWeeks* weeks and if the *Storage* is *StorageType*. -1 otherwise
- Age of used datasets: in years, if the data was used the last *NbOfWeeks* weeks and if the *Storage* is *StorageType*. -1 otherwise
- Nb Replicas UnusedOld: Number of replicas of the dataset if it is unused and its older than *NbOfWeeks* (*Age of unused dataset* > *NbOfWeeks/52*) (folks from the Scrutiny group want that)
- OverSize: see below
- Archives Real Data: for real data on *StorageType*, this is the number of ArchReps (see *Nb ArchReps* bellow). -1 otherwise
- Archives MC: For MC or Dev data on *StorageType*, this is the number of ArchReps (see *Nb ArchReps* bellow). -1 otherwise
- (Rep-1)/Arch: see bellow
- (Rep-2)/Arch: see bellow

- Nb Replicas: like popularity.csv
- Nb ArchReps: like popularity.csv

A bit of math

There are a few formulas in the popularity that are useful to discriminate badly replicated datasets. Here is how:

In a dataset of *NbLFN* files, *N* will be correctly replicated to disks, and *n* will not be:

```
NbLFN = N + n
```

If we make the assumption that a file is either replicated the correct number of time, or not at all, you have:

```
NbReplicas = (k*N + n) / (N + n)
NbArchRep = N / ( N + n)
```

where *k* is the target number of replicas.

In the case where data has 2 disk copies and one archive, you can then compute the following:

```
(NbReplicas - 1)/NbArchRep = 1

(NbReplicas - 2)/NbArchRep = -n / N
```

This helps finding pathological datasets, as in ideal case, these values will respectively be 1 and 0.

In the old case where data has 3 disk copies and one archive, you can then compute the following:

```
(NbReplicas - 1)/NbArchRep = 2

(NbReplicas - 2)/NbArchRep = (N - n) / N
```

Ideally these values will respectively be 2 and 1.

Any other values would show that the dataset is not perfectly replicated.

Another interesting value to compute is *OverSize*. This is basically an estimate of how much space (TB) is uselessly consumed if we assume that a dataset that wasn't used during the *NbOfWeeks* period should have only 1 replicas:

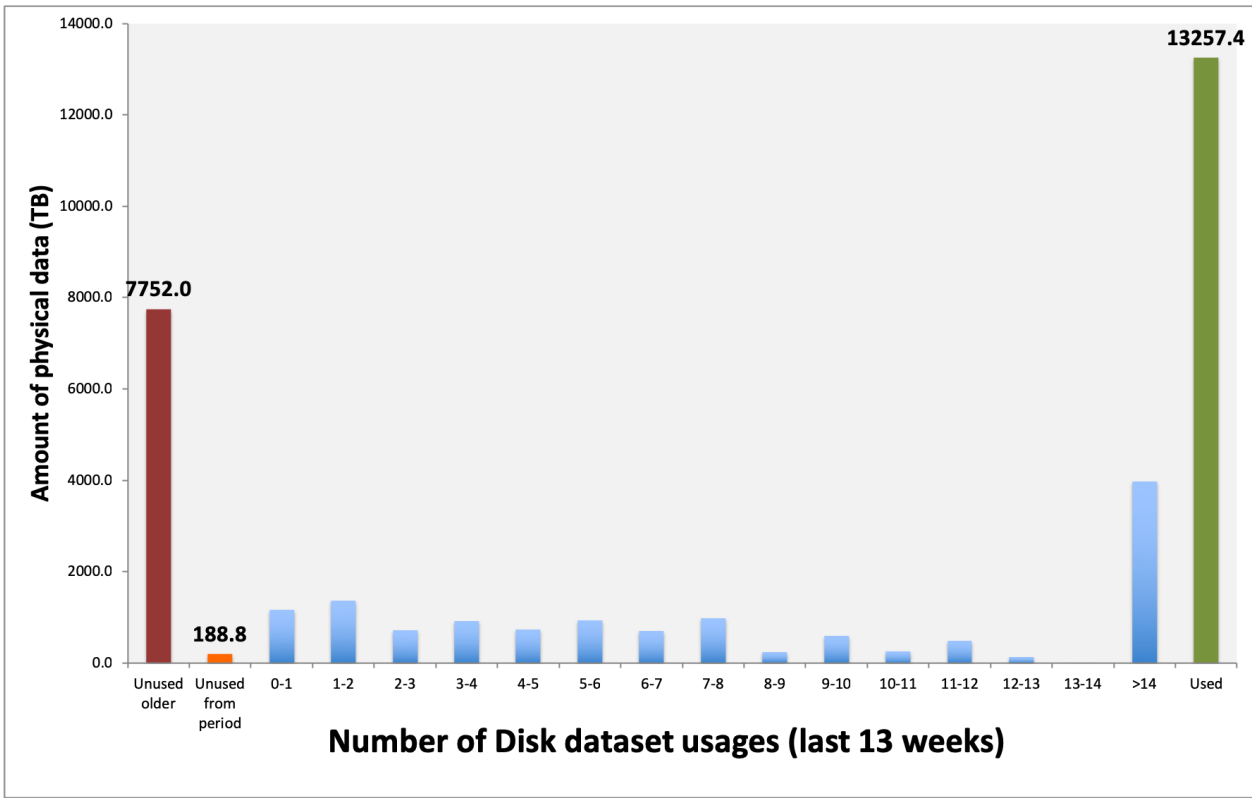
```
OverSize = (DiskSize)*([Nb Replicas UnusedOld]-1)/[Nb Replicas UnusedOld]
```

Popularity plots

This tab contains a lot of plots. It is a frequency table, just like the Dataset statistics tab, but containing data regarding the popularity and number of accesses.

RRD plots

The RRD plots are interested in a plot like the one bellow.



This translate how many TB on disks have been used 1, 2, . . . , 14 times in the last *n* weeks. Note that these is physical size, so the number of replicas counts! There are two special bins:

- Unused older: these datasets were created before *n* weeks ago, and were not used in the last *n* weeks
- Unused from period: these datasets were created during the last *n* weeks

For a reason which is known to them only, but certainly is very well justified, they want these plots for 13, 26 and 52 weeks.

2.14 LHCbWebAppDIRAC

2.14.1 Installing LHCbWebAppDIRAC

The installation requires two steps:

1. Install the machine:

The machine should be installed using the `webportal` puppet template. LHCbWepAppDIRAC is using `Nginx` for better performance, which is also puppetized. The main configuration file used to install `Nginx` can be found in this gitlab repository . The `site.conf` configuration file is used for handling the user requests and pass to the `Tornado` based LHCbWebAppDIRAC component. The configuration file can be found in this repository .

2. Installing LHCbWebAppDIRAC extension:

- cd /home/dirac
- curl -O https://raw.githubusercontent.com/DIRACGrid/DIRAC/integration/Core/scripts/install_site.sh

- chmod +x install_site.sh
- Edit install_site.sh add the Release = version
- ./install_site.sh install.cfg

Note: install.cfg file must exists in the /home/dirac directory

You may have have problem with the SELinux configuration. If you see the following error message, you need to generate the correct role:

```
[dirac@lbvobox202 dirac]$ tail -200f data/log/nginx/error.log
2019/05/06 16:57:07 [crit] 19494#0: *1 connect() to 127.0.0.1:8000 failed (13:␣
↪Permission denied) while connecting to upstream, client: 128.141.212.123, server:␣
↪lhcb-portal-dirac.cern.ch, request: "GET / HTTP/1.1", upstream: "http://127.0.0.
↪1:8000/", host: "lbvobox202.cern.ch"
```

To do that please execute the following commands as root:

```
grep nginx /var/log/audit/audit.log | audit2allow -M nginx
semodule -i nginx.pp
refresh the web portal
```

NOTE:

```
- You may need to execute the commands above more than once (for example if you␣
↪change the certificate).
- Most probably, it may not work. Ask Joel to create the correct dirac.cfg file. The␣
↪dirac.cfg file content must be the same as the existing web machine.
```

2.15 CERN centralized Elasticsearch service

This document contains all information needed to manage the ES. ES is provided by CERN.

2.15.1 Communication channels:

1. open a ticket: ‘ snow ticket: <https://cern.service-now.com/service-portal/service-element.do?name=Elasticsearch-Service>_‘.

2. mattermost: LHCb ‘ specific channel <https://mattermost.web.cern.ch/it-dep/channels/es-for-lhcb>‘_ or ‘ it general channel <https://mattermost.web.cern.ch/it-dep/channels/it-es-project>‘_.

2.15.2 Elasticsearch instances

We are using three instances(host:username):

1. es-lhcb-monitoring:lhcb for monitoring WMS and ComponentMonitoring
2. es-lhcb-dirac-logs:lhcb-dirac-logs for centralized Monitoring
3. es-lhcb-mcstats:lhcb-mcstats for MC statistics

2.15.3 Elasticsearch performance monitoring

IT/ES provides monitoring tool for monitoring ES instances. You can access in the following link.

2.15.4 Kibana

Kibana is used for visualize the data. IT/ES provides a Kibana end point for each ES instance. You can access using https://instance/kibana for example: https://es-lhcb-monitoring.cern.ch/kibana

Note: You can access to kibana, if you are in one of the group: lhcb-dirac, lhcb-geoc, lhcb-gridshifters

2.15.5 Managing ES templates

Each ES instance has a dedicated template, what you can found in the repository by searching lhcb. For example: *https://gitlab.cern.ch/it-elasticsearch-project/endpoint-lhcb-dirac-logs-settings*.

2.15.6 Curator

Curator can be used for easily manage ES data. It can be used in different purpose. We are using for deleting indexes, which are older a certain age. To setup Curator you need to use the ES template repository (see Managing ES templates section.) and create *curator4.actions* file. For example: deleting indexes older a certain period.

2.15.7 Re-indexing existing index

You may need to re-index indexes from one cluster to another cluster. You can use the following script to reindex.

2.16 Setup a new vobox

In order to install a vobox you need a configuration file so called install.cfg. If the machine correctly created, this configuration file will be in /home/dirac directory.

Please follow this instructions and use the configuration file from /home/dirac/install.cfg

Make sure the dirac.cfg file is correctly created in the machine.

CHAPTER 3

Certification

3.1 LHCbDIRAC Certification (development) Releases

The following procedure applies to pre-releases (AKA certification releases) and it is a simpler version of what applies to production releases.

This page details the duty of the release manager. The certification manager duties are detailed in the next page.

3.1.1 What for

The *release manager* of LHCbDIRAC has the role of:

1. creating the pre-release
2. making basic tests
3. deploying it in the certification setup

The *certification manager* would then follow-up on this by: 4. making even more tests

And, after several iterations of the above, before: 5. merging in the production branch

Points 4 and 5 won't anyway be part of this first document.

3.1.2 1. Creating the release

Unless otherwise specified, certification releases of LHCbDIRAC are done "on top" of the latest pre-release of DIRAC. The following of this guide assumes the above is true.

Creating a pre-release of LHCbDIRAC means creating a tarball that contains the code to certify. This is done in 2 steps:

1. Merging "Merge Requests"
2. Creating the release tarball, add uploading it to the LHCb web service

But before:

Pre

If you use a version of git prior to 1.8, remove the option *–pretty* in the command line

Verify what is the last tag of DIRAC:

```
# it should be in this list:
git describe --tags $(git rev-list --tags --max-count=10)
```

A tarball containing it is should be already uploaded here

You may also look inside the .cfg file for the DIRAC release you're looking for: it will contain an "Externals" version number, that should also be a tarball uploaded in the same location as above.

If all the above is ok, we can start creating the LHCbDIRAC pre-release.

Merging "Merge Requests"

Merge Requests (MR) that are targeted to the devel branch and that have been approved by a reviewer are ready to be merged

If there are no MRs, or none ready: please skip to the "update the CHANGELOG" subsection.

Otherwise, simply click the "Accept merge request" button for each of them.

Then, from the LHCbDIRAC local fork you need to update some files:

```
# if you start from scratch otherwise skip the first 2 commands
mkdir $(date +20%y%m%d) && cd $(date +20%y%m%d)
git clone https://:@gitlab.cern.ch:8443/lhcb-dirac/LHCbDIRAC.git
git remote add upstream https://:@gitlab.cern.ch:8443/lhcb-dirac/LHCbDIRAC.git
# update your "local" upstream/master branch
git fetch upstream
# create a "newDevel" branch which from the upstream/devel branch
git checkout -b newDevel upstream/devel
# determine the tag you're going to create by checking what was the last one from the␣
↪following list (add 1 to the "p"):
git describe --tags $(git rev-list --tags --max-count=5)
# Update the version in the __init__ file:
vim LHCbDIRAC/__init__.py
# Update the version in the releases.cfg file:
vim LHCbDIRAC/releases.cfg
# Update the version in the Dockerfile file:
vim container/lhcbdirac/Dockerfile
# For updating the CHANGELOG, get what's changed since the last tag
#please use the proper LHCbDIRAC tag; replace v8r2p46
git log --pretty=oneline ${t}..HEAD | grep -Ev "($(git log --pretty=oneline  ${t}..
↪v8r2p46 | awk {'print $1'} | tr '\n' '|')BOOM)"
# copy the output, add it to the CHANGELOG (please also add the DIRAC version)
vim CHANGELOG # please, remove comments like "fix" or "pylint" or "typo"...
#If needed, change the versions of the packages
vim dist-tools/projectConfig.json
# Commit in your local newDevel branch the 3 files you modified
git add -A && git commit -av -m "<YourNewTag>"
```

Time to tag and push:

```
# make the tag
git tag -a <YourNewTag> -m <YourNewTag>
# push "newDevel" to upstream/devel
git push --tags upstream newDevel:devel
# delete your local newDevel
git branch -d newDevel
```

Remember: you can use "git status" at any point in time to make sure what's the current status.

When a new git tag is pushed to the repository, a gitlab-ci job takes care of testing, creating the tarball, uploading it to the web service, and to build the docker image.

3.1.3 2. Making basic verifications

Once the tarball is done and uploaded, the release manager is asked to make basic verifications, via Jenkins, if the release has been correctly created.

The tests may vary, but are announced on the Trello board, and on the Slack channel 'lhcb-certification' of the 'lhcb-dirac' team.

If you are running tests from lxplus, make sure that you are in the certification setup (e.g. check the content of your .dirac.cfg file)

3.1.4 3. Deploying the release

Deploying a release means deploying it for some installation:

```
* client
* server
* pilot
```

release for client

Please refer to this TWIKI page a quick test to validate the installation is to run the SHELL script $LHCBRELEASE/LHCBDIRAC/LHCBDIRAC_vXrY/LHCbDiracSys/test/client_test.csh

go to https://jenkins-lhcb-nightlies.web.cern.ch/job/nightly-builds/job/release/build page for asking to install the client release in AFS and CVMFS:

- in the field "Project list" put : "Dirac vNrMpK LHCbGrid vArB LHCbDirac vArBpC " (LHCbGrid version can be found: https://gitlab.cern.ch/lhcb-dirac/LHCbDIRAC/blob/devel/dist-tools/projectConfig.json)
- in the field "platforms" put : "x86_64-slc6-gcc48-opt x86_64-slc6-gcc49-opt x86_64-slc6-gcc62-opt x86_64-centos7-gcc62-opt"

Then click on the "BUILD" button

- within 10-15 min the build should start to appear in the nightlies page https://lhcb-nightlies.cern.ch/release/
- if there is a problem in the build, it can be re-started via the dedicated button (it will not restart by itself after a retag)

When the release is finished https://lhcb-nightlies.cern.ch/release/, you can deploy to the client to afs dev area or prod.

prod area

If you want to deploy this release to production release area, you have to create a JIRA task and make the request via https://its.cern.ch/jira/projects/LHCBDEP.

- **NOTE: If some package is already released, please do not indicate in the Jira task. For example: a Jira task when:**
  - DIRAC is not released, then the message in the JIRA task: Summary:Dirac v6r14p37 and LHCbDirac v8r2p50; Description: Please release Dirac and LHCbDirac in this order based on build 1526;
  - DIRAC is released, then the message in the JIRA task: Summary:LHCbDirac v8r2p50; Description: Please release LHCbDirac based on build 1526;

Server

To install it on the VOBOXes (certification only) from lxplus:

```
lhcb-proxy-init  -g diracAdmin
dirac-admin-sysadmin-cli --host lbtestvobox.cern.ch
>update LHCbDIRAC-v8r4-pre1
>restart *
```

Today, the other cert machine in use is lbtestvobox2.cern.ch.

The (better) alternative is using the web portal.

Pilot

Update the pilot version from the CS.

CHAPTER 4

Documentation sources

Certification How to run the certification process	*Developers Guide* Adding new functionality to DIRAC
Administrator Guide Administration of the DIRAC services (server installations)	Code reference to be added

CHAPTER 5

Indices and tables

- genindex
- search