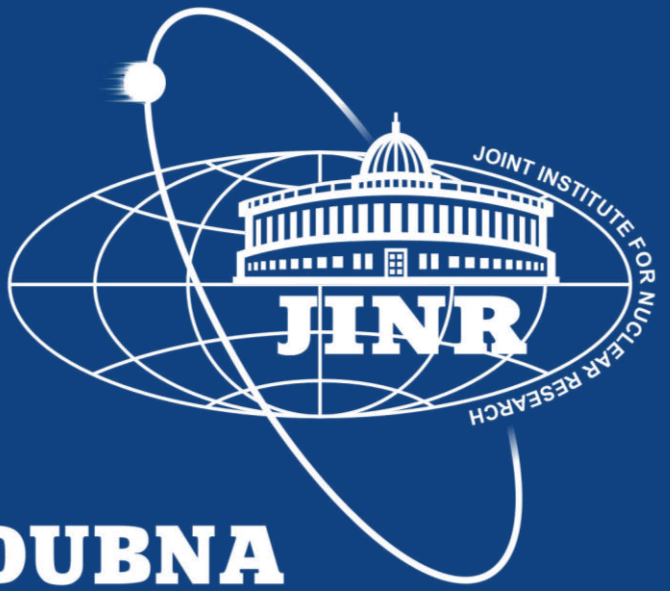

JOINT INSTITUTE FOR NUCLEAR RESEARCH
JINR
DUBNA

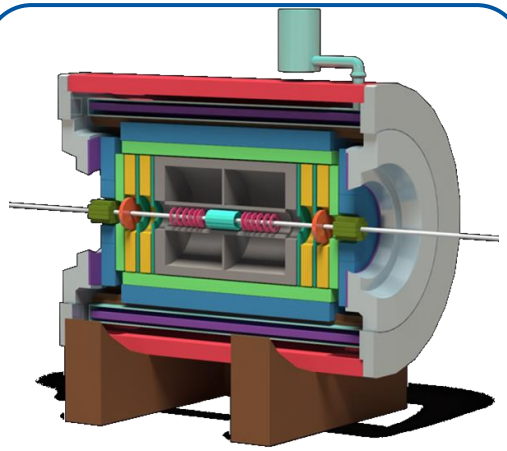
# DIRAC@JINR report

Speaker: Igor Pelevanyuk
Joint Institute for Nuclear Research



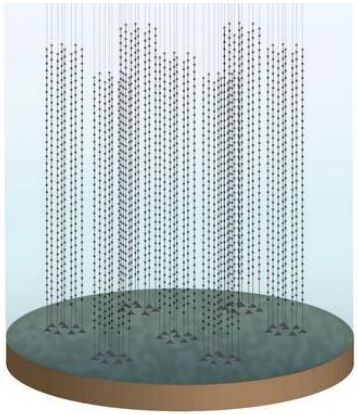

17 October 2023

# What do we use DIRAC for?



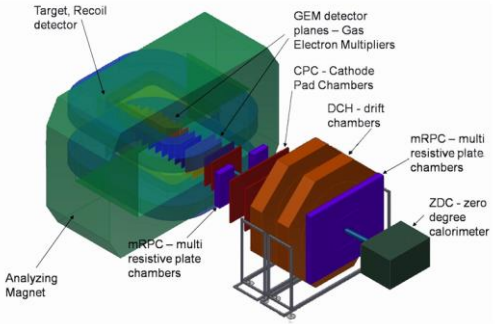
## MPD@NICA

Monte-Carlo – Real
Analysis – Real



## Baikal-GVD

Monte-Carlo – Real



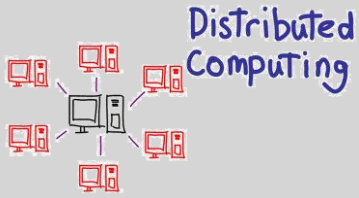

## BM@N

Monte-Carlo – Real
Reconstruction – Real

## SPD@NICA

Monte-Carlo – Real

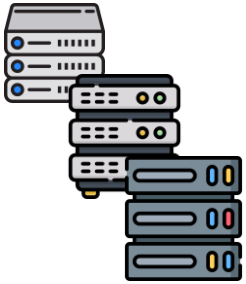
## Folding@HOME




## Teaching

# DIRAC features we use

## Integration



ARC CE
Slurm
OpenNebula
SunGridEngine
EOS

## FileCatalog

Not so much MetaData

## Multi-VO

Cant imagine life without it

## VMDIRAC

**Baikal-GVD** and **Folding@HOME** rely solely on clouds

## WebApp

Mostly JobMonitor and Accounting (and Configuration)



What do you use DIRAC for, and which DIRAC functionalities you don't use, and why?

# DIRAC features we **do not** use

## RSS

Once upon a time it did not worked out, may be we should try again.

Interested

## Request MS

We have just one SE really working. Will try it when there will be two of them.

Interested in future

## Transformation S

MC transformation tested. Going to try transformation initiated by meta data.

Interested

## ElasticSearch

Unclear, what questions it may answer.

Interested



What do you use DIRAC for, and which DIRAC functionalities you don't use, and why?

Any notable operations incident in the last year?

# No major incidents from DIRAC

But, major issue with our single EOS instance,

up to 10% of files were damaged.

Do you have a DIRAC extension? Why?

# We do not use extensions,

Not clear how it may be useful for us

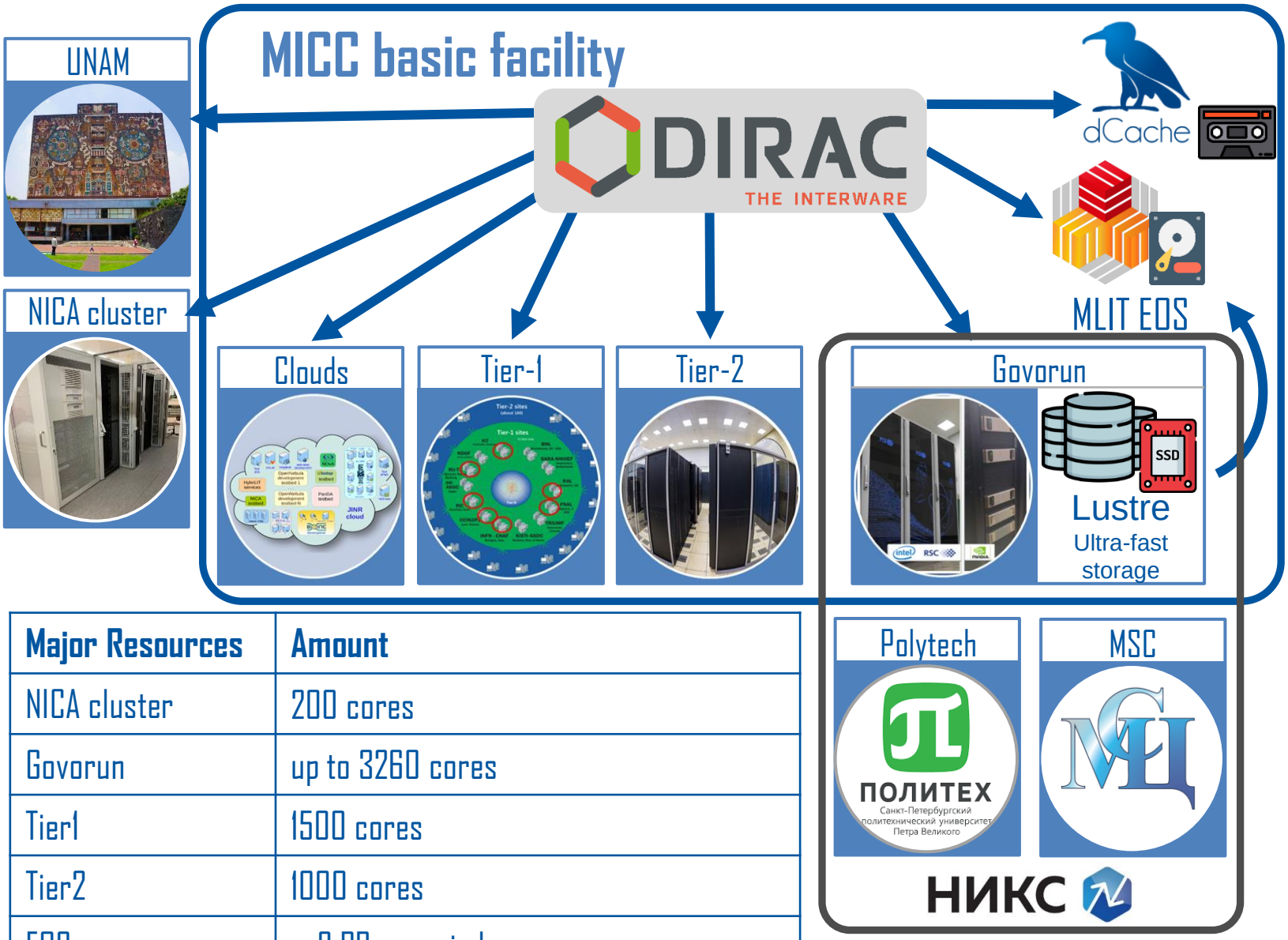
# DIRAC Pilot setup take too much resources: 60000 files to extract with total size of 2GB

It was not such a big issue before, when pilot was relatively small and we had smaller amount of available resources. But, with Pilot2 based on Python3 the issue became obvious.
We confine usage of clouds because of that issue!

To support your "Grid", do you have to use other systems than DIRAC?

- Ansible – restart all services/agents
- InfluxDB1.8 + Telegraf + Chronograf
  for monitoring and some special use-cases like users' job monitoring, "zombie" VirtualMachines checks
- DIRAC CA – for educational purposes and Folding@HOME
- Some homemade staff
  More on this later

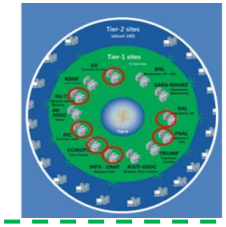
# DIRAC@JINR now



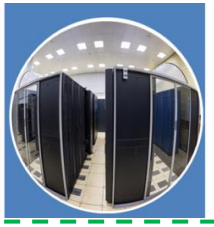

| Major Resources | Amount |
|---|---|
| NICA cluster | 200 cores |
| Govorun | up to 3260 cores |
| Tier1 | 1500 cores |
| Tier2 | 1000 cores |
| EOS | ~ 2 PB occupied |

# Computing resources

JINR



Tier-1
1500 slots
Quota increased



CICC/Tier-2
1000 slots

Clouds
250 slots

Govorun
up to 3500 slots

NICA Cluster
250 slots
(single user quota)

UNAM
100 slots

MPD collaboration

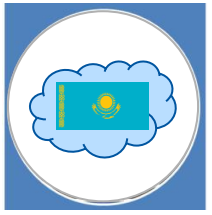
Plekhanov REA
40 slots

Member-states clouds

IPANAS
20 slots

INP
10 slots

INRNE
3 slots

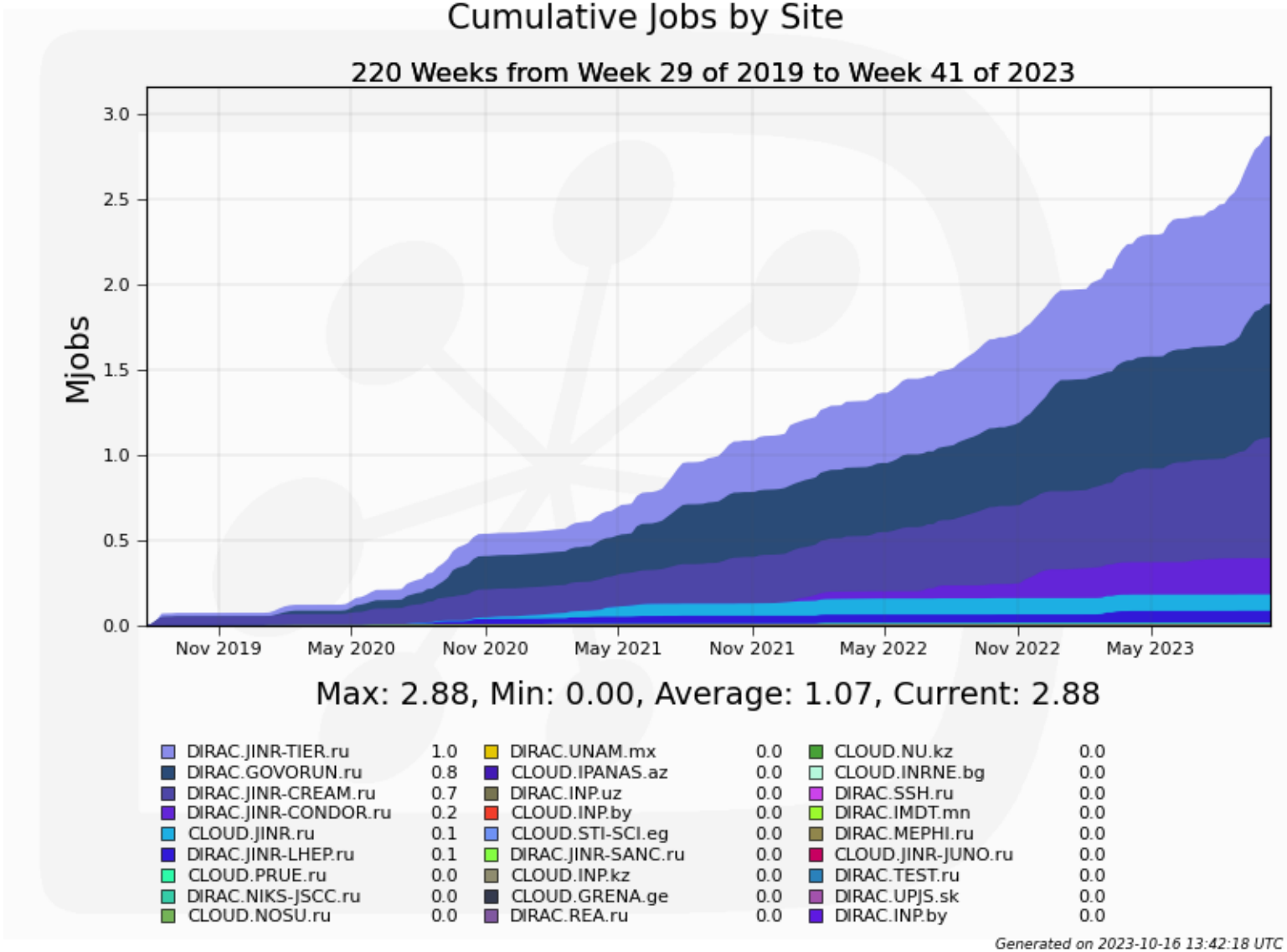


INP
50 slots

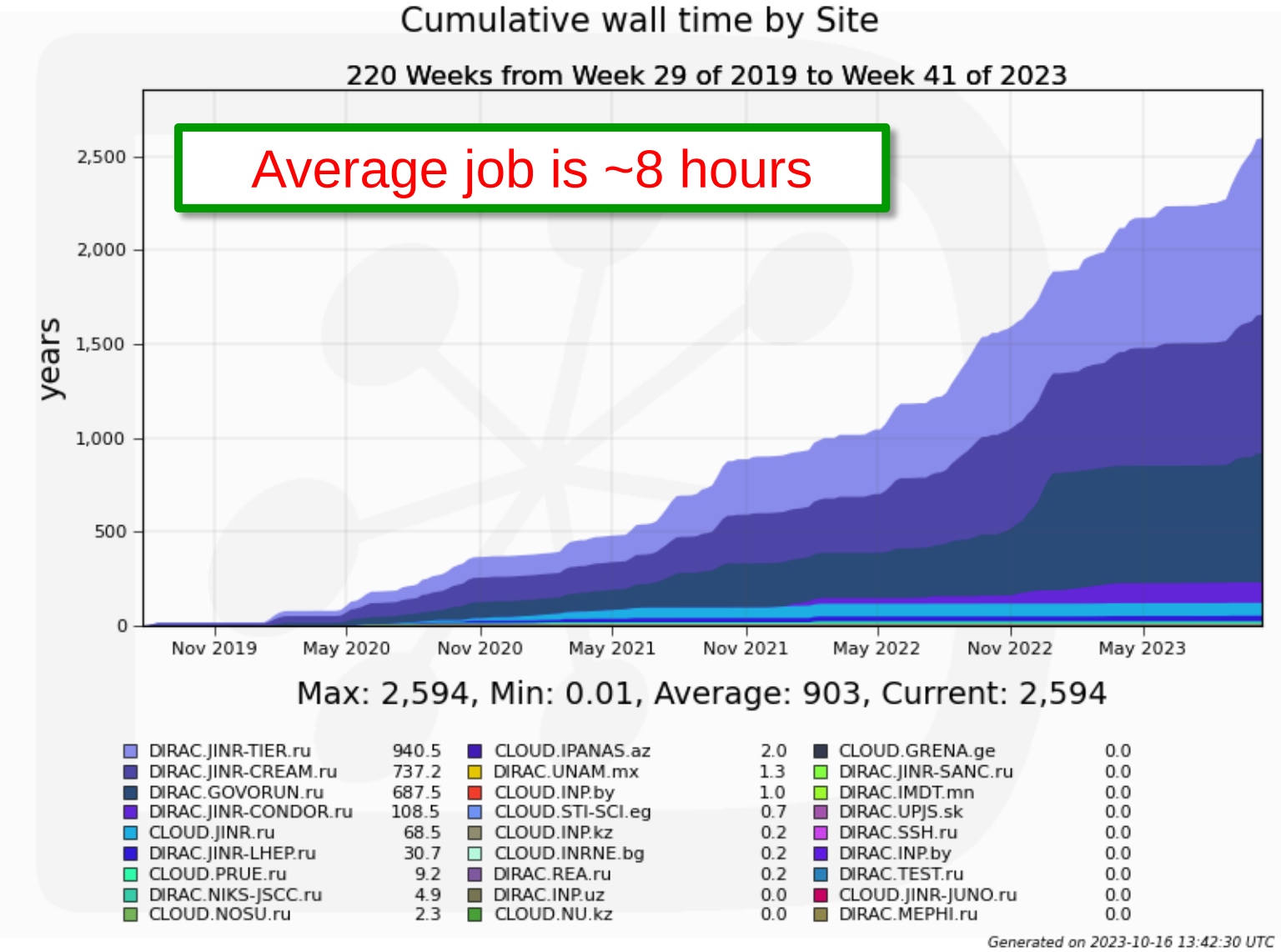
NOSU
60 slots

Quotas in different resources may be increased in case of successful and effective usage.

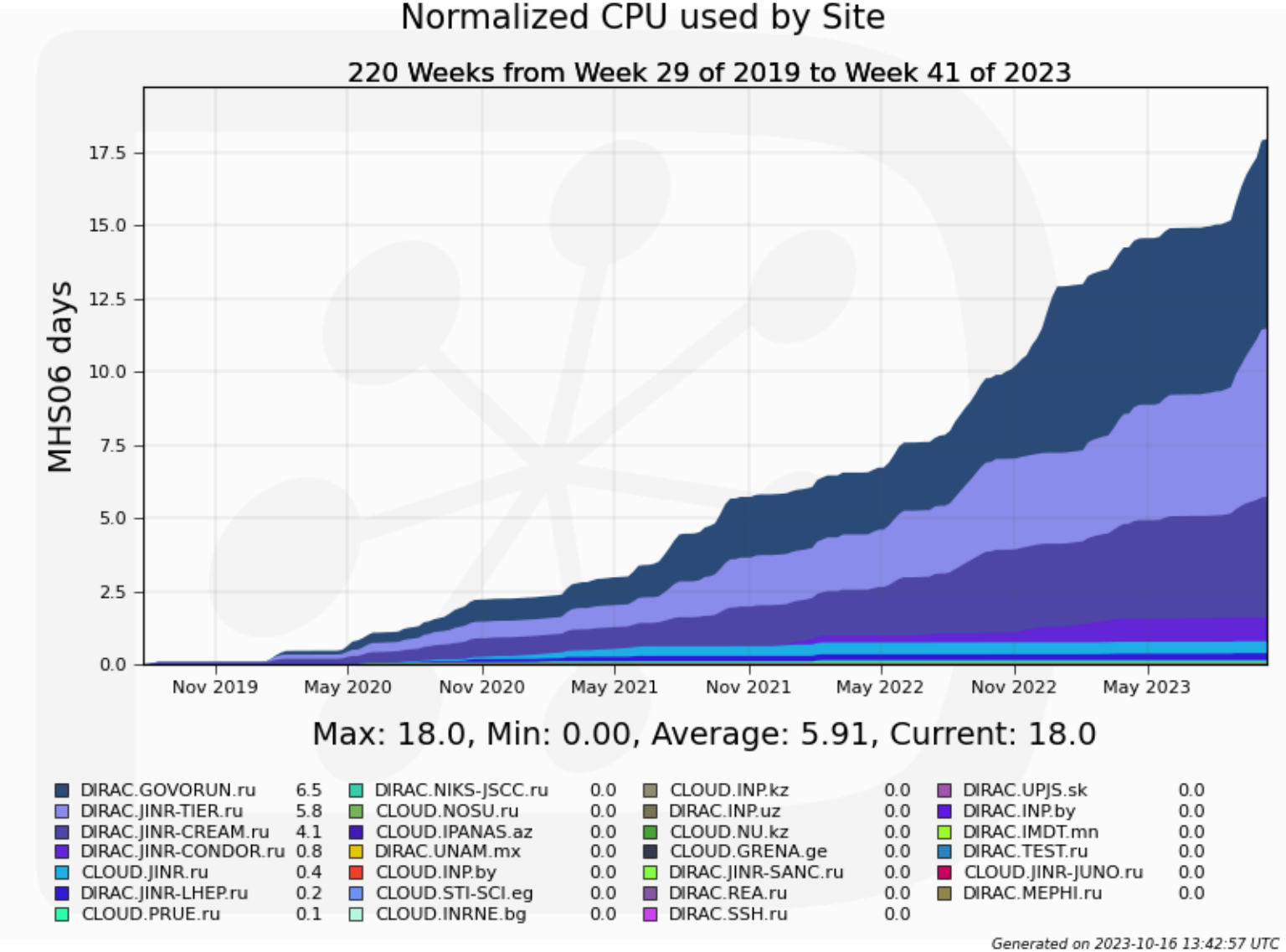
# Jobs done


Cumulative Jobs by Site
220 Weeks from Week 29 of 2019 to Week 41 of 2023
Mjobs
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Nov 2019
May 2020
Nov 2020
May 2021
Nov 2021
May 2022
Nov 2022
May 2023
Max: 2.88, Min: 0.00, Average: 1.07, Current: 2.88
DIRAC.JINR-TIER.ru 1.0
DIRAC.GOVORUN.ru 0.8
DIRAC.JINR-CREAM.ru 0.7
DIRAC.JINR-CONDOR.ru 0.2
CLOUD.JINR.ru 0.1
DIRAC.JINR-LHEP.ru 0.1
CLOUD.PRUE.ru 0.0
DIRAC.NIKS-JSCC.ru 0.0
CLOUD.NOSU.ru 0.0
DIRAC.UNAM.mx 0.0
CLOUD.IPANAS.az 0.0
DIRAC.INP.uz 0.0
CLOUD.INP.by 0.0
CLOUD.STI-SCI.eg 0.0
DIRAC.JINR-SANC.ru 0.0
CLOUD.INP.kz 0.0
CLOUD.GRENA.ge 0.0
DIRAC.REA.ru 0.0
CLOUD.NU.kz 0.0
CLOUD.INRNE.bg 0.0
DIRAC.SSH.ru 0.0
DIRAC.IMDT.mn 0.0
DIRAC.MEPHI.ru 0.0
CLOUD.JINR-JUNO.ru 0.0
DIRAC.TEST.ru 0.0
DIRAC.UPJS.sk 0.0
DIRAC.INP.by 0.0
Generated on 2023-10-16 13:42:18 UTC

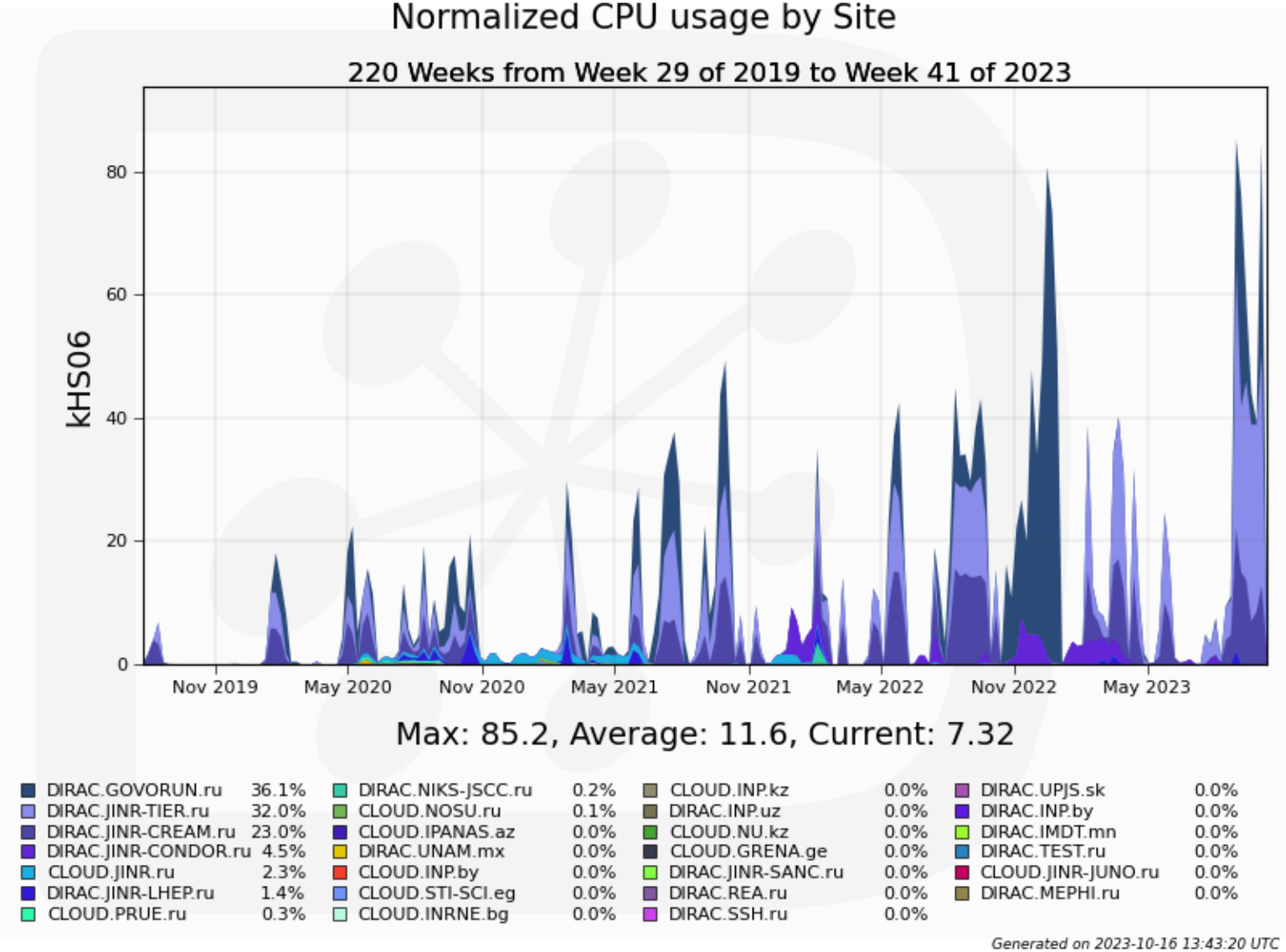
# Wall time consumed



# Normalized power



# Usage rate


Normalized CPU usage by Site
220 Weeks from Week 29 of 2019 to Week 41 of 2023
kHS06
0
20
40
60
80
Nov 2019
May 2020
Nov 2020
May 2021
Nov 2021
May 2022
Nov 2022
May 2023
Max: 85.2, Average: 11.6, Current: 7.32
DIRAC.GOVORUN.ru 36.1%
DIRAC.JINR-TIER.ru 32.0%
DIRAC.JINR-CREAM.ru 23.0%
DIRAC.JINR-CONDOR.ru 4.5%
CLOUD.JINR.ru 2.3%
DIRAC.JINR-LHEP.ru 1.4%
CLOUD.PRUE.ru 0.3%
DIRAC.NIKS-JSCC.ru 0.2%
CLOUD.NOSU.ru 0.1%
CLOUD.IPANAS.az 0.0%
DIRAC.UNAM.mx 0.0%
CLOUD.INP.by 0.0%
CLOUD.STI-SCI.eg 0.0%
CLOUD.INRNE.bg 0.0%
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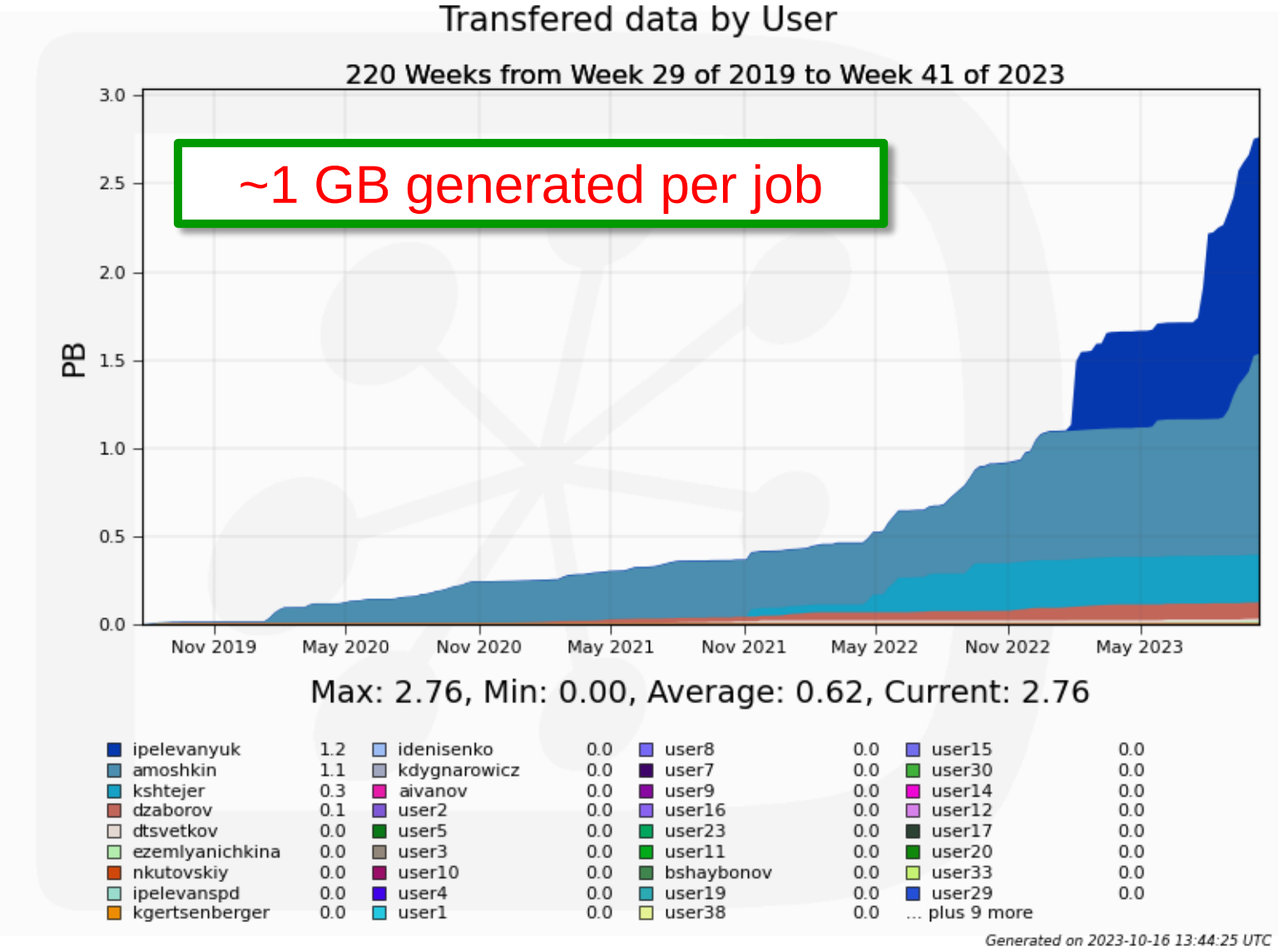
DIRAC.UPJS.sk 0.0%
DIRAC.INP.by 0.0%
DIRAC.IMDT.mn 0.0%
DIRAC.TEST.ru 0.0%
CLOUD.JINR-JUNO.ru 0.0%
DIRAC.MEPHI.ru 0.0%
Generated on 2023-10-16 13:43:20 UTC

# Data uploaded/generated



# Our developments and tools

## First, job analytics

# DB12 benchmark study

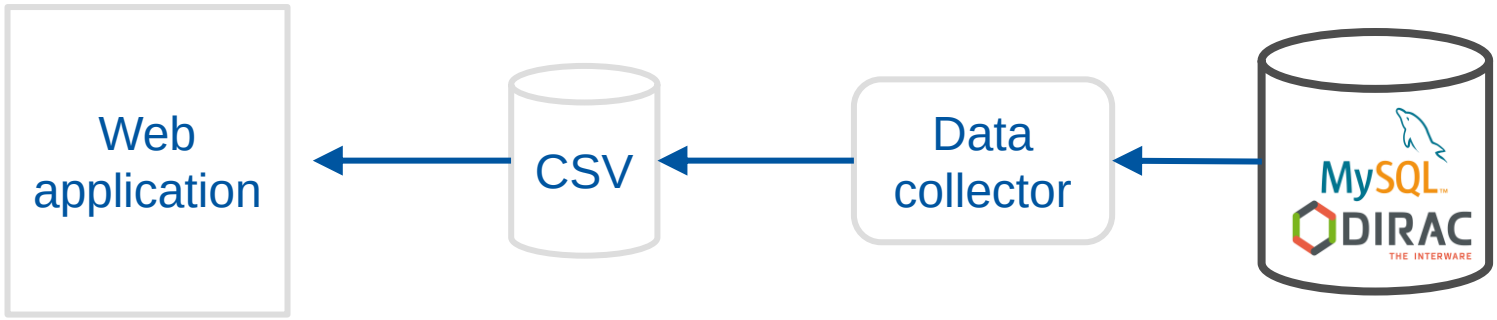
| | | |
|---|---|---|
| Piece of road from point A to B | ← | A Monte-Carlo task |
| Speed of the car | ← | Performance of the computer |
| Time to complete | ← | Time to complete |

$$Time = \frac{Amount\ of\ work}{Speed\ of\ computer}$$

DB12 gives results like: 10(old slow core), 17 (standard server core), 27 (high performance core)

What if we build a plot, where X is DB12 result, Y is time in seconds. Then, every point on the plot represent one job.
It would be mostly useless if all jobs were unique and different.
But, in the real life there are usually many similar jobs.

# General architecture

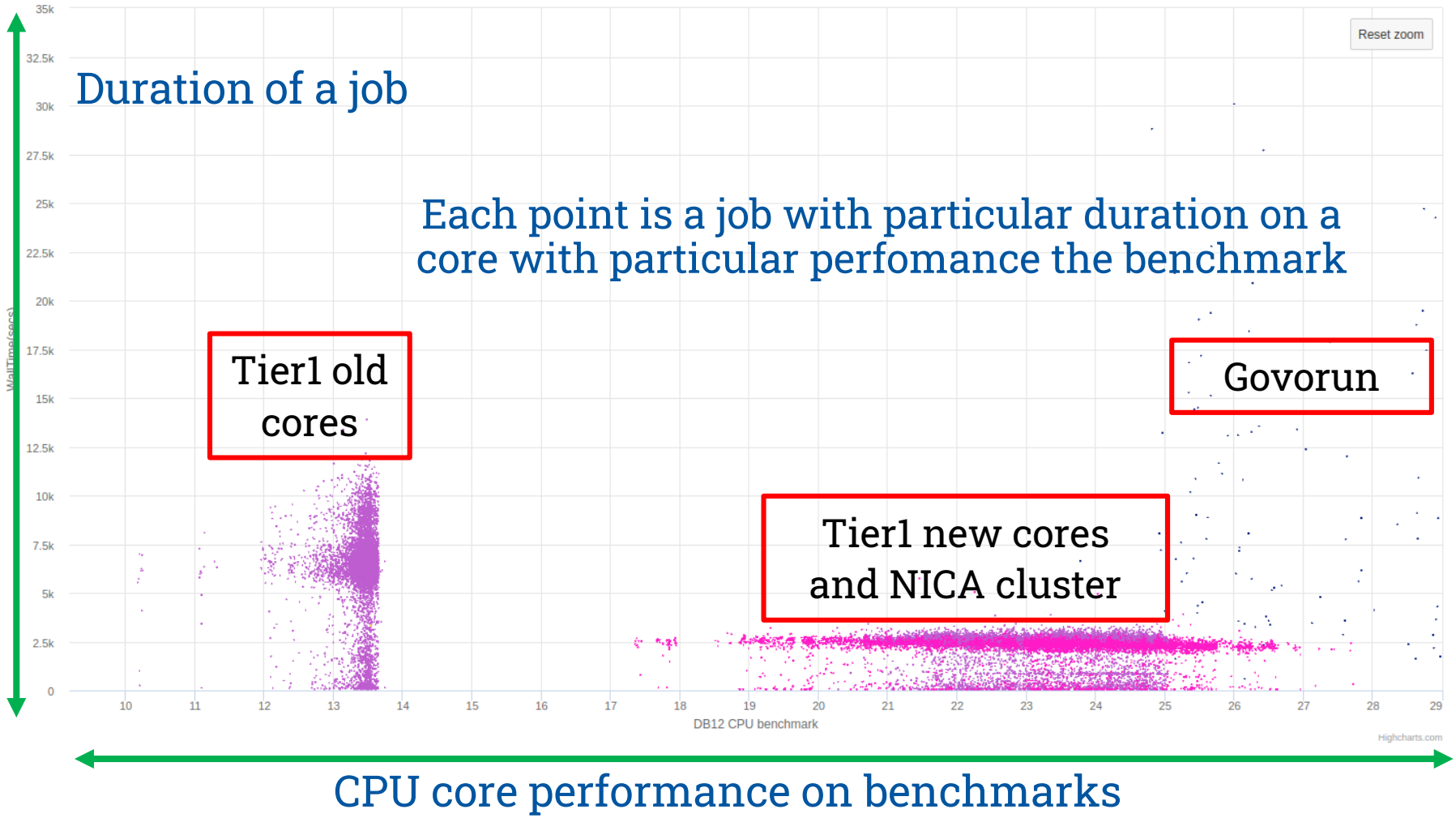



Challenges:

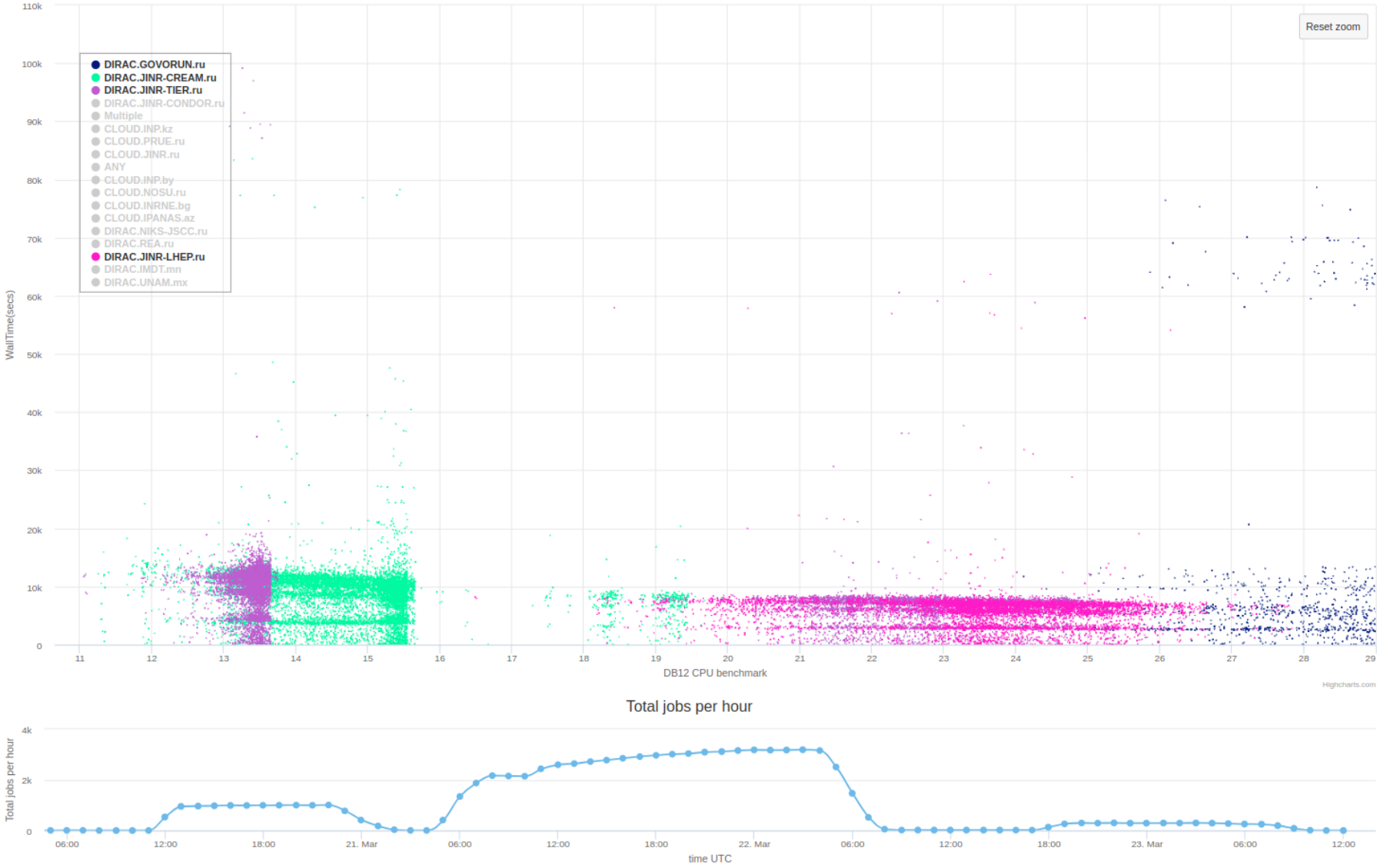
1. Data should be regularly collected from DIRAC Database.
2. Data Collector should update recent old data (they change sometimes).
3. WebApp should get data (CSV file) for visualization.
4. WebApp should be able to work with **millions** of jobs (points of data) simultaneously.

# System screenshot

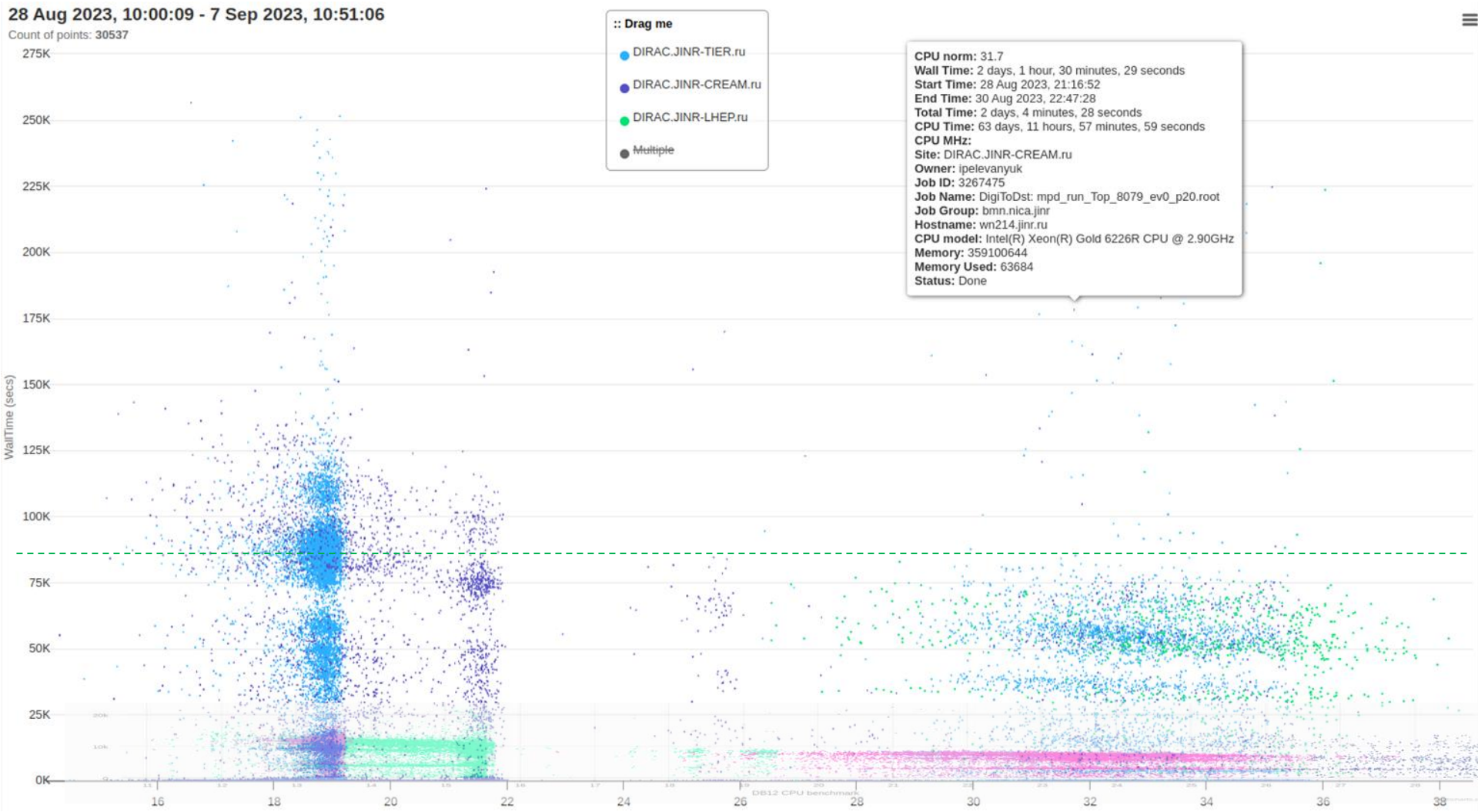
# Issue with Tier1 cluster



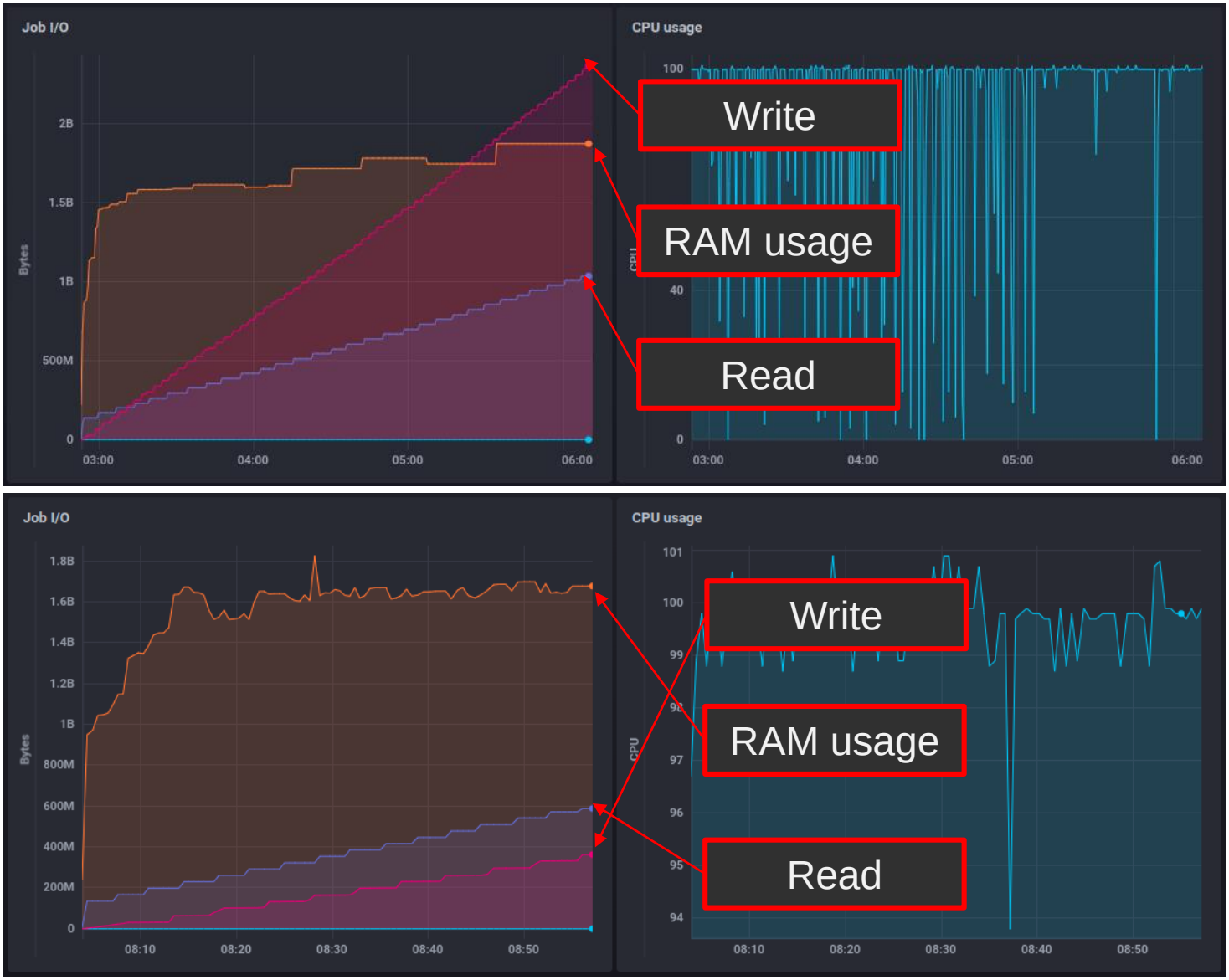
# Old Massive production BM@N



# New Massive production BM@N



# User job monitoring

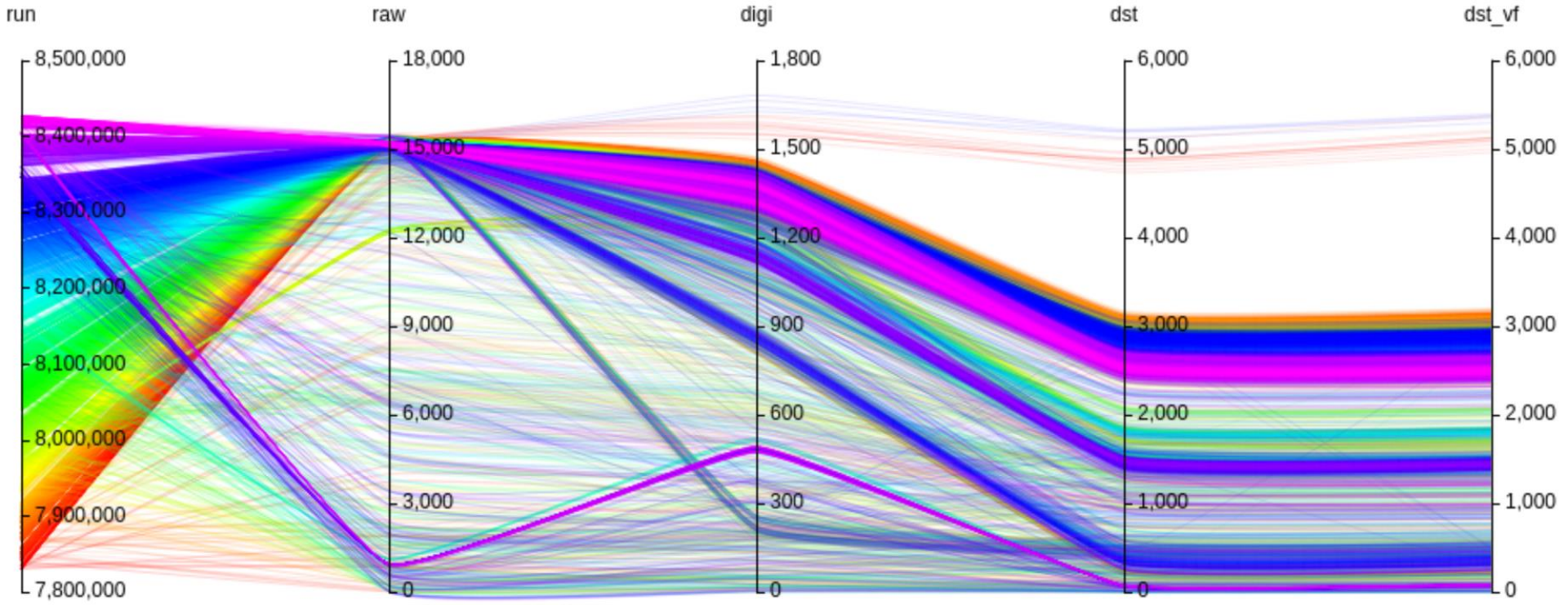


# User job monitoring


New BM@N code has strange 5m idle period

# File evolution analytics

## (proof of concept)



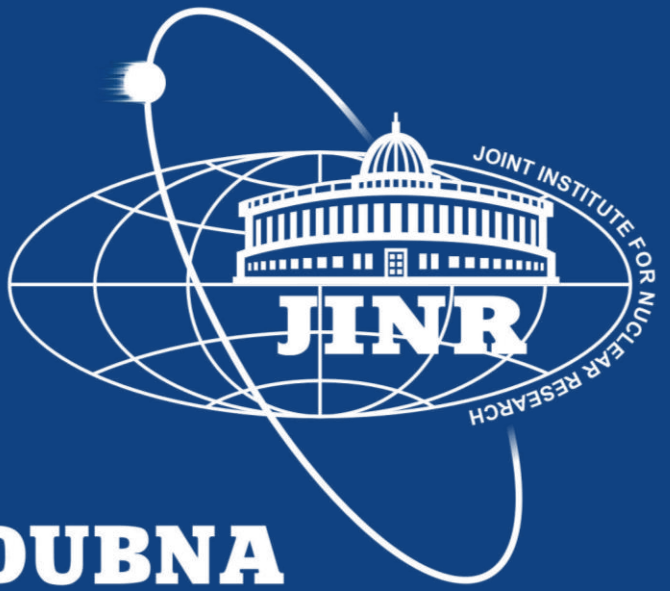

~13000 files are here that went through full reconstruction

# Acknowledgments


- JINR installation would not be possible without Andrei help and support during all these years.
- Thanks to all of you who helped me with DIRAC, especially: Federico, Daniela, Christophe, Xiaomei, Andre, Marko and Christopher

# Conclusions

- In JINR DIRAC allowed using all major computing resources. Biggest computing resource right now is just around 40% of peak united performance.
- Pilot extracting for each job is the biggest problem right now.
- When the system is operational, and users submit jobs, we may get intelligence about the performance, structure, components of computing resources “almost” “for free”.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