

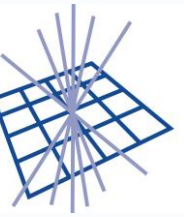
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# LHCb status

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GRIDPP 49

ALEXANDER ROGOVSKIY

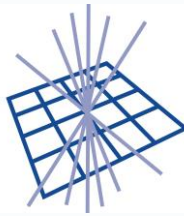


# Contents

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In this talk I'll try to cover the following topics:

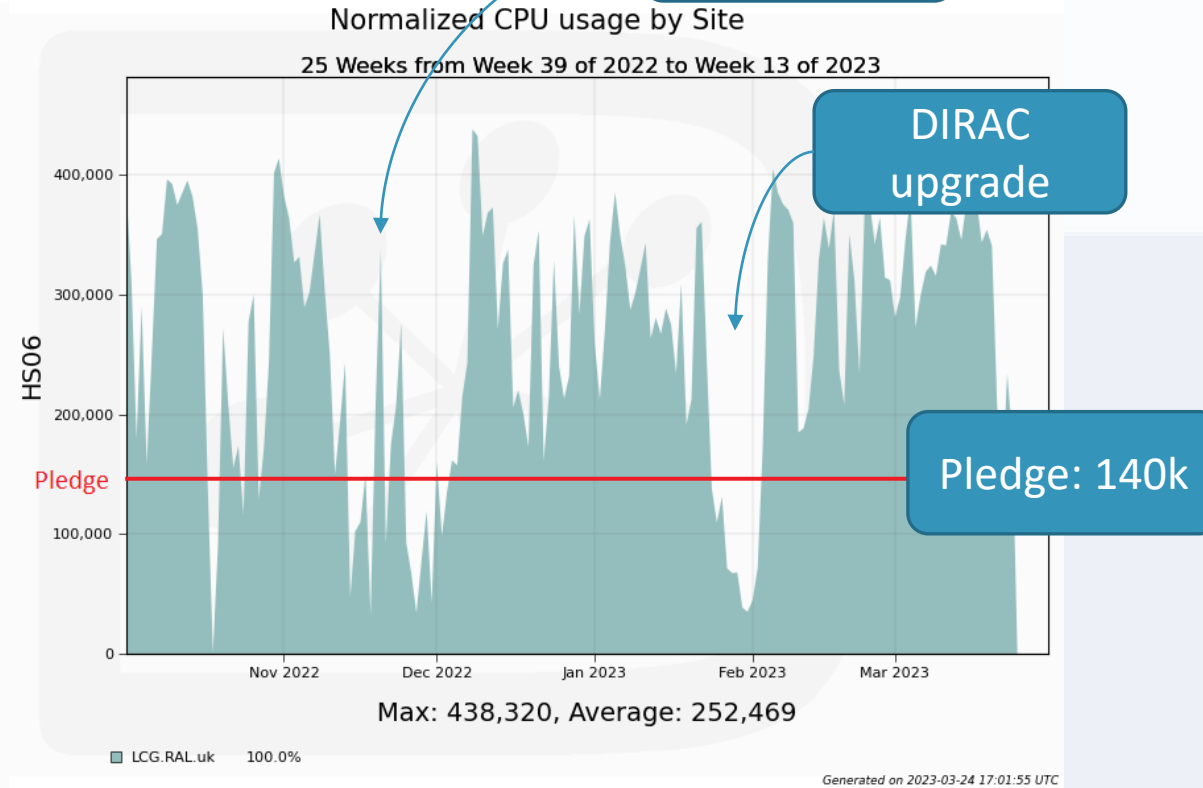
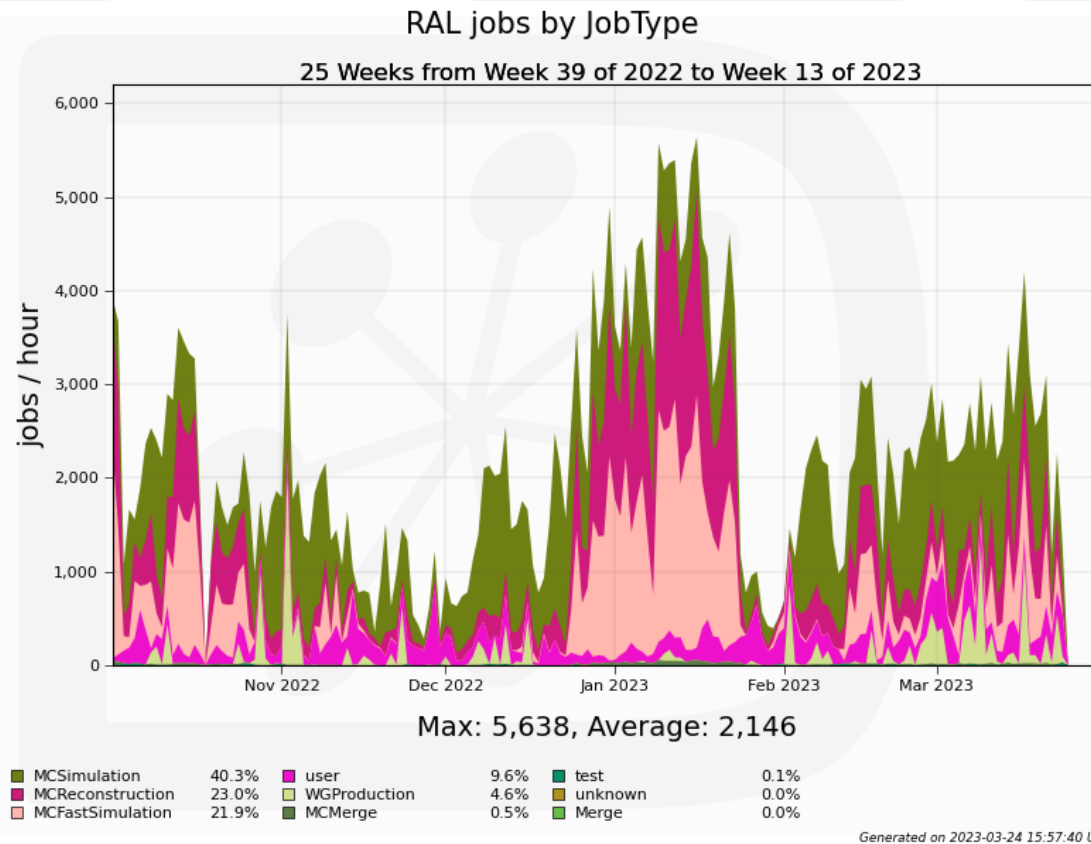
1. LHCb T1 resource usage for the last half year.
2. LHCb activities.
3. RAL T1 problems and solutions.
4. LHCb T2 resource usage.
5. LHCb plans.



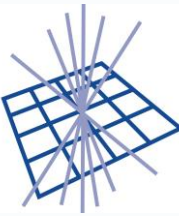
# LHCb Jobs at RAL T1

The majority of LHCb jobs at RAL for the last 6 months are Monte Carlo jobs.

Lack of Productions

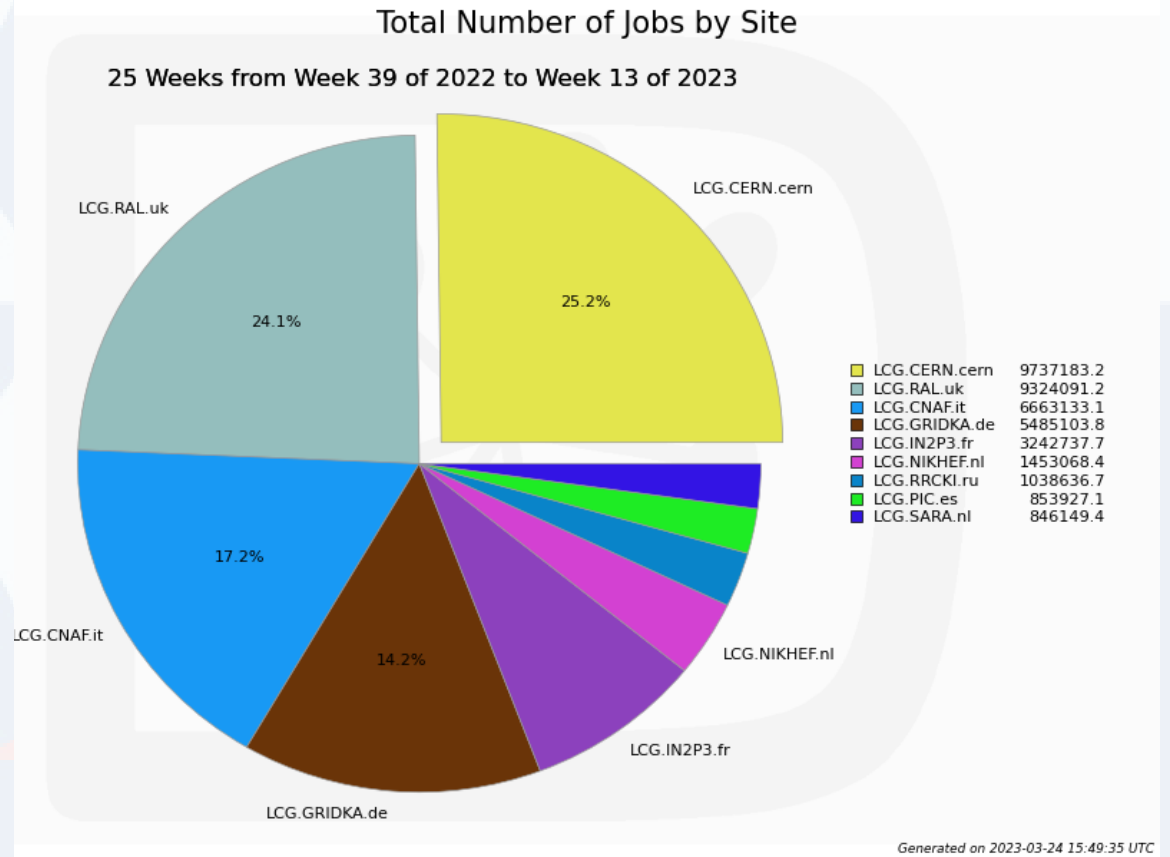
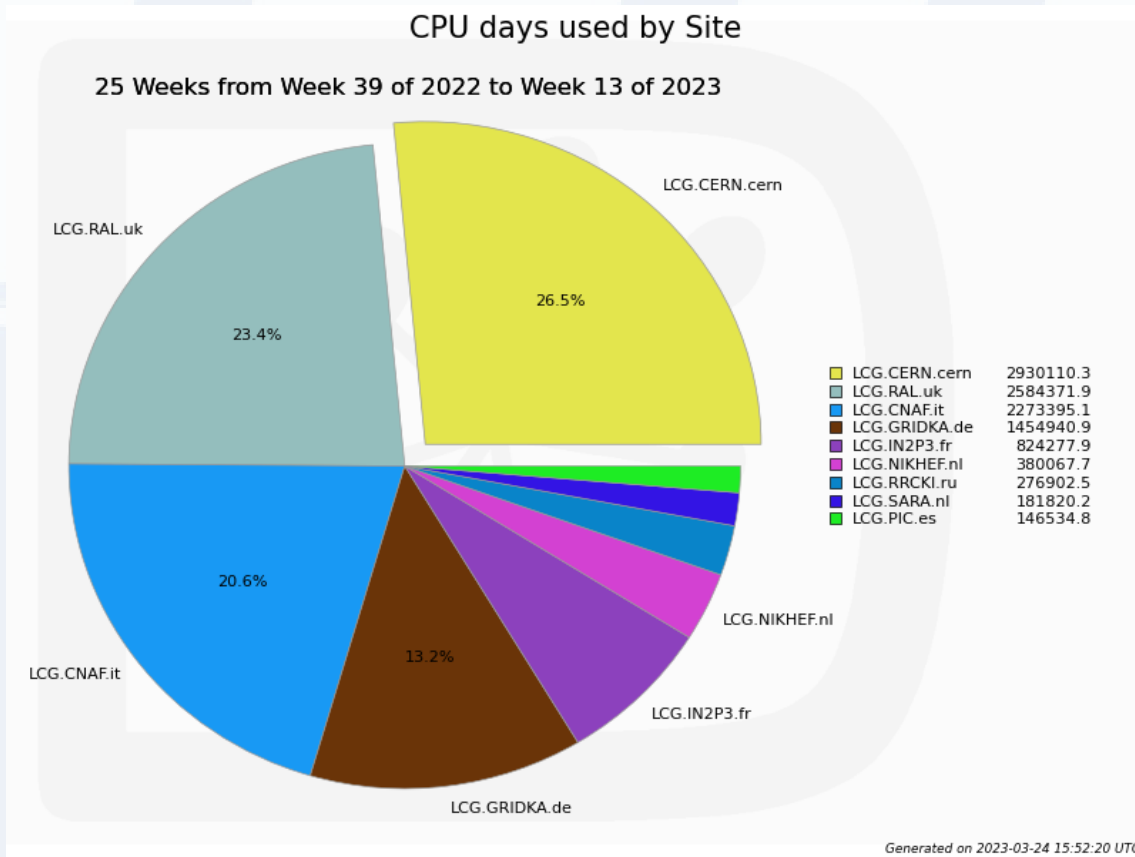


# Comparisson

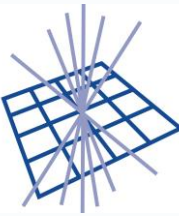


Everything is relative. How these results are compared with other T1s/CERN?

RAL T1 has provided for LHCb the most computational resources amont T1s, in terms of executed jobs and CPU time. Almost as much as CERN.



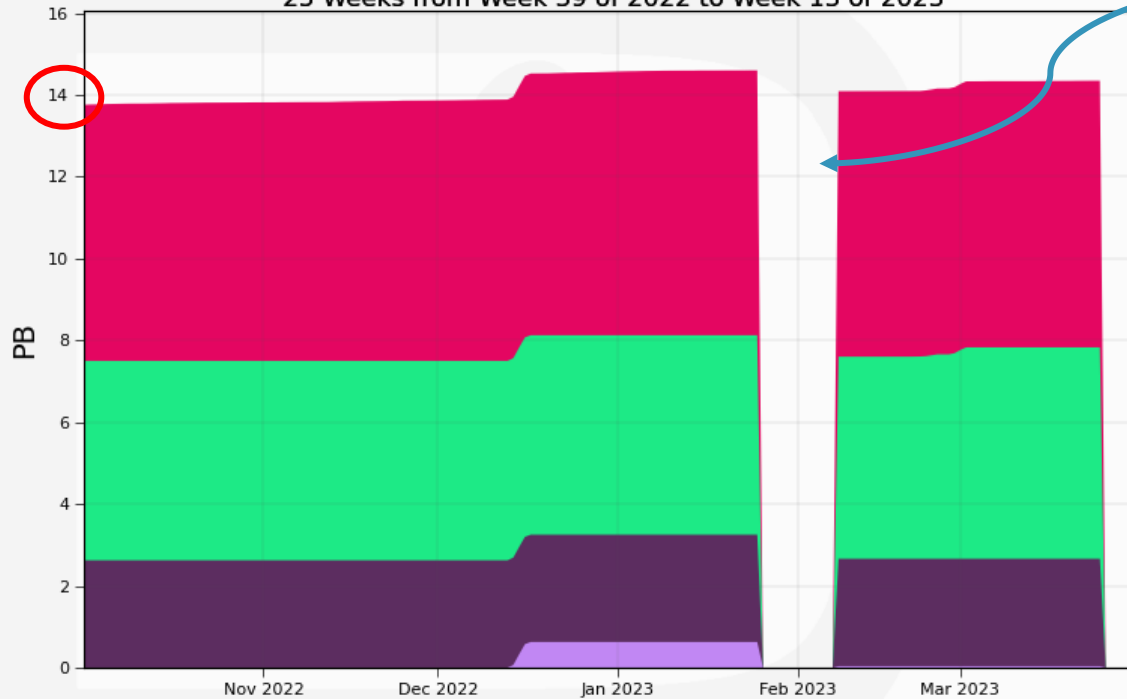
# Tape usage



Tape usage is significantly below the pledge. This is due to lack of data from the detector last year.

PFN space usage by StorageElement

25 Weeks from Week 39 of 2022 to Week 13 of 2023



Major DIRAC upgrade

## Tape Space - TBytes

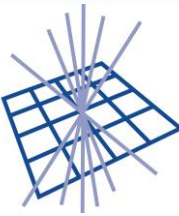
Tape Space - TBytes	Oct 2022	Nov 2022	Dec 2022	Jan 2023	Feb 2023	Total	% MoU
LHCB	13,800	13,870	14,550	14,090	0	56,310	
<b>Total</b>	<b>13,800</b>	<b>13,870</b>	<b>14,550</b>	<b>14,090</b>	<b>0</b>	<b>56,310</b>	<b>34%</b>
installed capacity	0	0	0	0	0	0	
MoU pledge	32,776	32,776	32,776	32,776	32,776	163,880	

Max: 14.6, Average: 12.7

■ RAL-ARCHIVE 45.3% ■ RAL-RAW 34.9% ■ RAL-RDST 18.6% ■ RAL-DC-RAW 1.2%

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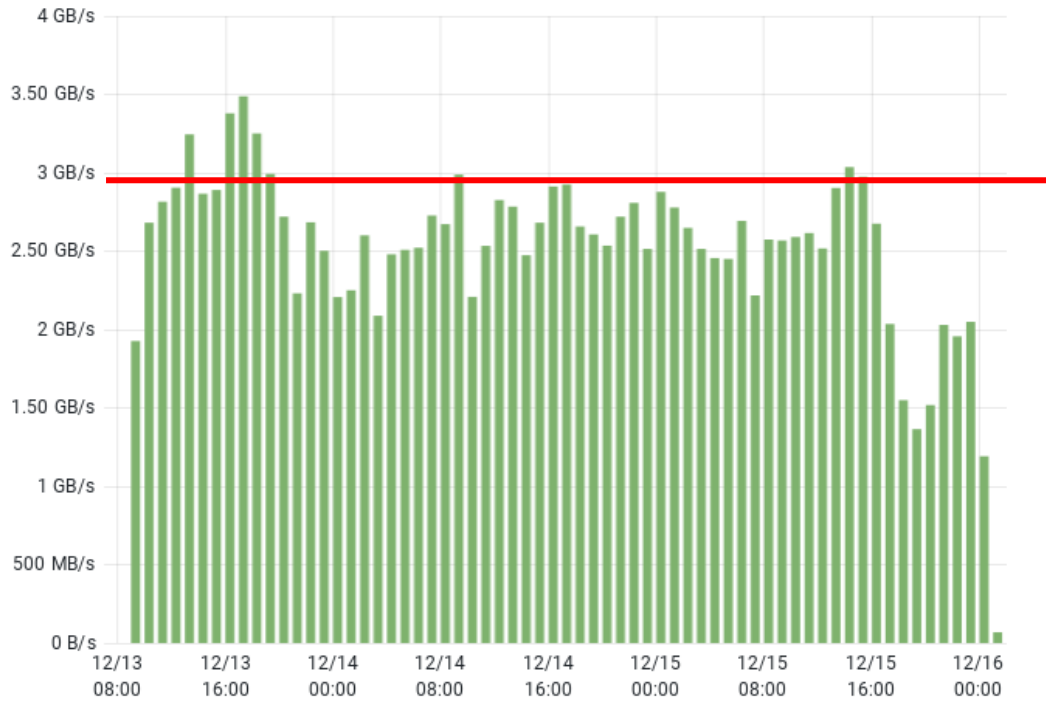
# Data challenge



We had one more data challenge for RAL T1 recently

- During the writing part we almost achieved target throughput
- Reading/staging throughput was well above the target

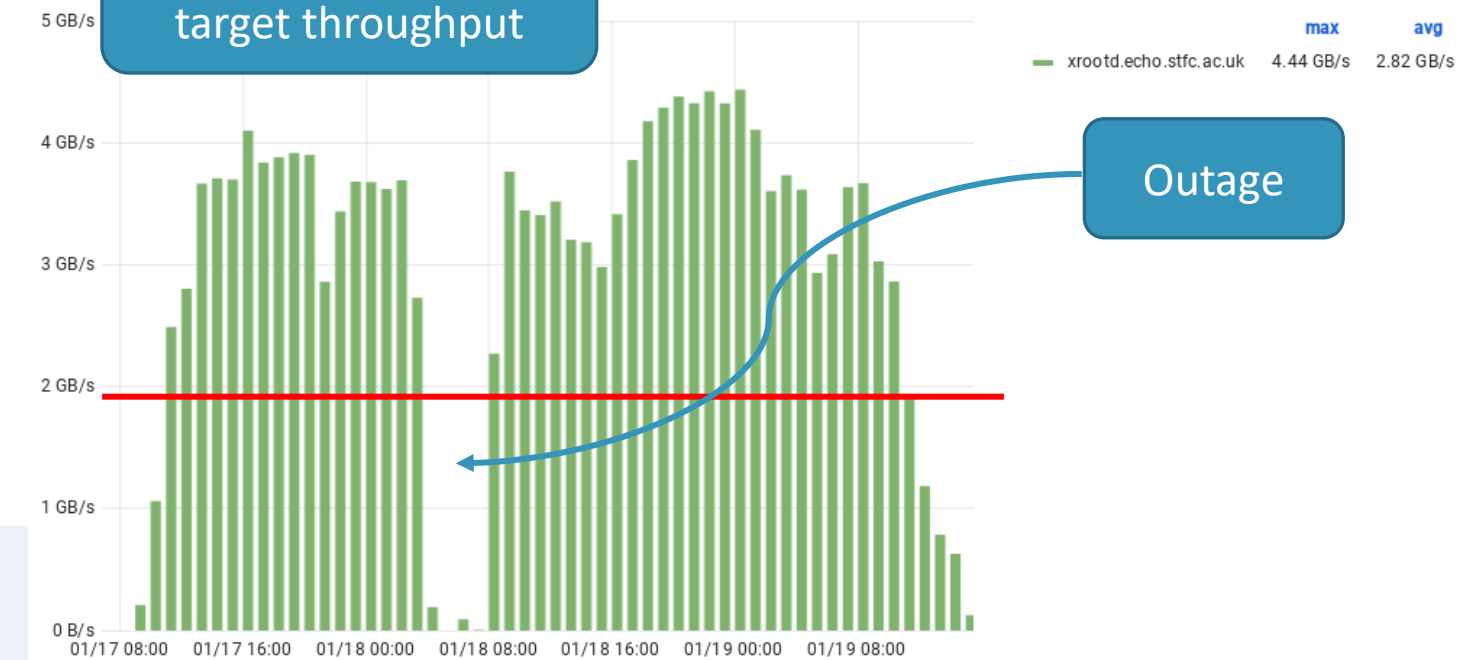
Transfer Throughput



max 3.49 GB/s avg 2.41 GB/s  
webdav.echo.stfc.ac.uk

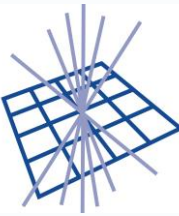
Red lines indicate target throughput

Staging Throughput



max 4.44 GB/s avg 2.82 GB/s  
xrootd.echo.stfc.ac.uk

Outage

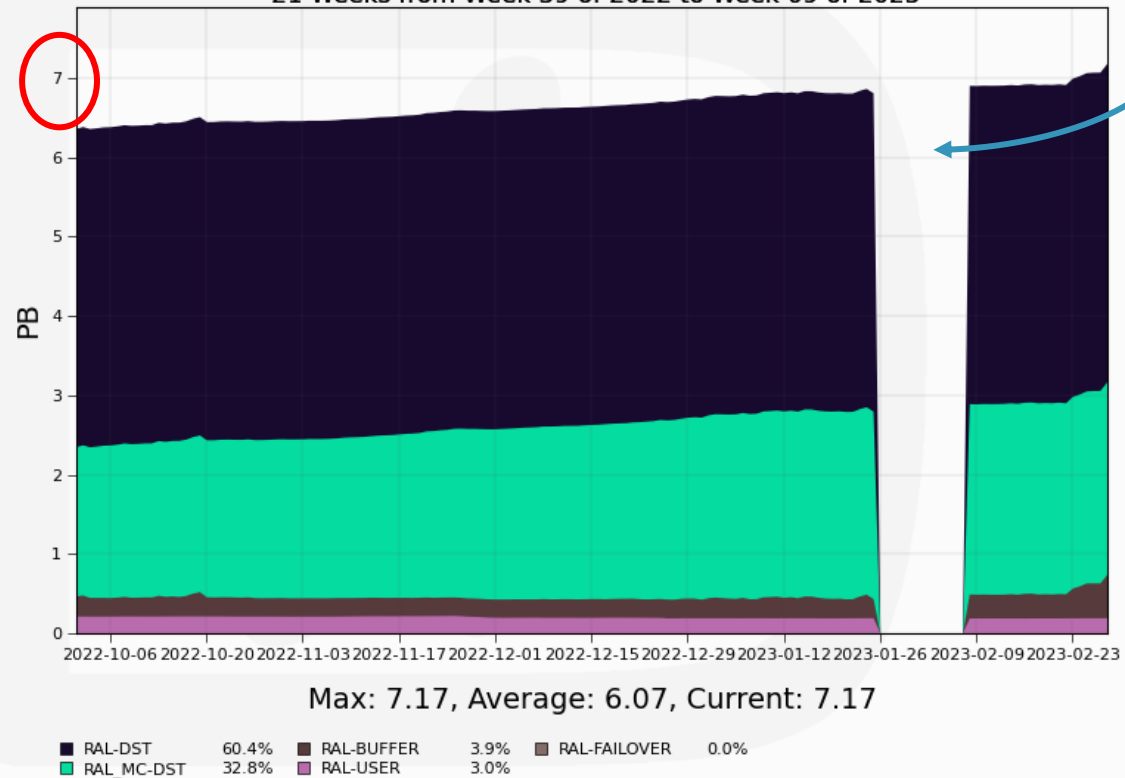


# Disk usage

About 60% of allocated disk space is used. Interesting that there is a discrepancy between WLCG accounting and LHCb accounting

PFN space usage by StorageElement

21 Weeks from Week 39 of 2022 to Week 09 of 2023



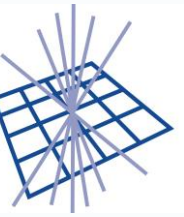
Major DIRAC upgrade

## Disk Space - TBytes

Search:

Disk Space - TBytes	Oct 2022	Nov 2022	Dec 2022	Jan 2023	Feb 2023	Total	% MoU
LHCB allocated	12,474	12,474	12,474	12,474	12,474	62,370	
LHCB used	7,359	7,476	7,608	8,003	7,943	38,388	
<b>Total allocated</b>	<b>12,474</b>	<b>12,474</b>	<b>12,474</b>	<b>12,474</b>	<b>12,474</b>	<b>62,370</b>	<b>100%</b>
<b>Total used</b>	<b>7,359</b>	<b>7,476</b>	<b>7,608</b>	<b>8,003</b>	<b>7,943</b>	<b>38,388</b>	<b>62%</b>
installed capacity	0	0	0	0	0	0	
MoU pledge	12,474	12,474	12,474	12,474	12,474	62,370	

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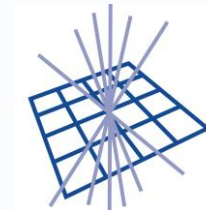


# Problems: consistency checks

The last consistency check for LHCb storages was ages ago. Luckily, recently it was done.

- Antares
  - Several lost and dark files
- ECHO
  - Several hundreds of lost files
  - ~750k files or ~1PB of dark data
    - Some parts of this dark data originated from CASTOR -> ECHO migration
    - The origin of other parts is unknown (deletion problems?)
    - Waiting for a final confirmation from the LHCb Data Manager to proceed with the deletions



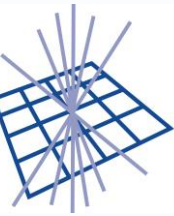


# Problems: long term issues

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There are/were several long-lasting issues for LHCb:

1. Vector read ([ticket](#)).
2. Deletion problems ([ticket](#), solved).
3. Slow stat calls ([ticket](#)).
4. Stub files ([ticket](#)), backup.

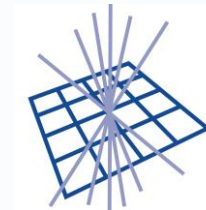


# Vector read issue

Vector read (aka readv) is an xrootd request that reads multiple chunks of file identified by offset and length.



These requests sometimes fail on ECHO, this causes job failures. This is a serious issue for LHCb since user jobs usually process a lot of files (up to 50). A single failure during the processing of the last file causes the whole job to fail, and results for the first successfully processed files are discarded.



# Vector read issue: problem

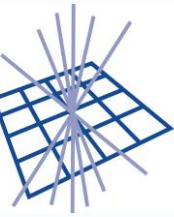
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The error happens when readv operations takes too long

- There is a “stream timeout” in xrootd – if nothing is transferred in the data channel for the given amount of time, failure will be declared.
- It is possible to increase this timeout via environment variable.
- There were a lot of attempts to fix the issue this way, without any success.

Example:

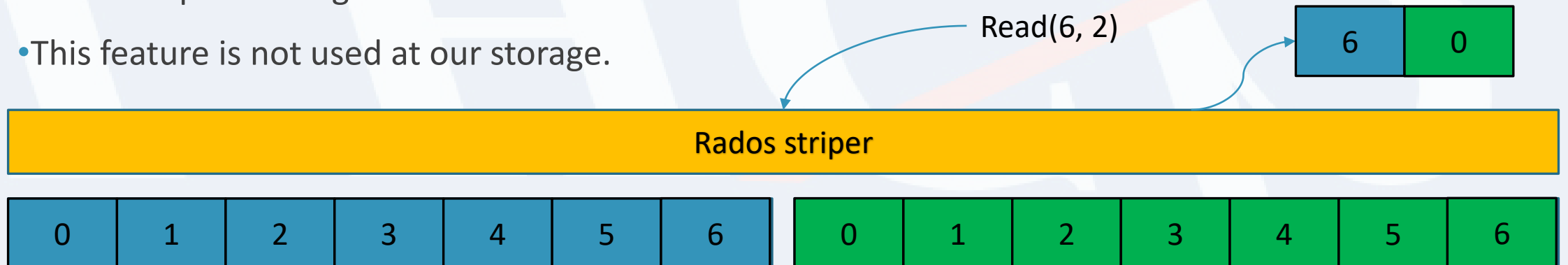
```
Error in <TNetXNGFile::ReadBuffers>: [ERROR] Socket timeout
```

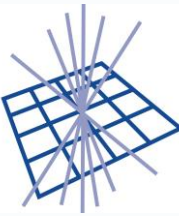


# Vector read issue: how storage works

To understand the reasons for these slow reads, let's see how the files are stored on ECHO

- Data is stored in ceph
- Clients access data through gateway servers
- Every file is split into “blocks” (i.e. ceph objects) of size  $\leq 64\text{MiB}$ .
- Rados striper library allow one to handle this transparently.
- Rados striper is designed to handle simultaneous reads and writes of the same file.
- This feature is not used at our storage.



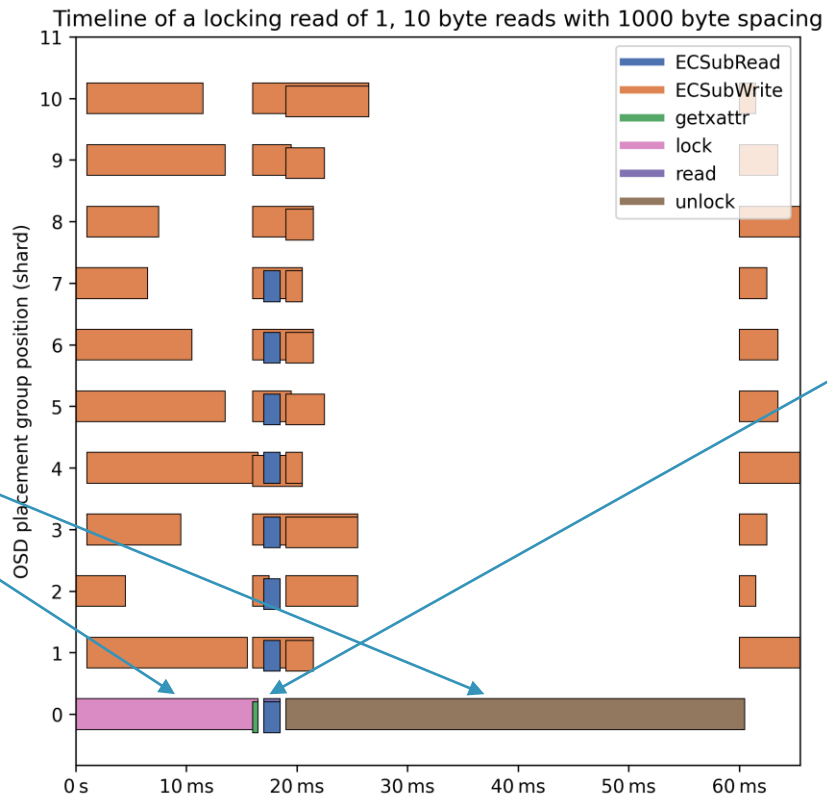


# Vector read issue: when read is not read

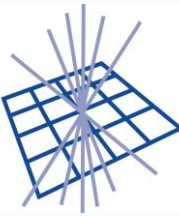
Rados striper is designed to handle simultaneous reads and writes (not useful for our storage), that's why every read operation actually involves writing of the lock. That's why reads are so slow. Many thanks to Tom Byrne for the plot and for the investigation!

Lock and unlock  
Take a lot of  
time

And vector read requests are executed sequentially (i.e. requested chunks are read sequentially), which makes the problem even worse.

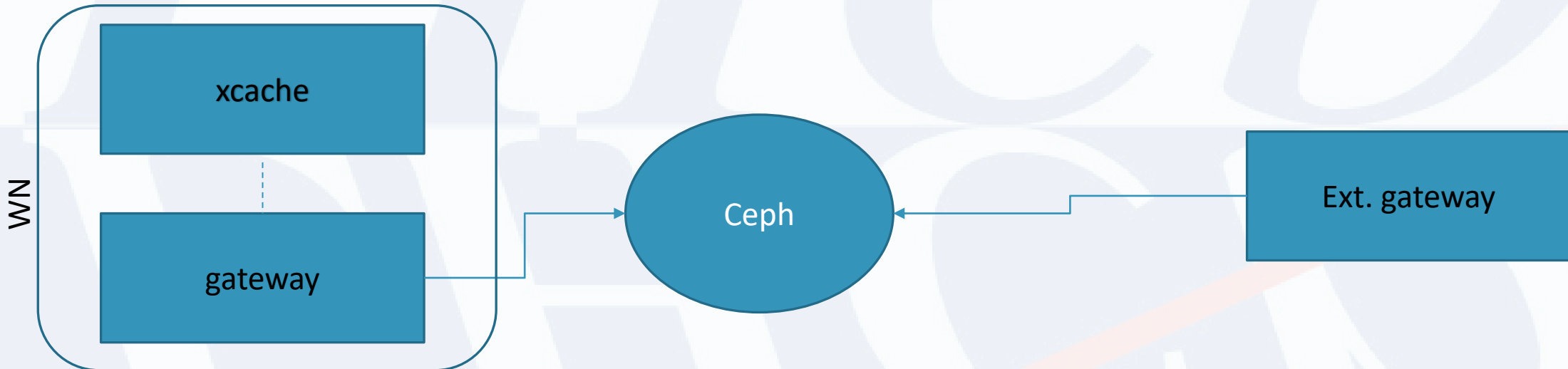


The actual read  
is comparatively  
quick



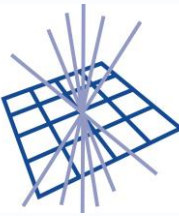
# Vector read issue: current configuration

To mitigate the problem, RAL's WNs have different configuration (from external gateways). There is an additional caching instance of xrootd, which tries to read data from ceph using huge blocks.



This mitigates the problem but does not resolve it completely (timeouts still happen sometimes). Furthermore, this configuration introduces additional errors.

# Vector read issue: non-striper reads

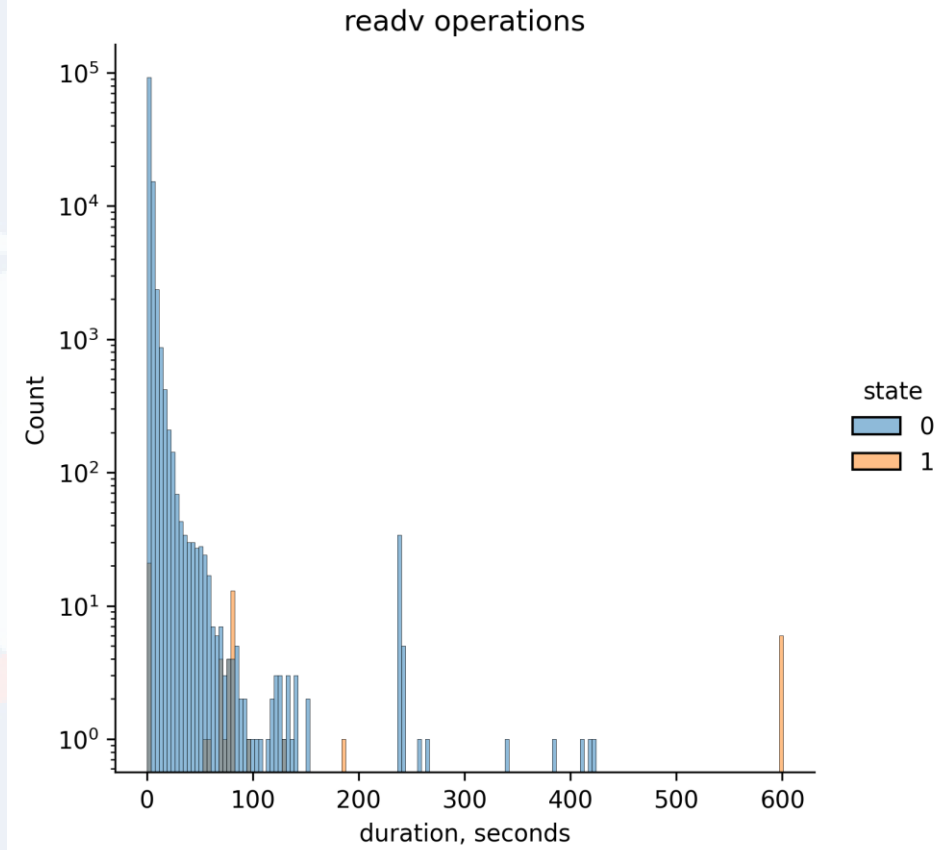
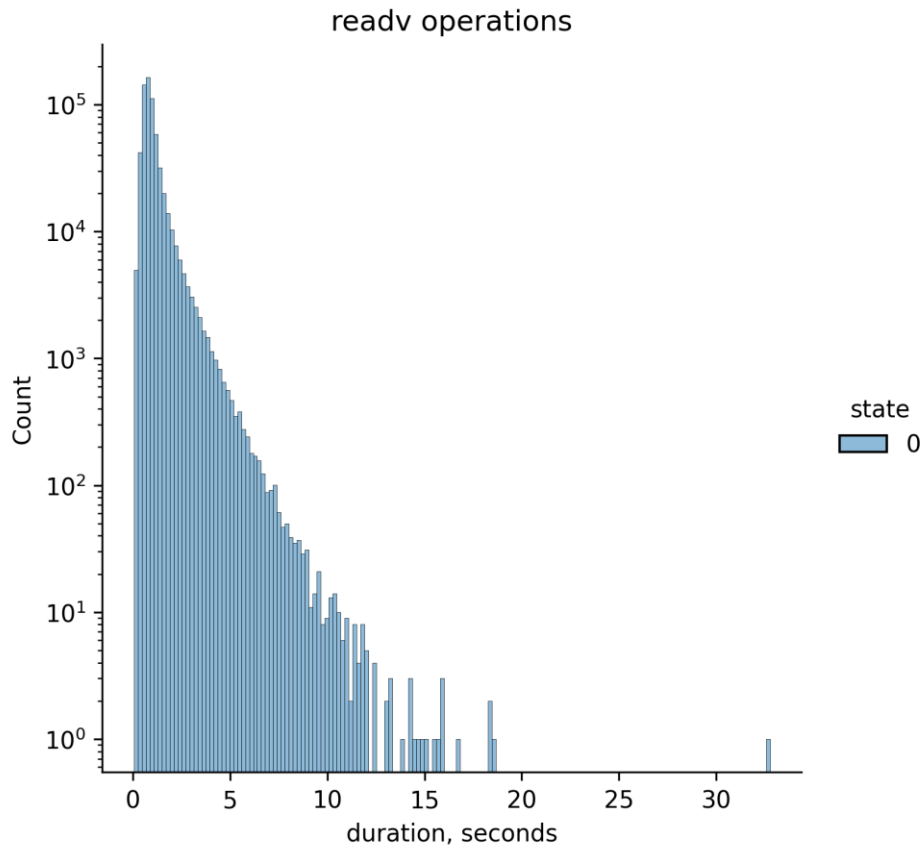


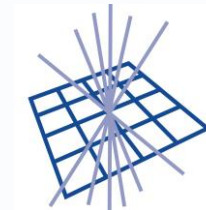
Can we remove this library for reads? Yes! This helps to improve the performance significantly

Ext.  
GW

WN test

Test type	No striper	No changes
Time	11m0.818s	323m1.111s





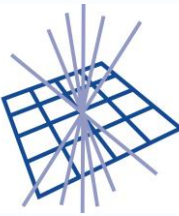
# Vector read issue: plans

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- There is a patch that removes rados striper for reads.
- The patch was applied on several test WNs ~1.5 months ago, since then there were no job failures due to vector read issues.
- Though the number of user jobs is not very high -- ~1500.
- Test with other VOs (waiting for CMS).
- [Code Review](#) is ongoing, feel free to comment!
- Large-scale test is planned once it is finished.
- Many thanks to all involved: Alastair Dewhurst, James Walder, Jyothish Thomas, Raja Nandakumar, Robert Currie, Steven Simpson, Tom Birkett, Tom Byrne et al.



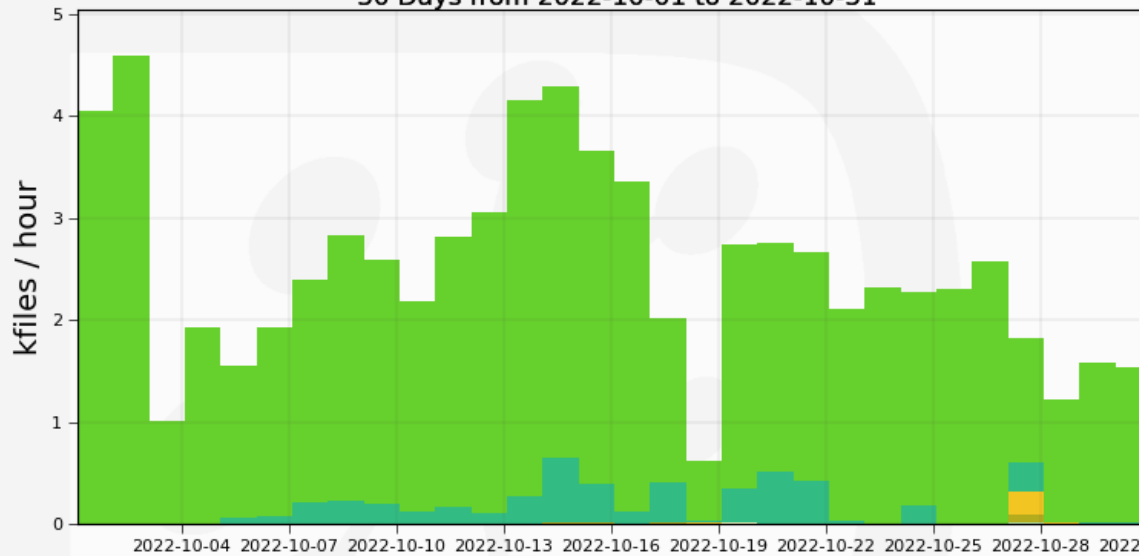
# Deletion problems



For a long time failure rate of the deletion operations on ECHO was high.

The issue was solved by xrootd development and by tuning timeouts on the client side.

Deletions by channel  
30 Days from 2022-10-01 to 2022-10-31

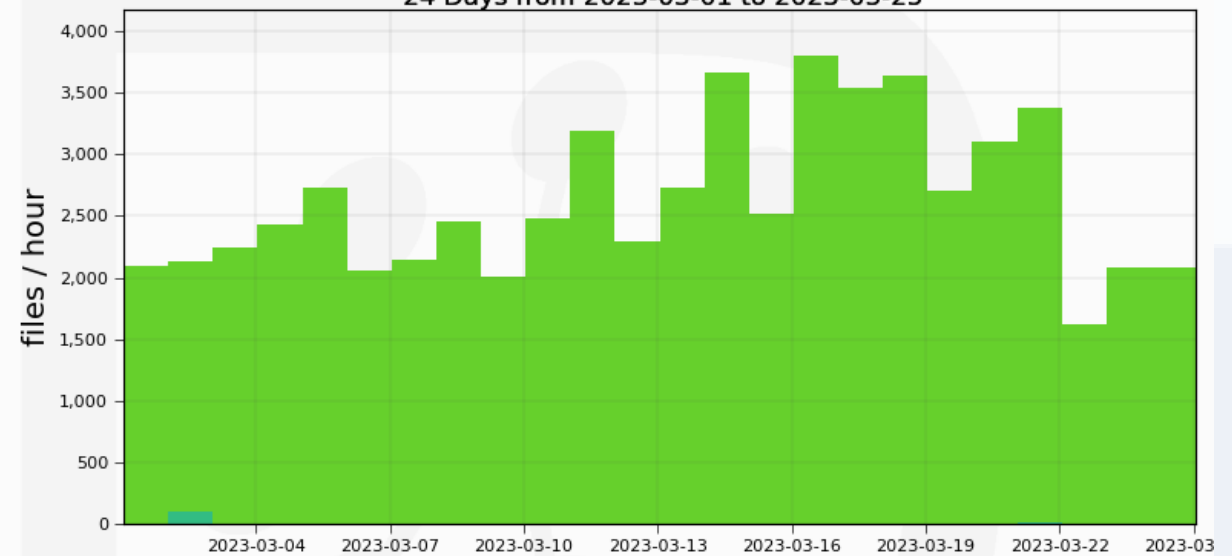


Max: 4.59, Min: 0.62, Average: 2.50, Current: 2.41

Succeeded	93.2%	DIRAC.Client.DE -> RAL-USER	0.0%
LCG.RAL.uk -> RAL-BUFFER	6.2%	DIRAC.Client.edu -> RAL-USER	0.0%
DIRAC.Client.ch -> RAL-USER	0.3%	DIRAC.Client.es -> RAL-USER	0.0%
Ibvobox309.cern.ch -> RAL-BUFFER	0.2%	LCG.UKI-LT2-IC-HEP.uk -> RAL-BUFFER	0.0%
DIRAC.Client.cn -> RAL-USER	0.0%	DIRAC.Client.uk -> RAL-USER	0.0%
Ibvobox309.cern.ch -> RAL-USER	0.0%	LCG.CERN.cern -> RAL-USER	0.0%
Ibvobox310.cern.ch -> RAL-BUFFER	0.0%	LCG.CERN.cern -> RAL-BUFFER	0.0%
DIRAC.Client.fr -> RAL-USER	0.0%	Ibvobox310.cern.ch -> RAL-FAILOVER	0.0%
Ibvobox309.cern.ch -> RAL-FAILOVER	0.0%	... plus 7 more	

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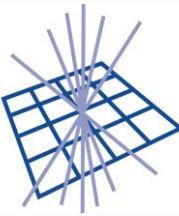
Deletions by channel  
24 Days from 2023-03-01 to 2023-03-25



Max: 3,795, Min: 125, Average: 2,529, Current: 125

Succeeded	99.7%	Ibvobox310.cern.ch -> RAL-BUFFER	0.0%
LCG.RAL.uk -> RAL-BUFFER	0.2%	DIRAC.Client.fr -> RAL-USER	0.0%
Ibvobox309.cern.ch -> RAL-USER	0.0%	DIRAC.Client.local -> RAL-USER	0.0%
DIRAC.Client.ch -> RAL-USER	0.0%	DIRAC.Client.net -> RAL-USER	0.0%
DIRAC.Client.uk -> RAL-USER	0.0%	Ibvobox310.cern.ch -> RAL-FAILOVER	0.0%
DIRAC.Client.es -> RAL-USER	0.0%	DIRAC.Client.edu -> RAL-USER	0.0%
Ibvobox309.cern.ch -> RAL-BUFFER	0.0%	Ibvobox309.cern.ch -> RAL-FAILOVER	0.0%
DIRAC.Client.cn -> RAL-USER	0.0%	Ibvobox310.cern.ch -> RAL_MC-DST	0.0%
DIRAC.Client.DE -> RAL-USER	0.0%	... plus 8 more	

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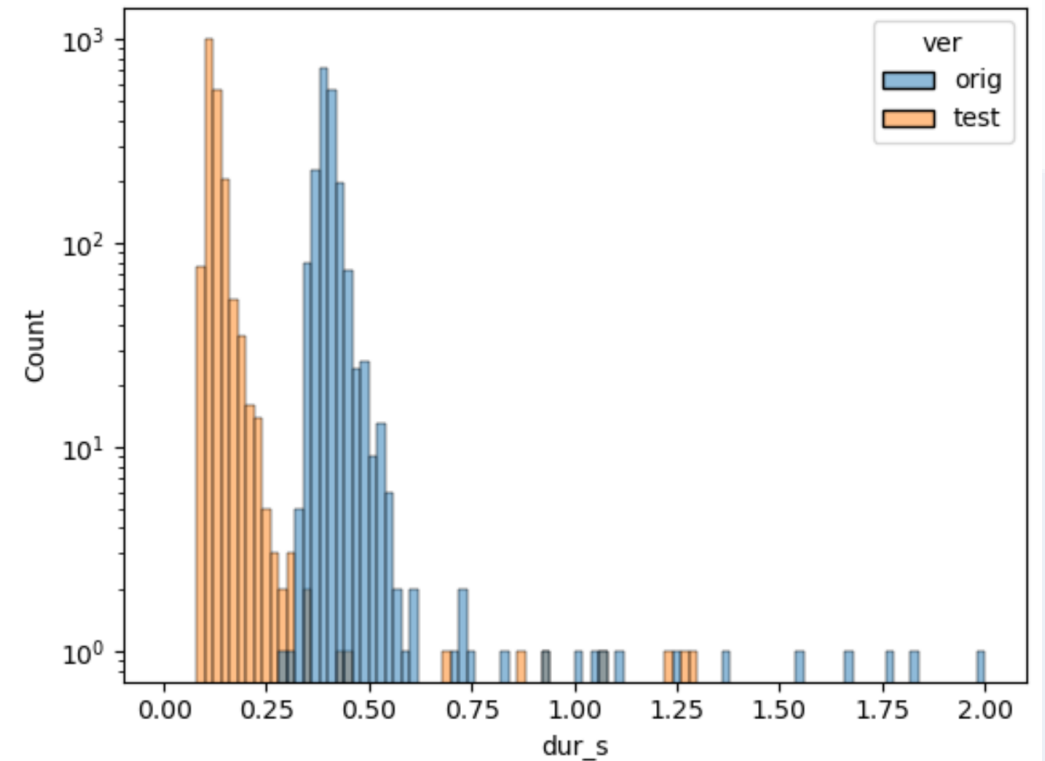
# Slow “stat” calls

There is a ticket with a complaint about “Slow stats” at RAL’s ECHO.

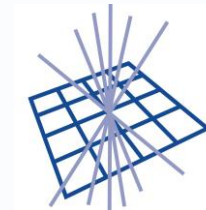
It turned out that it is not the stats that are slow, but the checksum requests (different request in terms of xrootd).

Xrootd development is ongoing (thanks to James W)

- There is a patch that is being tested right now



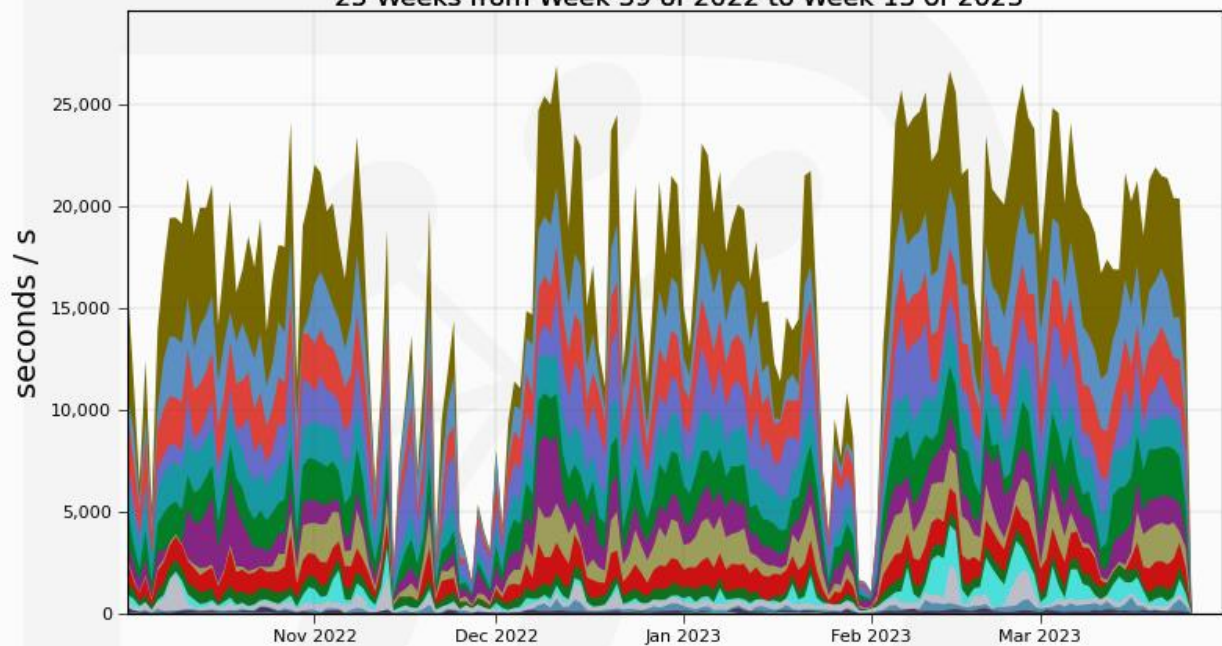
# Tier-2 statistics



Tier-2 jobs efficiency also looks OK

CPU usage by Site

25 Weeks from Week 39 of 2022 to Week 13 of 2023



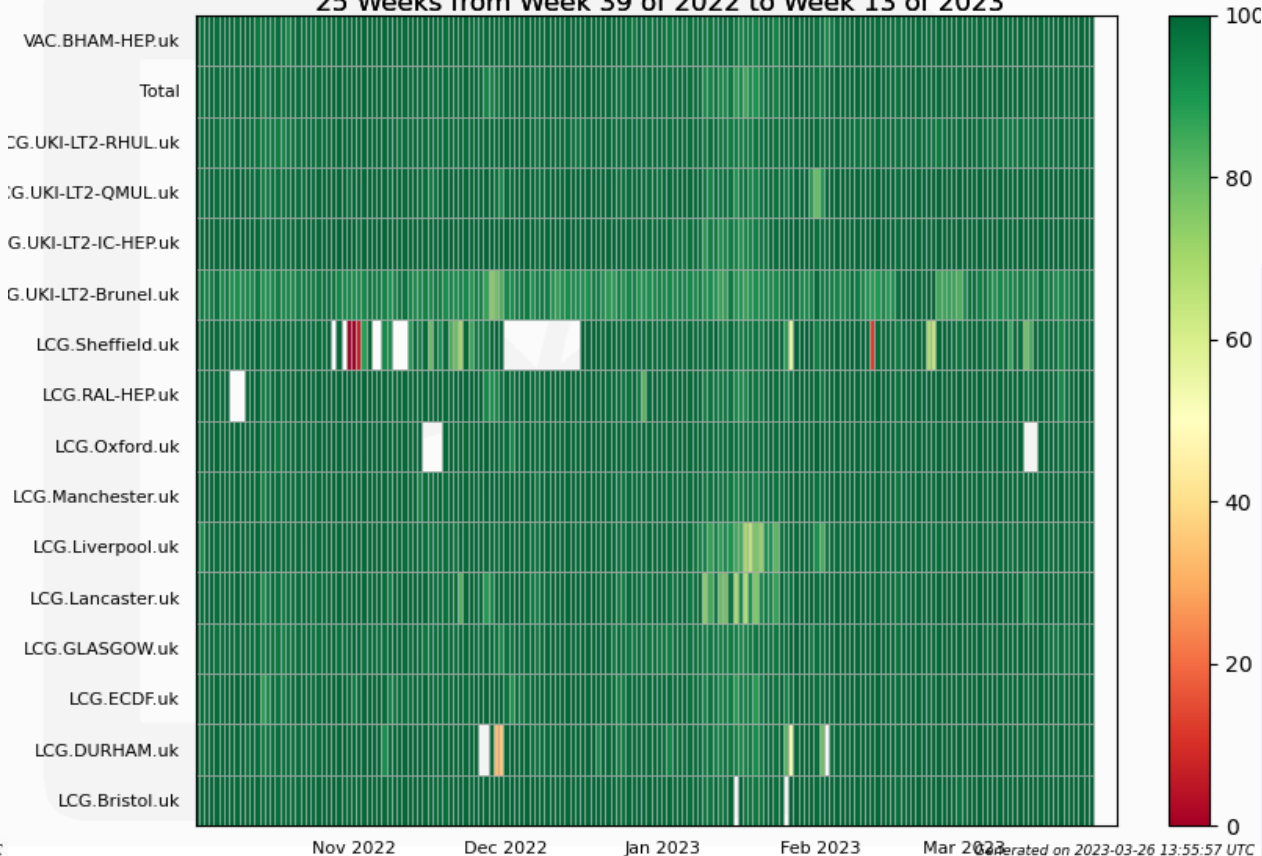
Max: 26,901, Average: 16,349

LCG.Manchester.uk	21.9%	LCG.Liverpool.uk	8.9%	LCG.DURHAM.uk	2.3%
LCG.UKI-LT2-QMUL.uk	11.9%	LCG.RAL-HEP.uk	7.0%	LCG.UKI-LT2-Brunel.uk	2.1%
LCG.GLASGOW.uk	11.3%	LCG.UKI-LT2-RHUL.uk	5.6%	VAC.BHAM-HEP.uk	0.9%
LCG.Lancaster.uk	10.0%	LCG.Oxford.uk	5.6%	LCG.ECDF.uk	0.6%
LCG.UKI-LT2-IC-HEP.uk	9.2%	LCG.Bristol.uk	2.7%	LCG.Sheffield.uk	0.1%

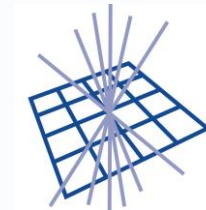
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Job CPU efficiency by Site

25 Weeks from Week 39 of 2022 to Week 13 of 2023



Generated on 2023-03-26 13:55:57 UTC



# Ticket summary

Site	Tickets opened since Oct 2022	Open tickets
RAL-T1	14	4
UKI-LT2-Brunel	3	0
UKI-LT2-QMUL	4	0
UKI-LT2-RHUL	2	0
UKI-NORTHGRID-LANCS-HEP	3	0
UKI-NORTHGRID-LIV-HEP	2	1
UKI-NORTHGRID-MAN-HEP	2	0
UKI-NORTHGRID-SHEF-HEP	2	0
UKI-SCOTGRID-DURHAM	1	0
UKI-SCOTGRID-ECDF	3	0
UKI-SOUTHGRID-BRIS-HEP	3	0
UKI-SOUTHGRID-RALPP	1	0
All	40	5

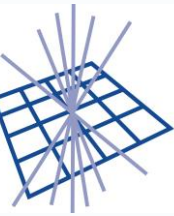
# LHCb ETF tests .ac.uk

The screenshot shows the Checkmk web interface for 'Host search ac.uk'. The browser address bar is 'etf-lhcb-prod.cern.ch'. The interface includes a sidebar with navigation options like 'Overview', 'Hosts', 'Host Groups', 'Services', 'Service Groups', and 'Metrics'. The main content area displays a table of host status for 'Local site etf'.

state	Host	Icons	OK	Wa	Un	Cr	Pd
UP	arc-ce-test02.gridpp.rl.ac.uk		9	0	0	0	0
UP	arc-ce01.gridpp.rl.ac.uk		9	0	0	0	0
UP	arc-ce02.gridpp.rl.ac.uk		9	0	0	0	0
UP	arc-ce03.gridpp.rl.ac.uk		9	0	0	0	0
UP	arc-ce04.gridpp.rl.ac.uk		9	0	0	0	0
UP	arc-ce05.gridpp.rl.ac.uk		9	0	0	0	0
UP	arcce02.esc.qmul.ac.uk		8	1	0	0	0
UP	arcce03.esc.qmul.ac.uk		8	1	0	0	0
UP	ce01.gla.scotgrid.ac.uk		9	0	0	0	0
UP	ce01.tier2.hep.manchester.ac.uk		9	0	0	0	0
UP	ce02.gla.scotgrid.ac.uk		9	0	0	0	0
UP	ce02.tier2.hep.manchester.ac.uk		9	0	0	0	0
UP	ce03.gla.scotgrid.ac.uk		9	0	0	0	0
UP	ce03.tier2.hep.manchester.ac.uk		9	0	0	0	0
UP	ce04.gla.scotgrid.ac.uk		9	0	0	0	0
UP	ce1.gridpp.ecdf.ed.ac.uk		9	0	0	0	0
UP	ce2.gridpp.ecdf.ed.ac.uk		9	0	0	0	0
UP	ce3.dur.scotgrid.ac.uk		8	1	0	0	0
UP	ce4.dur.scotgrid.ac.uk		8	1	0	0	0
UP	ceprod00.grid.hep.ph.ic.ac.uk		8	1	0	0	0
UP	ceprod01.grid.hep.ph.ic.ac.uk		8	1	0	0	0
UP	ceprod02.grid.hep.ph.ic.ac.uk		8	1	0	0	0

- Tests of functionality of services at sites
  - In most cases by submitting jobs to CE
  - Test CE API, certificates, cvmfs, memory on worker node ...
- Tests are simple shell scripts
  - Easy for admins and other GridPP staff to look at
  - Outputs of tests are visible to site admins
- Manchester took on ETF maintenance again, at start of March
- Imminent release of updated suite of tests
  - Including new storage tests
  - Need special handling for subset of WebDAV RAL Echo has
  - Especially important for GridPP/LHCb since UK has so many of the LHCb Tier2s with storage

- Plan is to use ETF tests for advance testing of new DIRAC requirements / API support
  - ETF tests are trivial shell scripts
    - easy to change
  - DIRAC is a large monolithic system which LHCb relies on for production and user work
    - harder to change and riskier to deploy updates
- Site admins can see ETF test outputs and the test source code
  - Provides a concrete target in advance of deployment in DIRAC
- Key changes
  - Storage technology changes - eg move away from DPM
  - Token support for storages - one goal of DC24 in early 2024

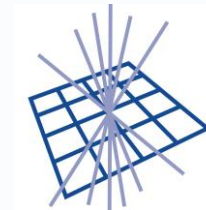


# Summary

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- UK sites provided a lot of resources to LHCb during the last 6 months.
- In general operations were smooth.
- There are some long-lasting issues, their solutions are progressing.
  - xrootd-related issues, require xrootd development

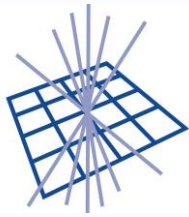




# Backup: Stub files

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- Sometimes a failed upload to ECHO results in a corrupted file: some garbage data (i.e. some ceph objects) are left on the storage.
- This prevents further uploads of the file.
- To solve the problem these garbage objects have to be removed manually using low level rados operations (only accessible by admins).
- Previously such files were identified via GGUS tickets from the VO.
- Hopefully, this will change soon -- [tools](#) that will allow one to detect such files on the server side (i.e. perform internal consistency checks) are being developed (almost finished).

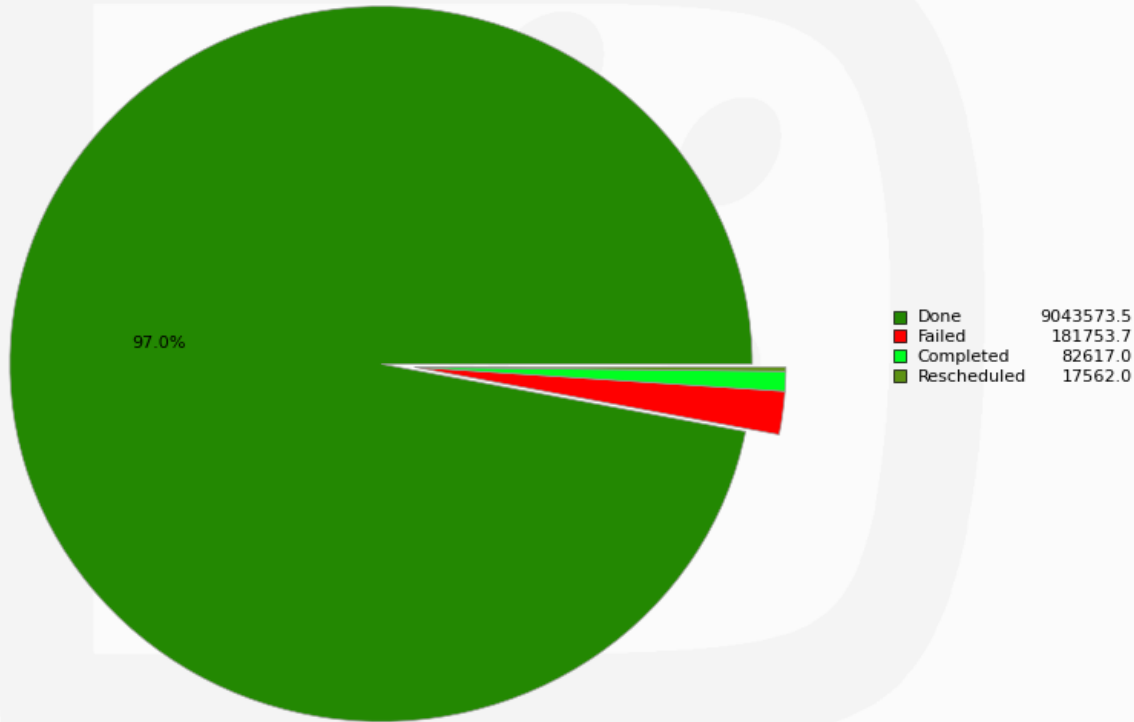


# Backup: RAL T1 jobs success rate

What about the success rate of RAL's jobs? Very high for MC jobs and acceptable for user jobs.

RAL jobs

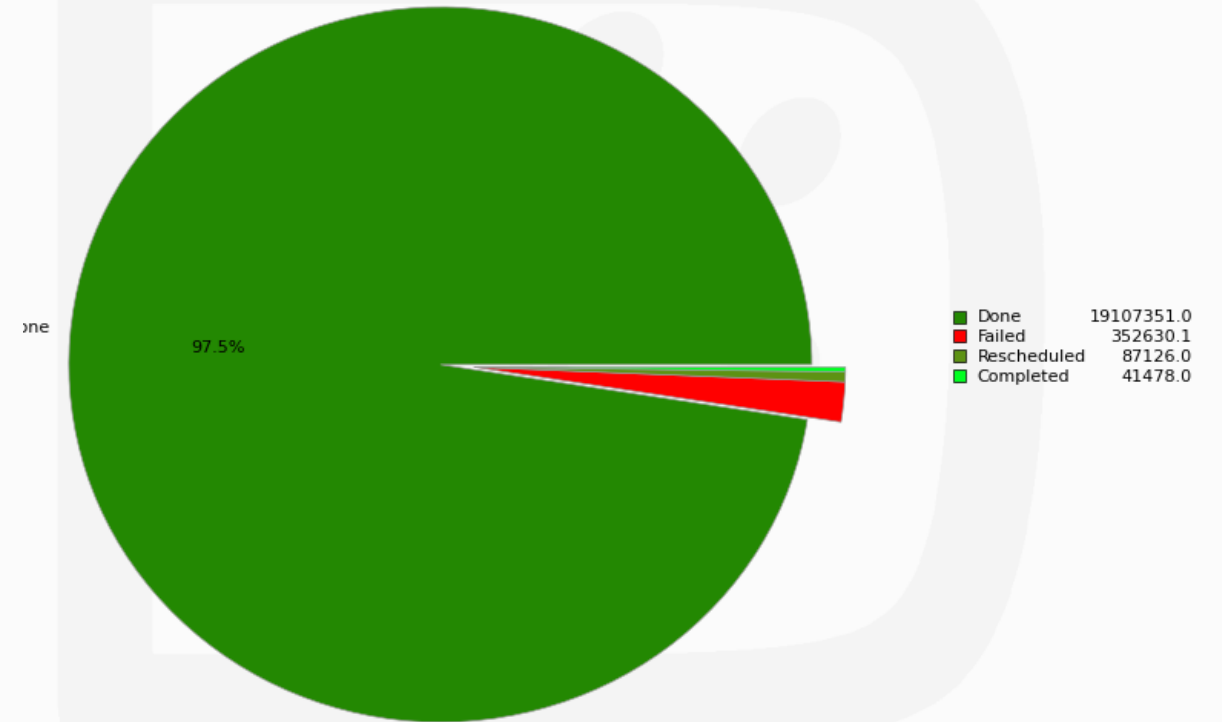
25 Weeks from Week 39 of 2022 to Week 13 of 2023



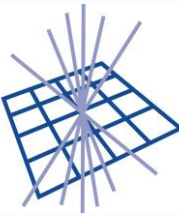
Generated on 2023-03-24 16:14:01 UTC

T1\RAL jobs

25 Weeks from Week 39 of 2022 to Week 13 of 2023



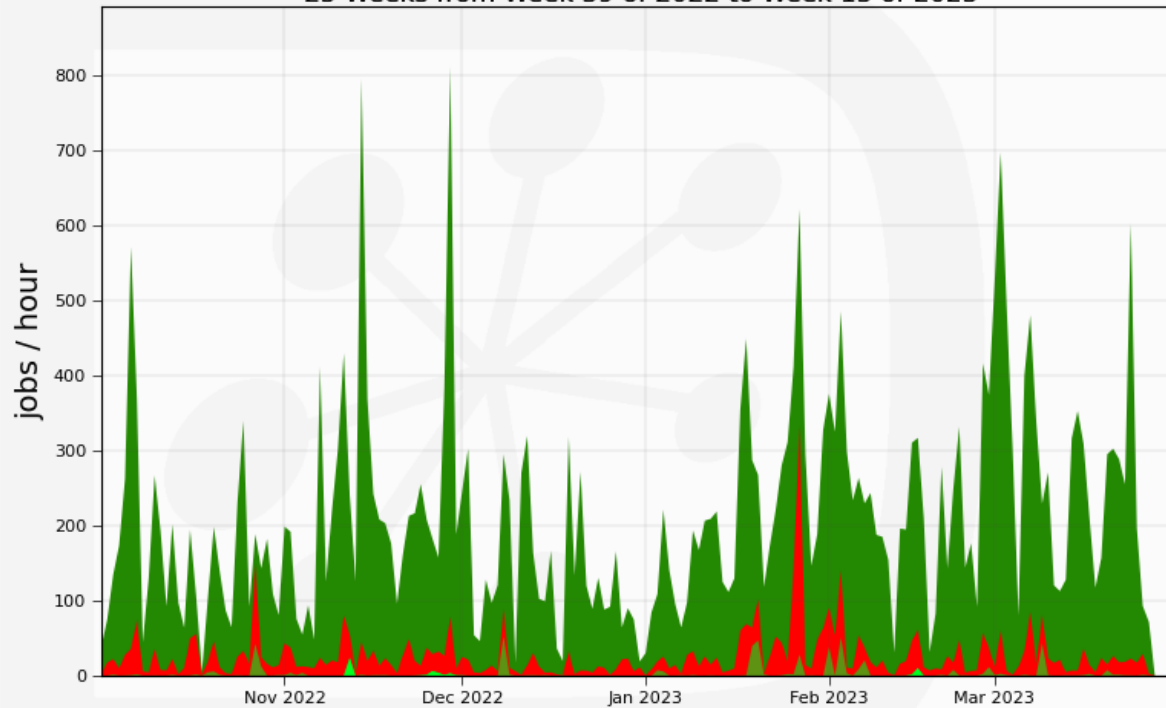
Generated on 2023-03-24 16:30:36 UTC



# Backup: RAL T1 user jobs success rate

RAL Jobs by MajorStatus

25 Weeks from Week 39 of 2022 to Week 13 of 2023



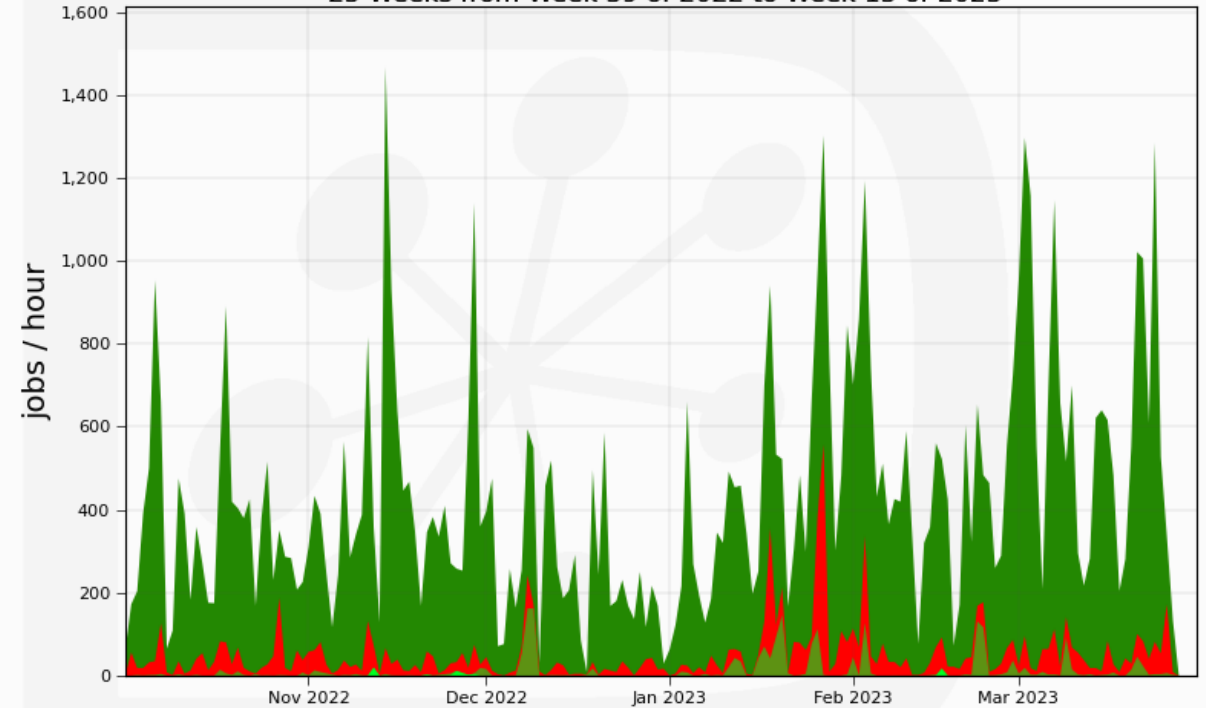
Max: 811, Average: 208

Done 87.6% Failed 11.0% Rescheduled 1.3% Completed 0.1%

Generated on 2023-03-27 10:14:45 UTC

T1\RAL Jobs by MajorStatus

25 Weeks from Week 39 of 2022 to Week 13 of 2023

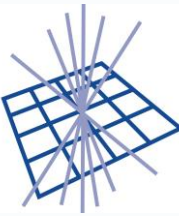


Max: 1,466, Average: 423

Done 88.1% Failed 9.2% Rescheduled 2.7% Completed 0.1%

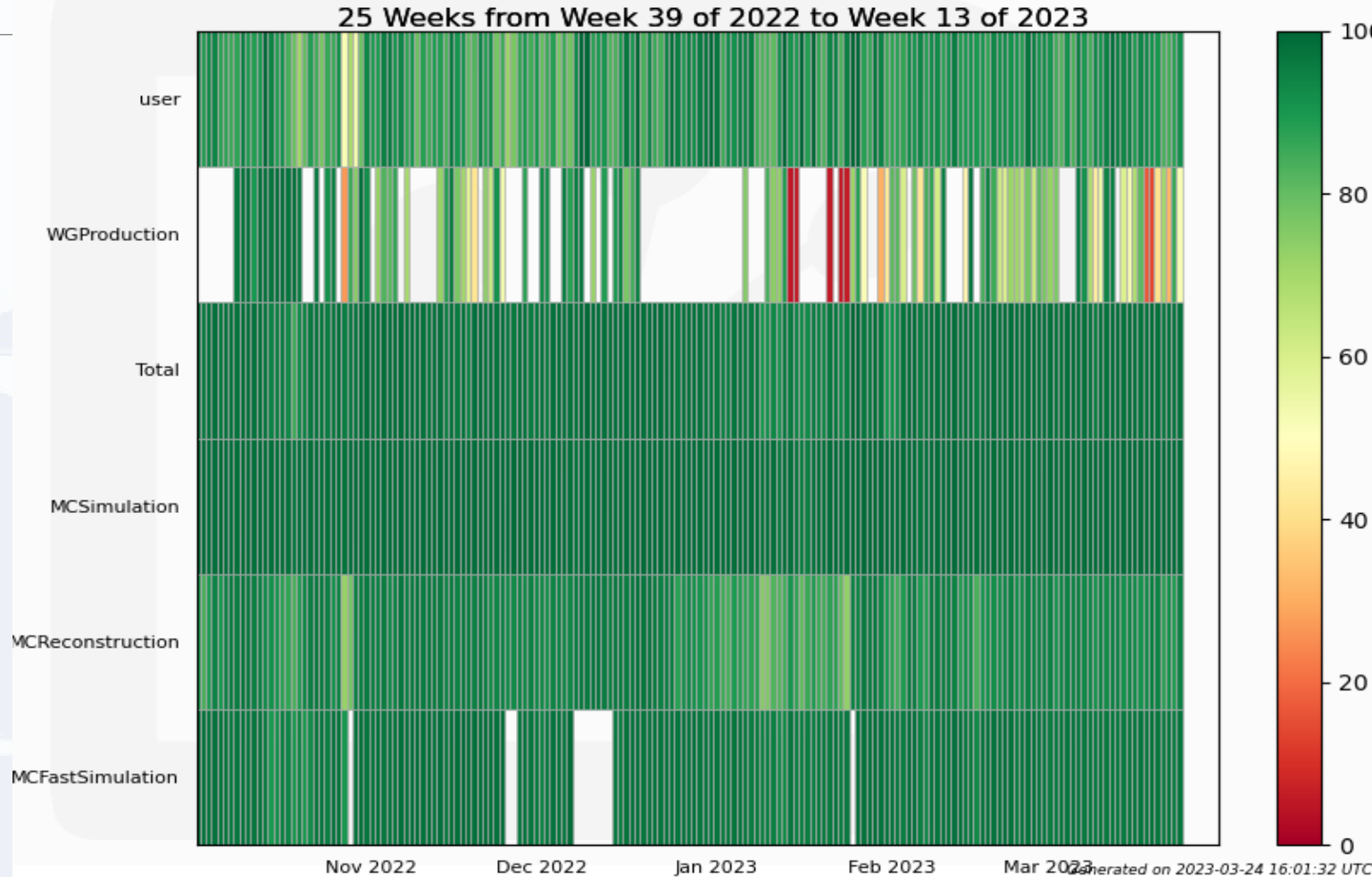
Generated on 2023-03-27 10:11:31 UTC

# Backup: RAL T1 Job efficiency

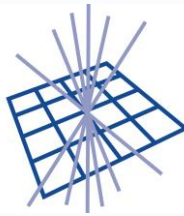


Efficiency of MC jobs is good, user and WG Production jobs have lower efficiency (not surprising).

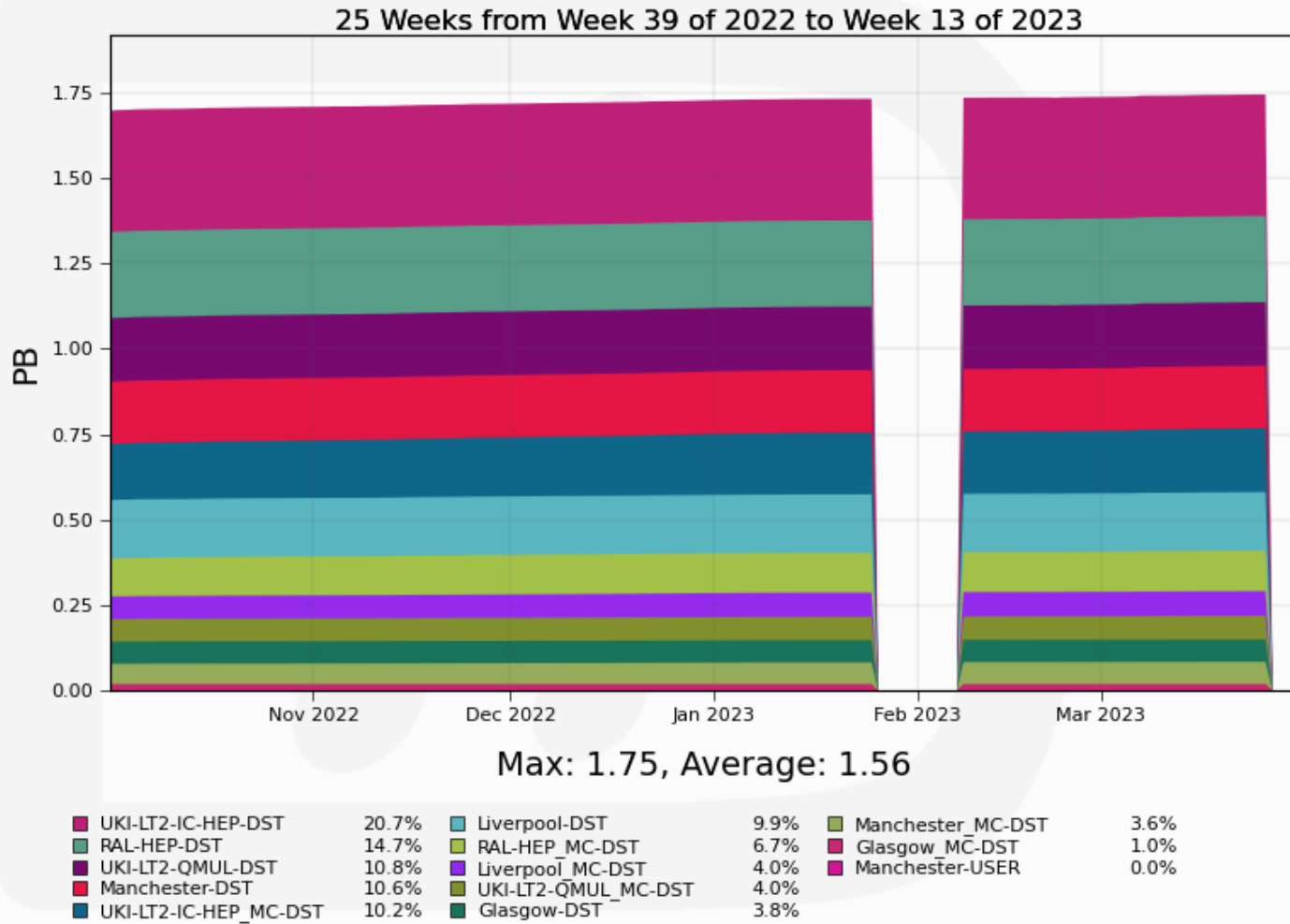
RAL jobs CPU efficiency



# Tier-2 statistics

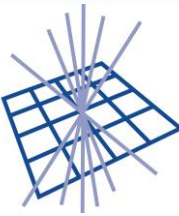


Limited data operations during the last 6 months  
PFN space usage by StorageElement



Generated on 2023-03-26 12:37:33 UTC

# Backup: xcache-gateway error



Presence of xcache v5.3.3 causes additional errors sometimes. This is due to inconsistency of read vector length between xcache and the gateway. Furthermore, xcache obscures error message and reports it as "File name too long"

Read(   )

Readv(    )

gateway

