LHCb news

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CPPM-IN2P3-CNRS, Marseille
Journées LCG-France, 24 mai 2019

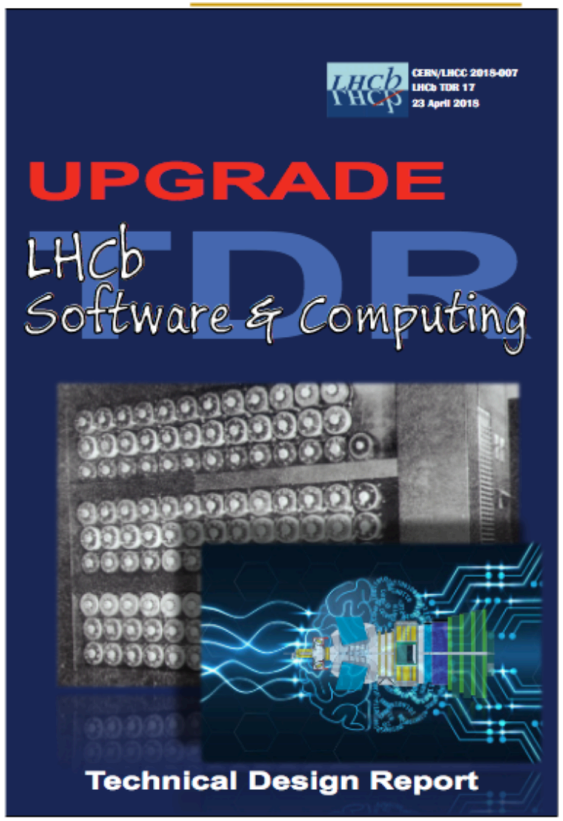
Outline

- Computing Upgrade TDR's
- Current activities
  - T1 activities
  - T2 activities
  - Opportunistic resources
- Resources needs
- Conclusions

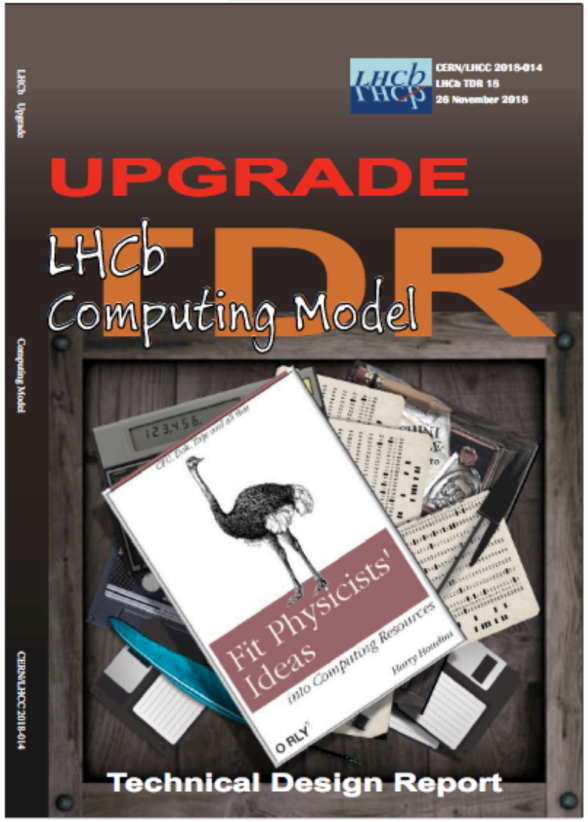
Computing Upgrade TDR's

- The LHCC recommends (Feb 28) approving the LHCb Upgrade Software and Computing TDR and the LHCb Upgrade Computing Model TDR
- The CERN Research Board (RB) approved (Mar 5) both TDRs

LHCb-TDR-017



LHCb-TDR-018



LHC RRB Meeting April 16th

LHCb Recommendations

21

LHCb-1 C-RSG congratulates LHCb on the successful management of their computing resources, in particular opportunistic CPU resources within WLCG and HLT farm. The usage of opportunistic resources in supercomputing centers (HPC) is small though. C-RSG recommends to invest more effort in this direction, specially given the large CPU needs foreseen for Run 3.

LHCb-2 C-RSG recommends the implementation of an automatic procedure to delete cold data from disk using popularity monitoring and following pre-established lifetime policies.

LHCb-3 C-RSG considers appropriate the resource requests for 2020 and recommends its granting.

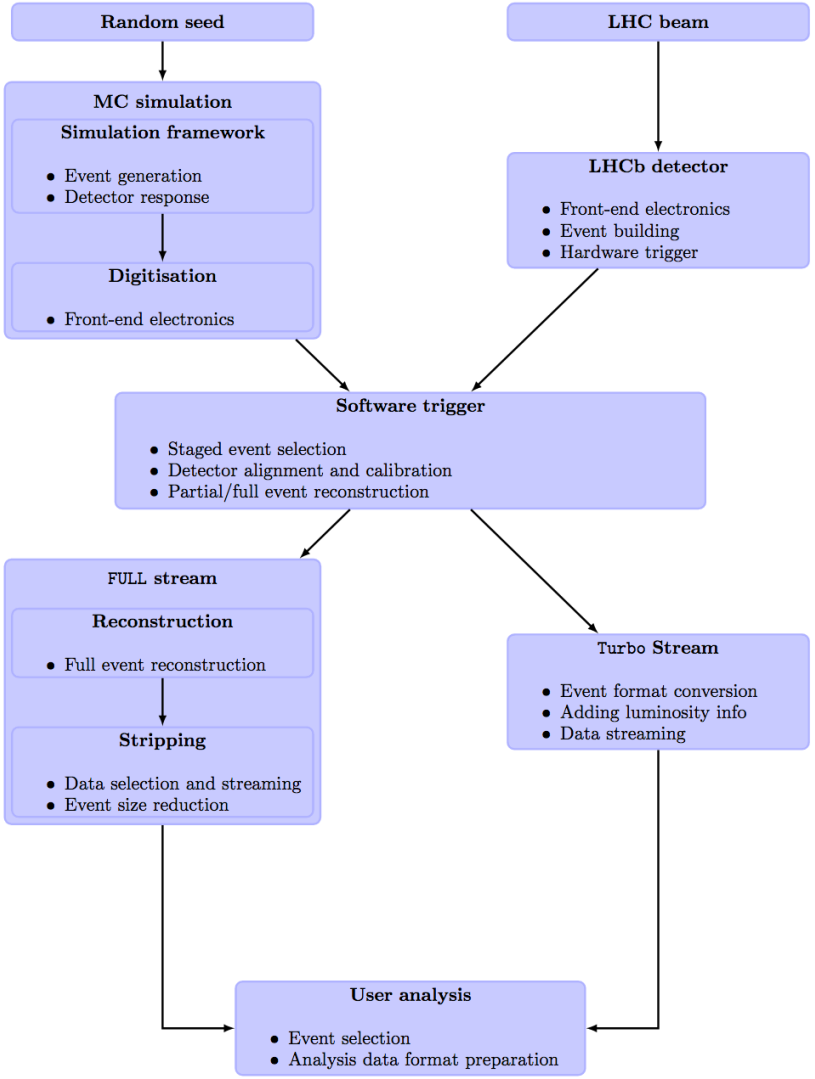
LHCb-4 C-RSG congratulates LHCb for the enormous effort in reducing resource needs for Run 3 in view of the foreseen 10-fold increase in output event rate (and 30-fold data volume rate). Nevertheless, still large yearly resource growth factors are anticipated. We note that aggressive assumptions had to be made in order to reduce CPU, disk and tape needs to manageable levels, resulting in a significant risk. Important to retire as much of this risk as possible.

Pekka Sinervo, C-RSG

April 16, 2019

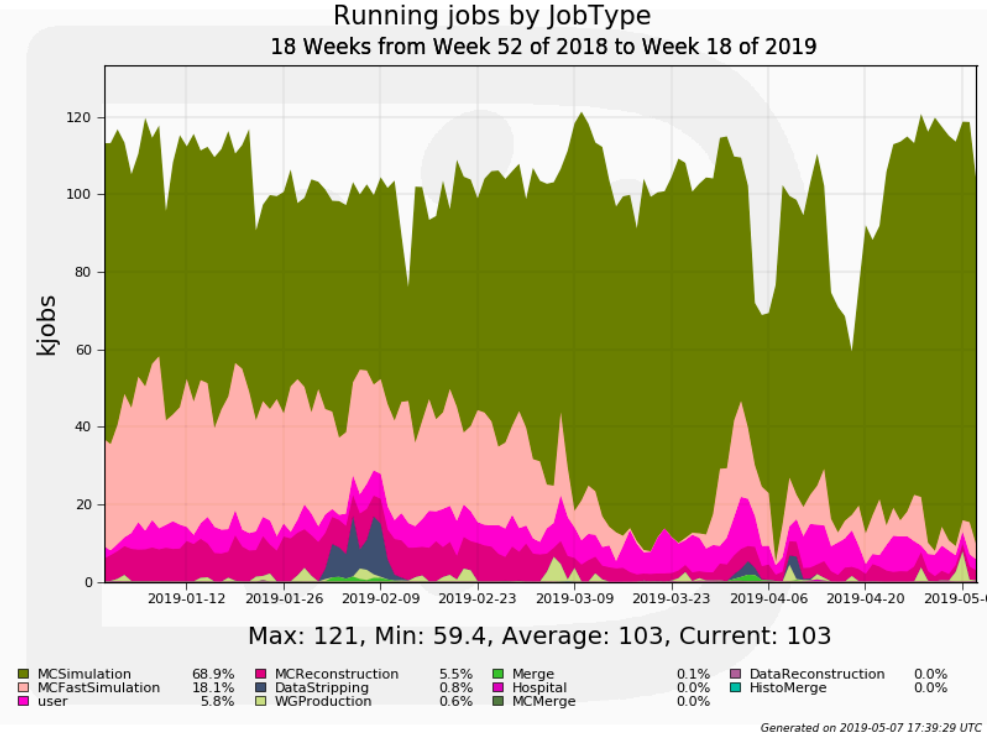
Run 2 data processing flow

- FULL stream
  - Raw data stored and (re)processed off-line
- Turbo stream
  - Raw data discarded
  - High level reconstructed objects are stored
    - MDF compressed format
  - Format conversion and stripping before user analysis



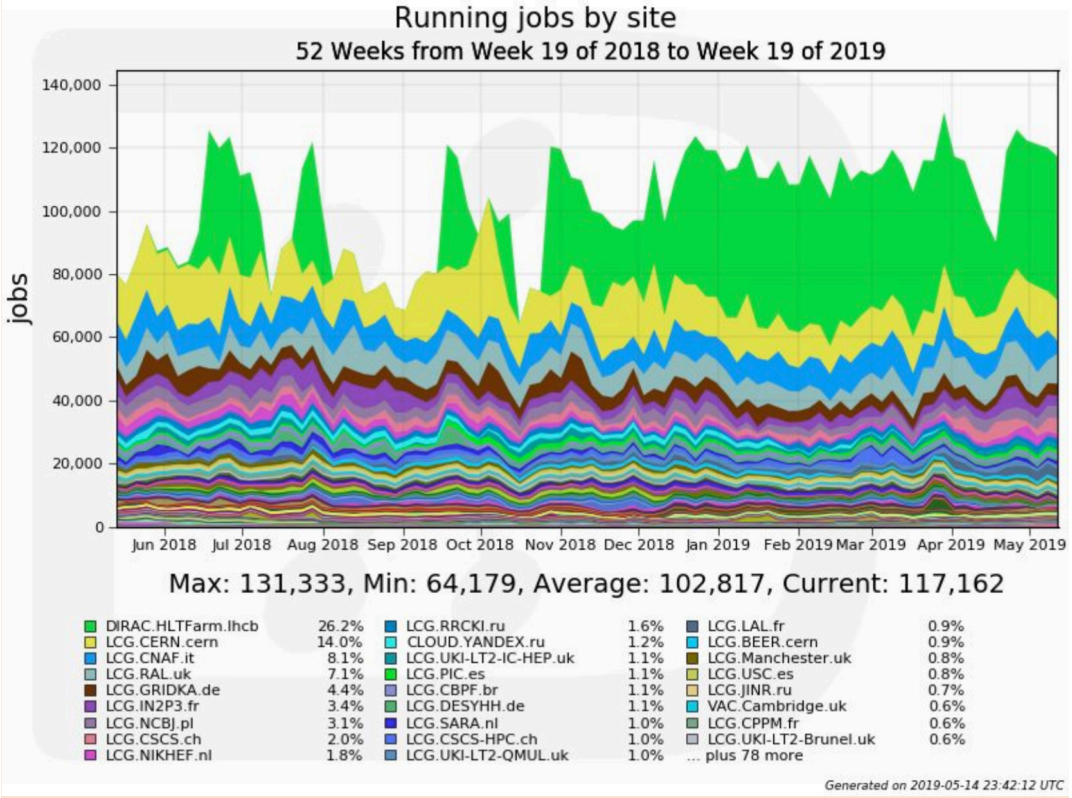
Recent activities

- MC simulation split in full (69% of jobs) and fast simulation (18%)
- MC reco at 5.5%
- User: 5.8%
- Data stripping: 0.8%
- WG productions: 0.6%
- Average: 103k
- HLT farm fully available



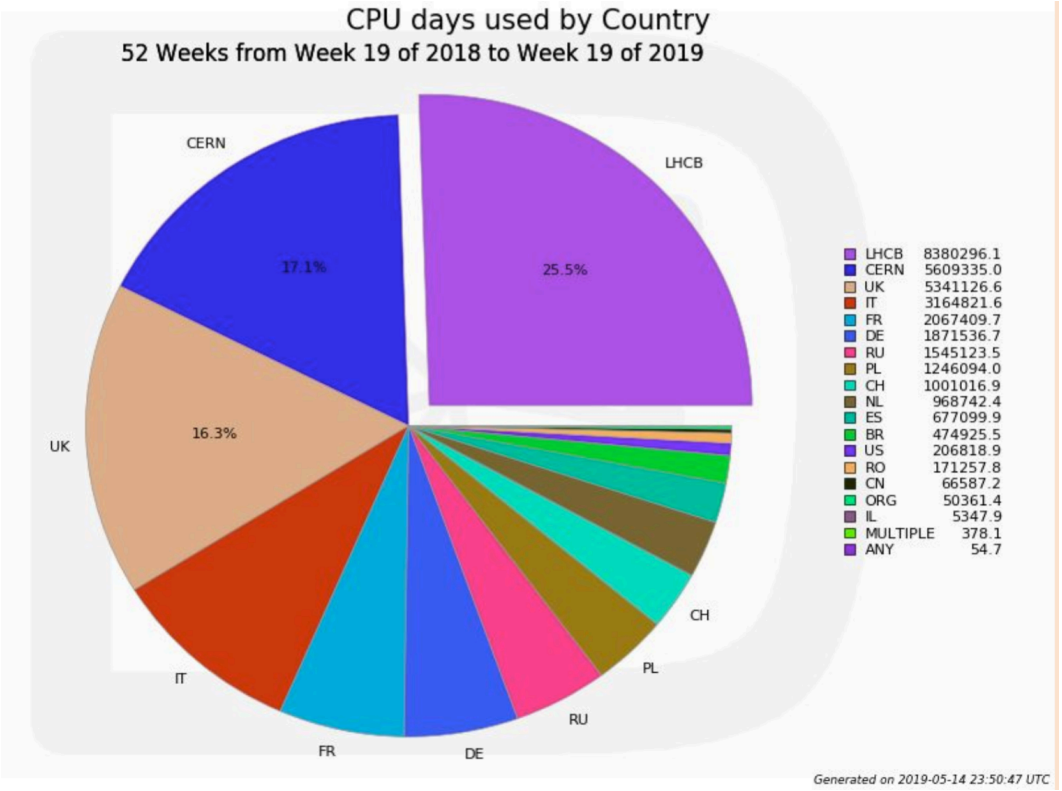
Recent activities

- 103 distinct sites in total
- HLT farm is fully available
  - ~40% of resources
- Mostly LCG sites
- Several non-traditional
  - CLOUD.YANDEX.ru



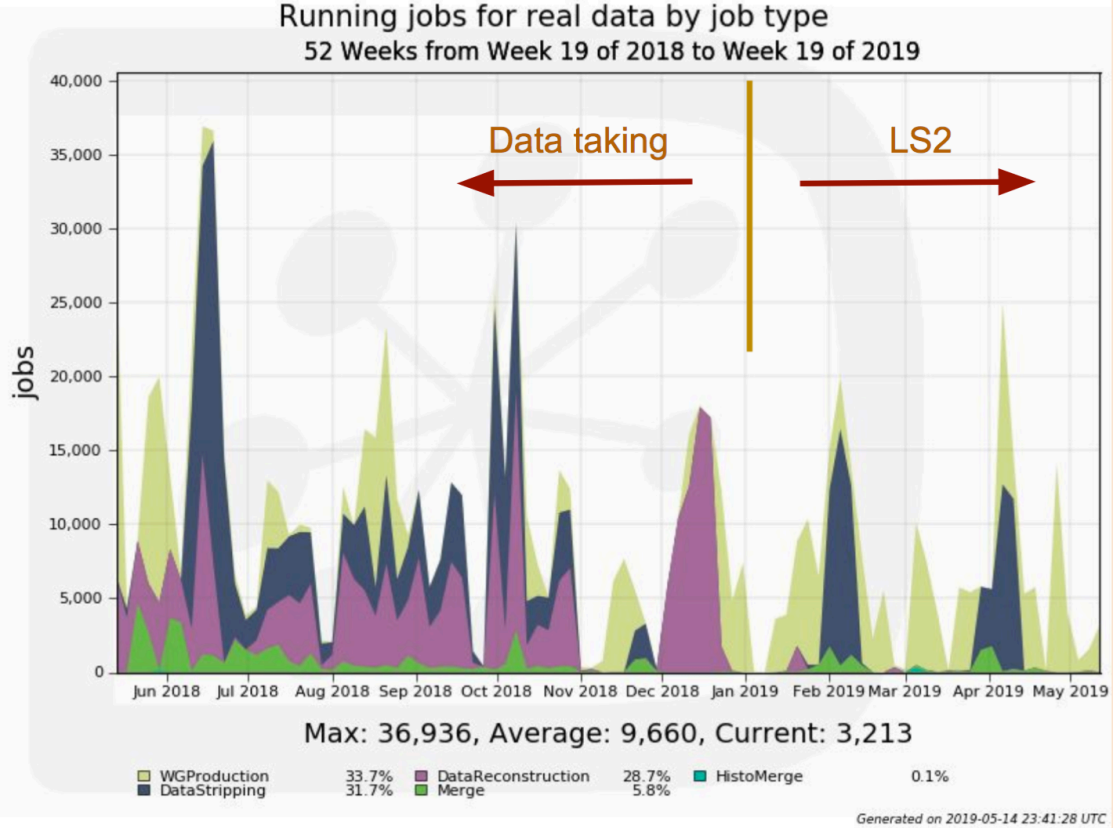
National contributions

- Main contributions are from T0 (CERN) and from LHCb HLT farm
- The share of France
  - ~7% of the total
  - ~12% of the total outside CERN



Real data activities in the last year

- Data taking
  - Prompt reconstruction
  - Prompt stripping
- LS2
  - Restripping
  - WG productions
- WG productions
  - First in real data processing (30%)
  - 2 times more than in the previous year

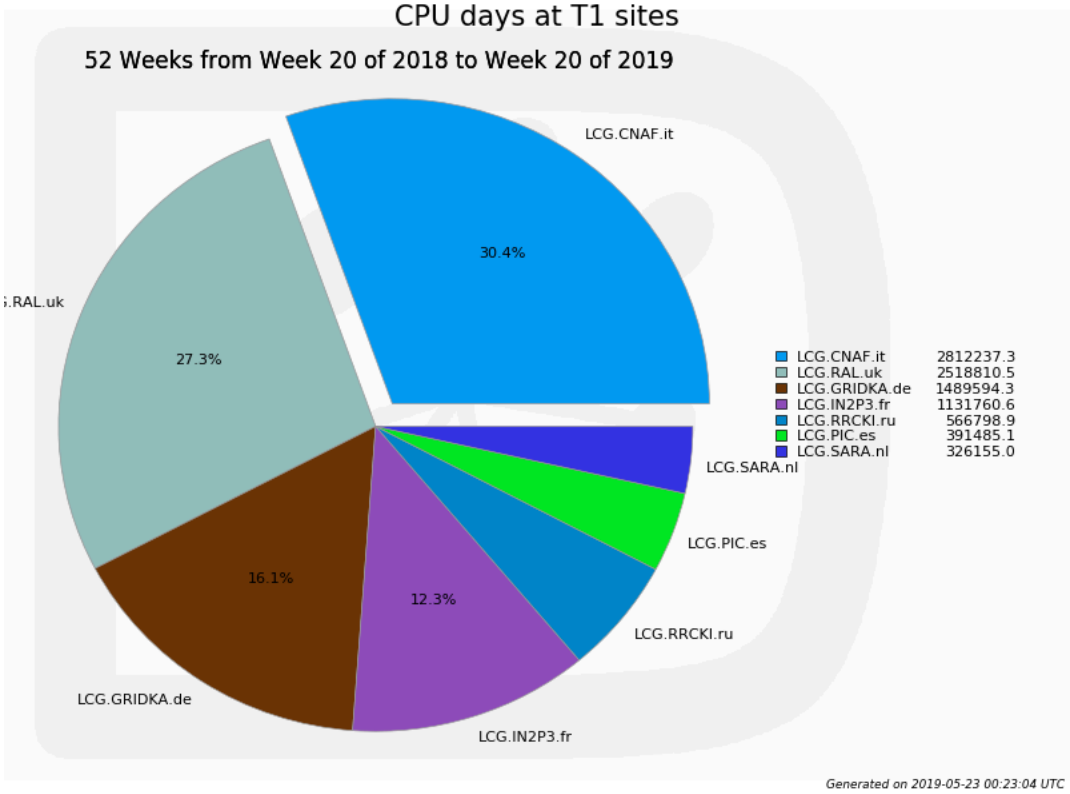


SLC6 to CC7 migration

- The majority of grid sites has switched to CC7
- However, a couple of Tier 1 sites will be running SLC6 for some other weeks
  - Multiple Tier 2 sites still at SLC6
- As a consequence CC7 jobs submitted to the GRID will fail if they land on an SLC6 site
- On the contrary, SLC6 workload can run on CC7
  - Effort made to update the LHCb analysis software to be CC7 ready

LHCb usage of T1 at CC/IN2P3

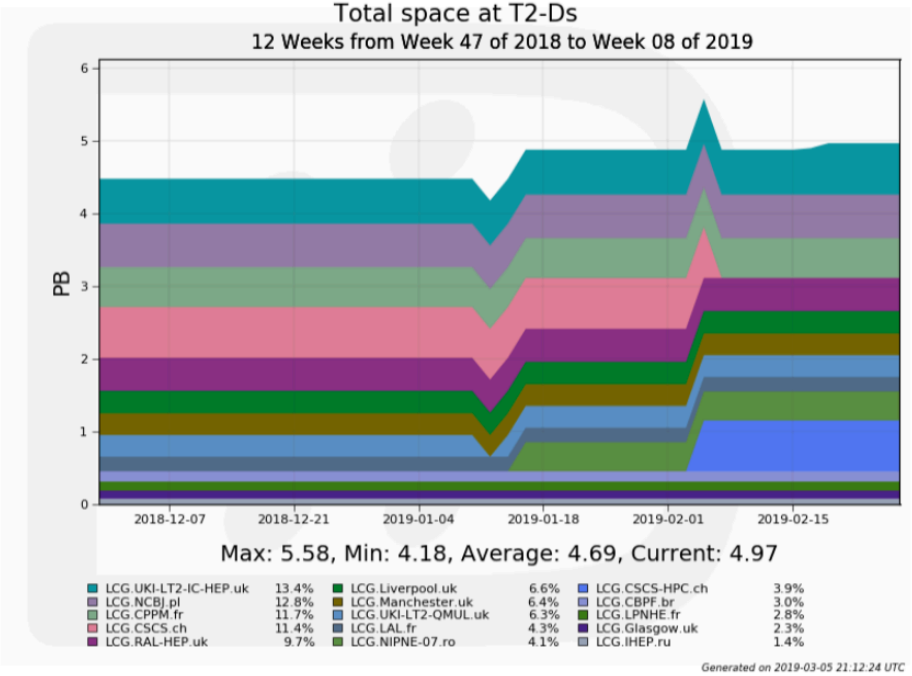
- ~ 12% of T1 LHCb resources
  - Without T0 at CERN
- Running smoothly with no major problems

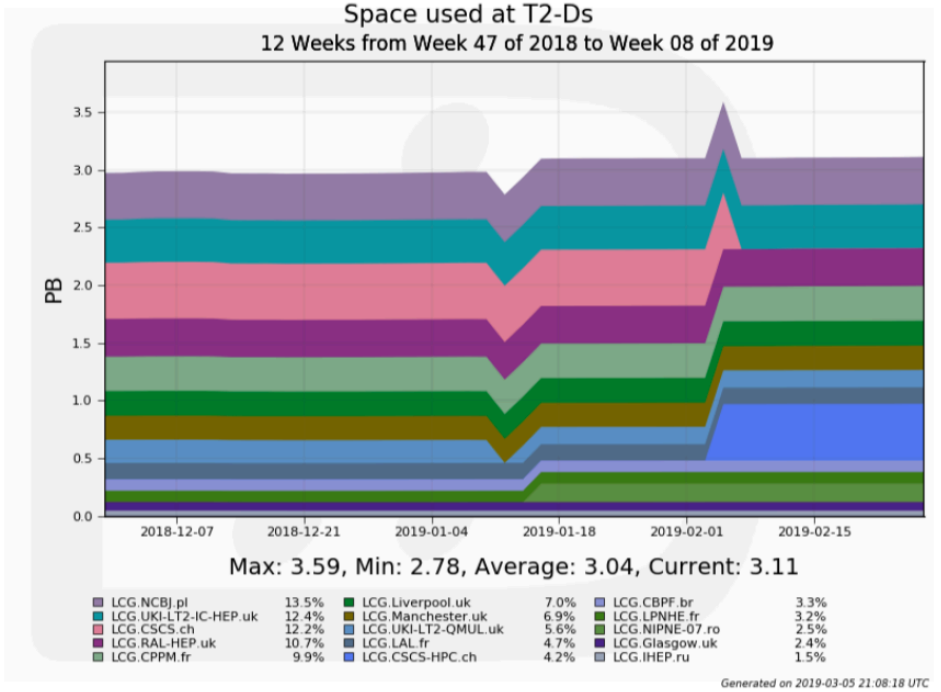


T2-D storage

Name	Type	Online (TB)	Free (TB)	Pledge (TB, Federation)
CBPF.br	DPM	143	43	300, Latin America Fd.
CPPM.fr	DPM	550	243	500, CPPM Marseille
CSCS-HEP.ch	dCache	700	205	920, CHIPP
Glasgow.uk	DPM	110	35	300, ScotGrid
IHEP.ru	dCache	64	20	65, Russian Data-Intensive GRID
IMPERIAL.uk	dCache	710	325	300*, London Tier 2
LAL.fr	DPM	200	56	300*, GRIF Paris
LPNHE.fr	DPM	130	31	300*, GRIF Paris
Liverpool.uk	DPM	308	92	600*, NorthGrid
Manchester.uk	DPM	300	88	600*, NorthGrid
NCBJ.pl	DPM	600	187	
NIPNE.ro	DPM	400	162	400, Romanian Tier-2 Fd.
RAL-HEP.uk	dCache	455	126	300, SouthGrid
UKI.uk	StoRM	300	147	300*, London Tier 2
TOTAL		**4970**	**1760**	**3985**

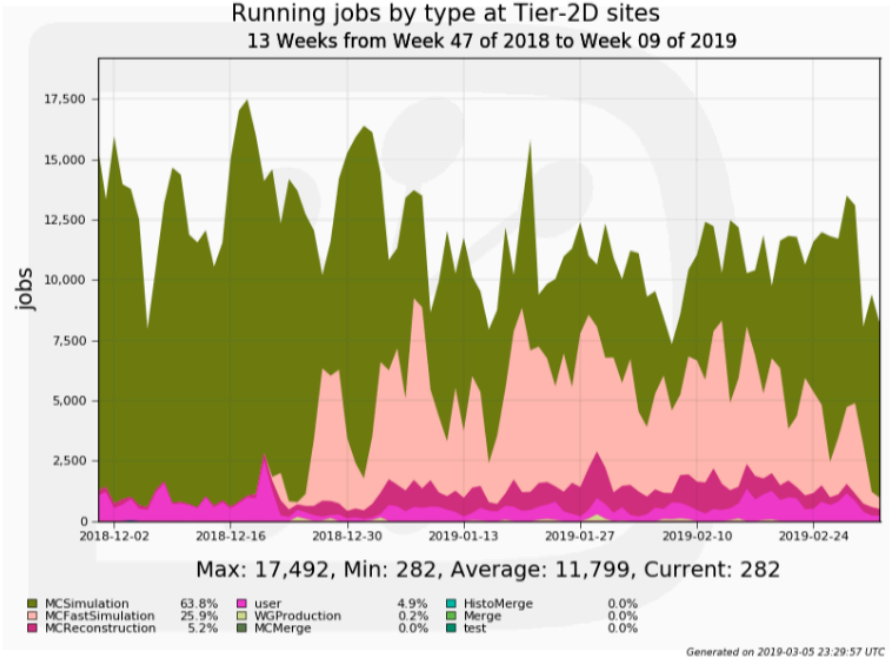
T2-D Total and Used space

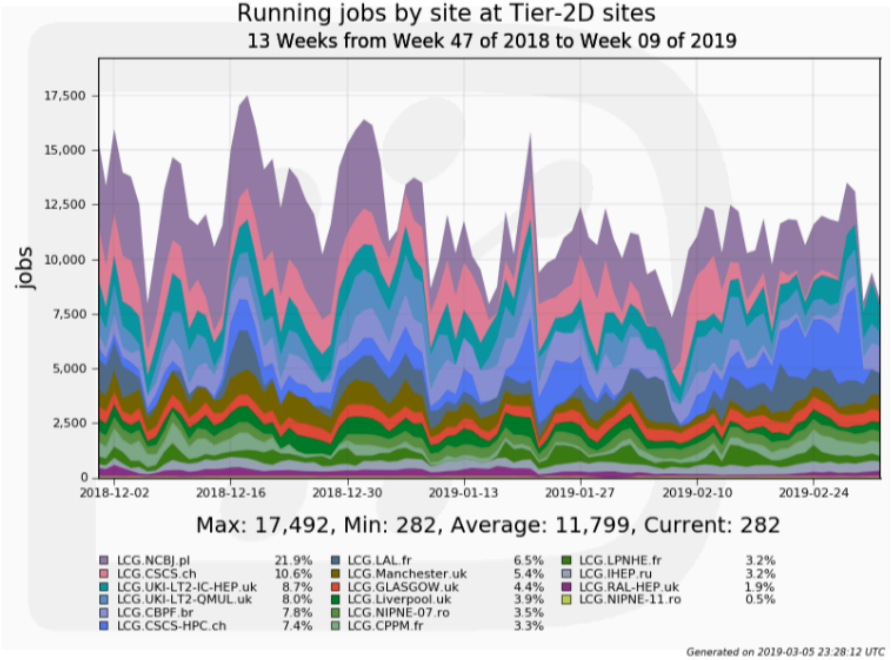




- Total available space increased by 0.5 PB in the last six months

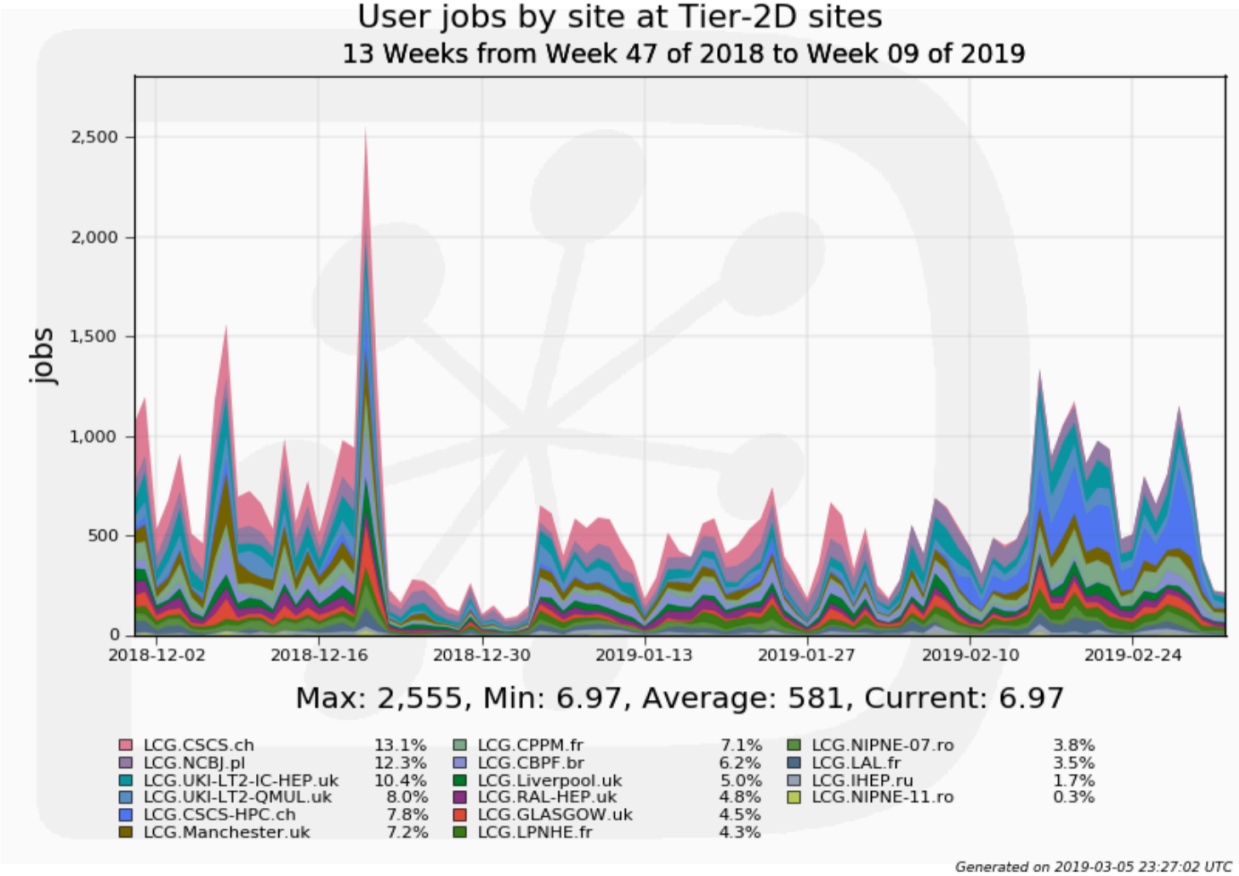
T2-D running jobs





- About 10% of the jobs was running at the T2-D sites

User jobs at T2-D sites



- User jobs represent about 5% of the T2-D sites load

LHCb usage of T1 at CC/IN2P3

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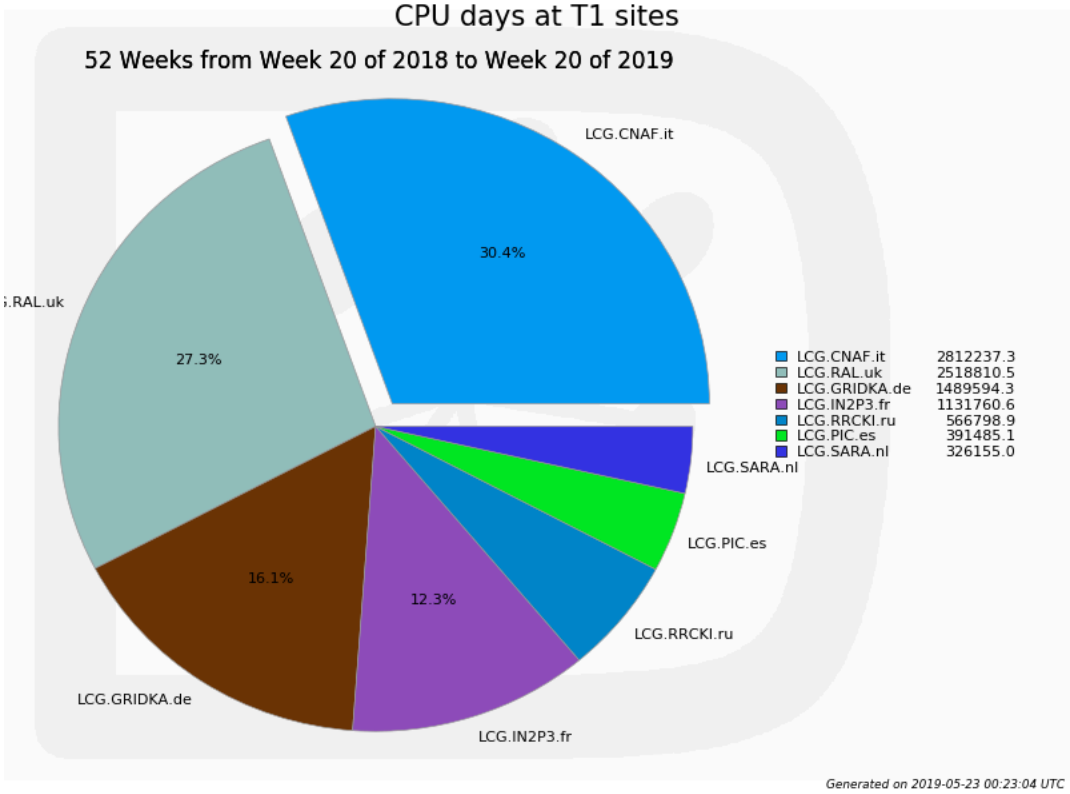
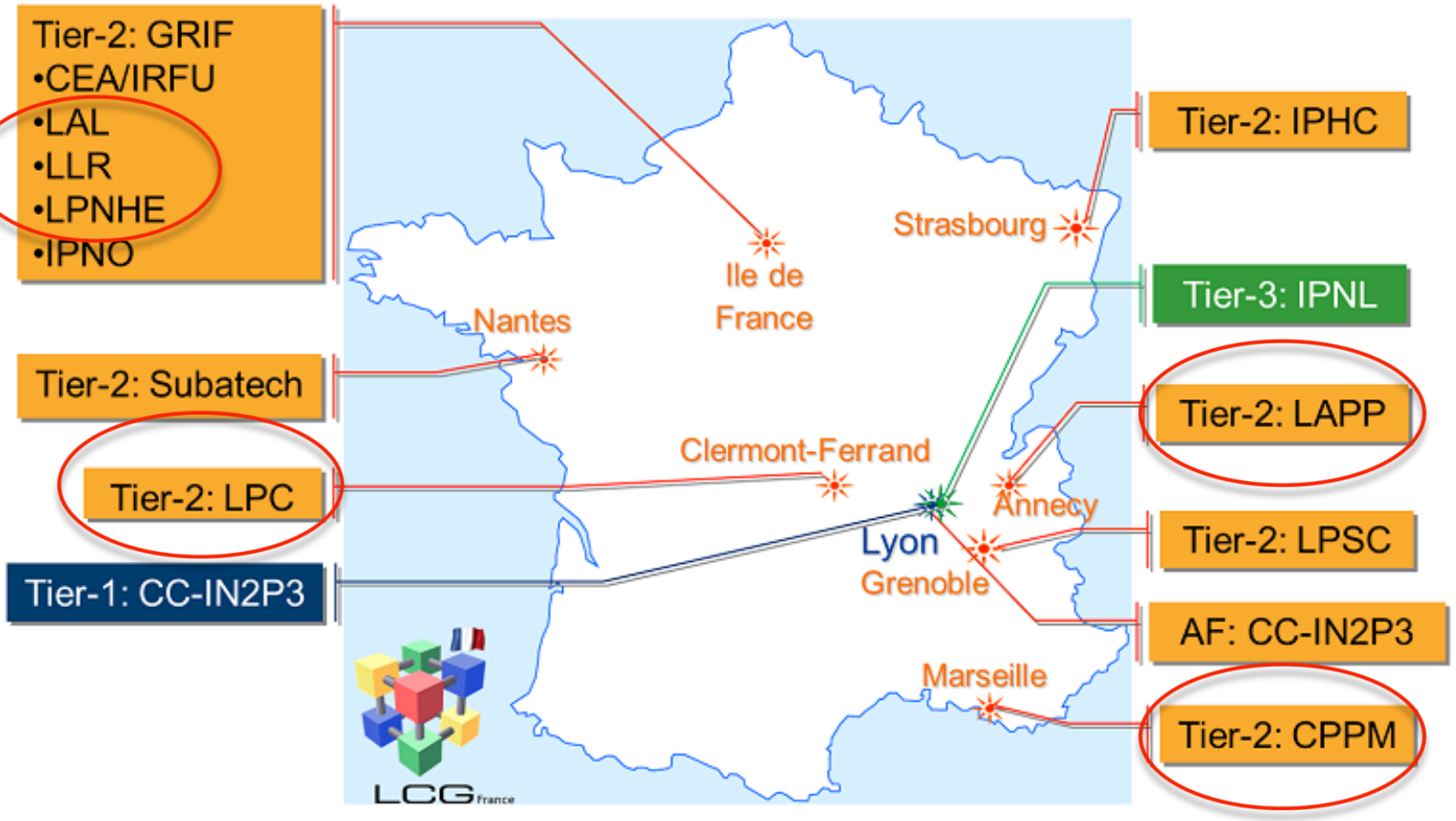
- Running smoothly with no major problems



T2's usage in LHCb

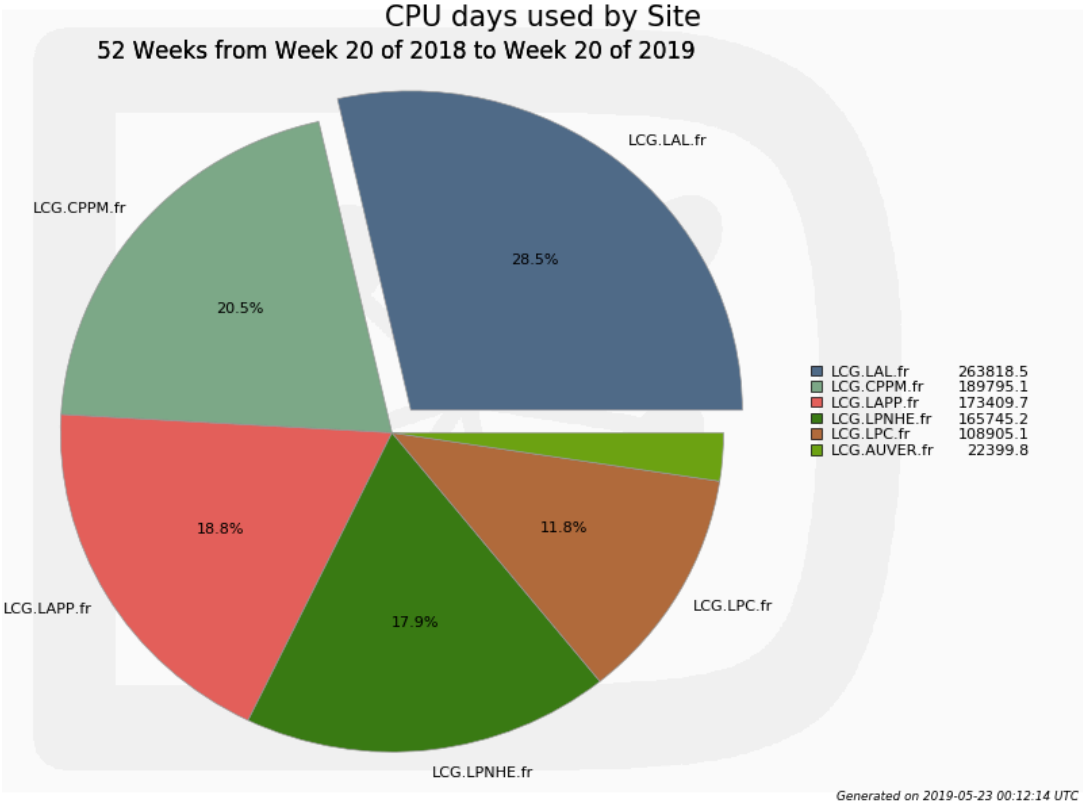
- Main usage in the LHCb Computing Model is for the Monte-Carlo production
  - No input data
  - Produced data stored in a near T1
- With the introduction of mesh-processing T2-D centers were added
  - Monte-Carlo production
  - Provide disk space for storing DST data
    - Can run also jobs of the type stripping, user analysis, etc

Sites T2 en France



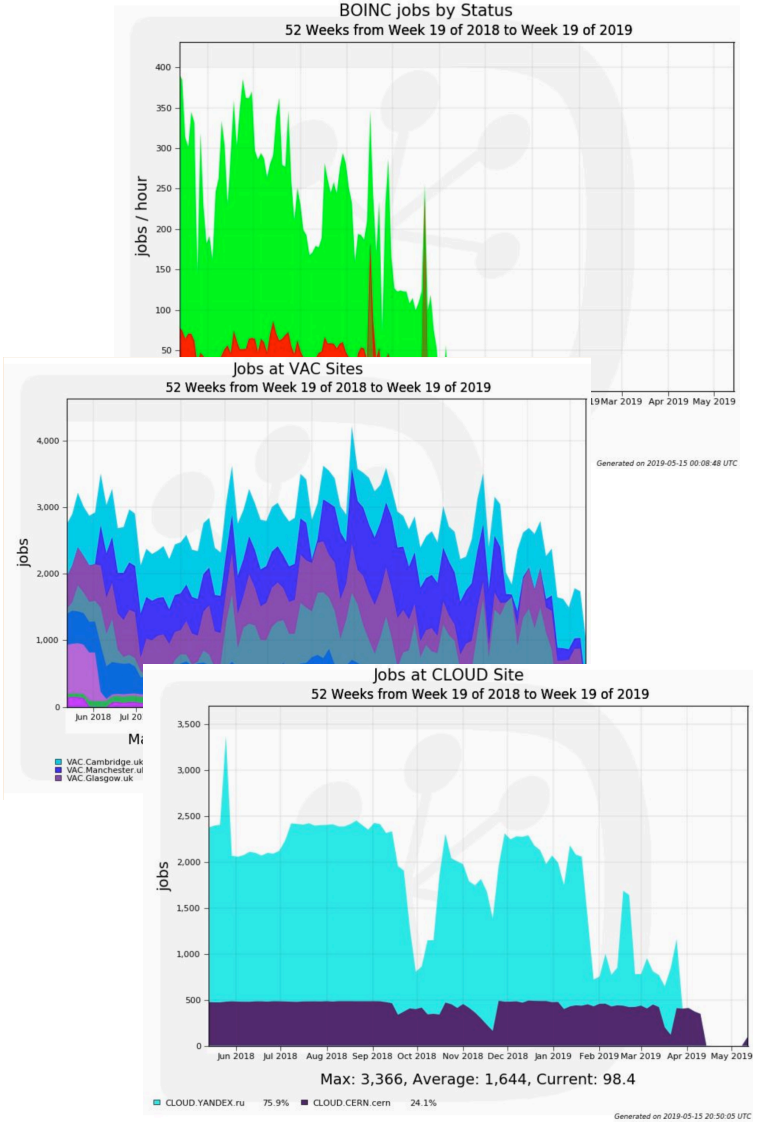
T2's usage in France

- No major problems
- Resource usage is usually above pledges



Non-traditional LHCb sites

- BOINC discontinued
  - << 1% CPU
  - Limited manpower
  - Scalability problems
- VAC sites
  - 3% CPU
  - Stable (*A. McNab*)
- Cloud sites
  - Declining
  - Limited manpower
  - Scalability problems



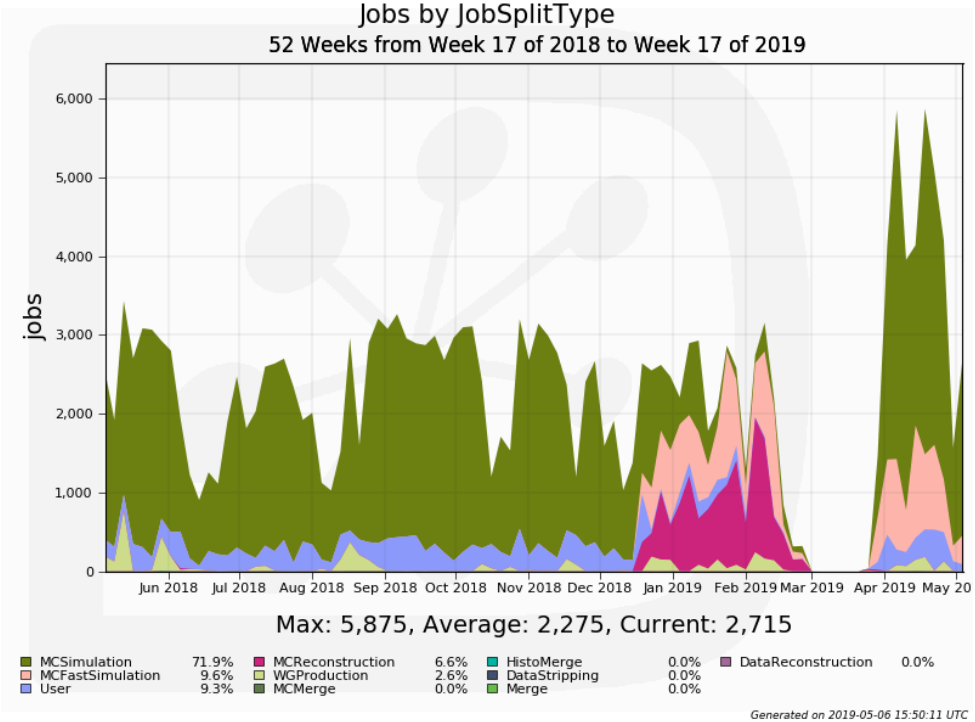
HPC: LCG.CSCS.ch

cscs.ch

swiss national supercomputing centre (5th in top500 list)

a LCG site, for us (ARC CE + slurm)

... so this was "transparent" for us



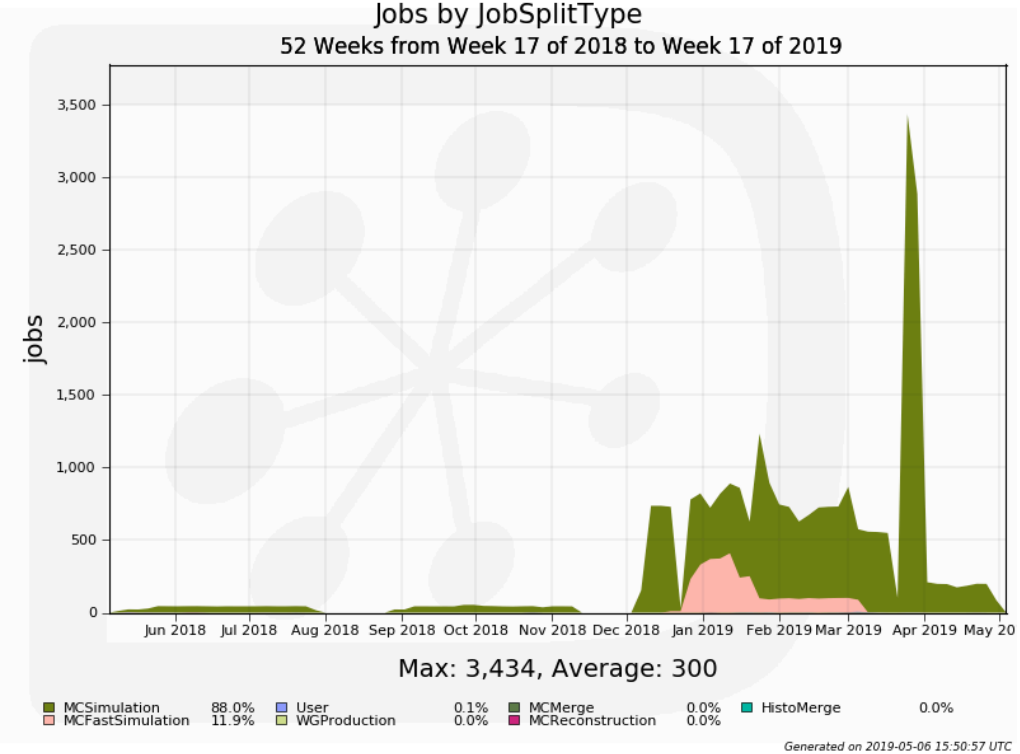
HPC: DIRAC.SDumont.br

HPC at LNCC

Laboratório Nacional de Computação Científica

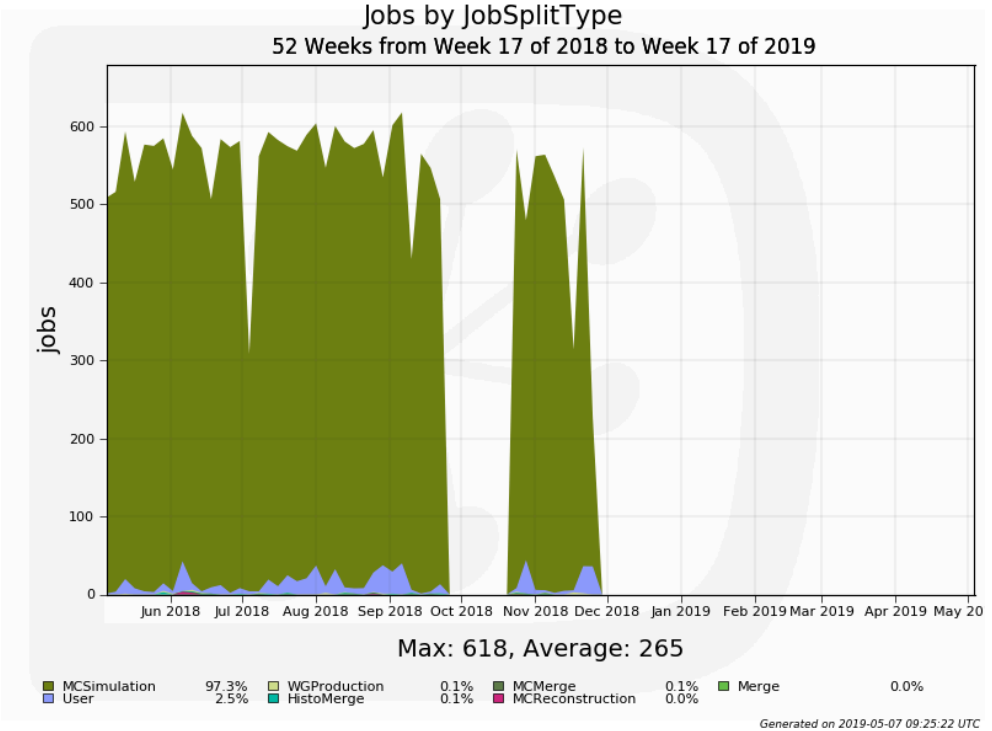
nicely documented in Portuguese only :)

- Used DIRAC SSH CE
- slurm batch
- basic setup ~easy
- but: several issues, bad communication, so bad operations



HPC: DIRAC.OSC.us

- Ohio SuperComputer
- "SSH" CE, and easy setup
- unused since a while…



HPC integration

Easy integration when:

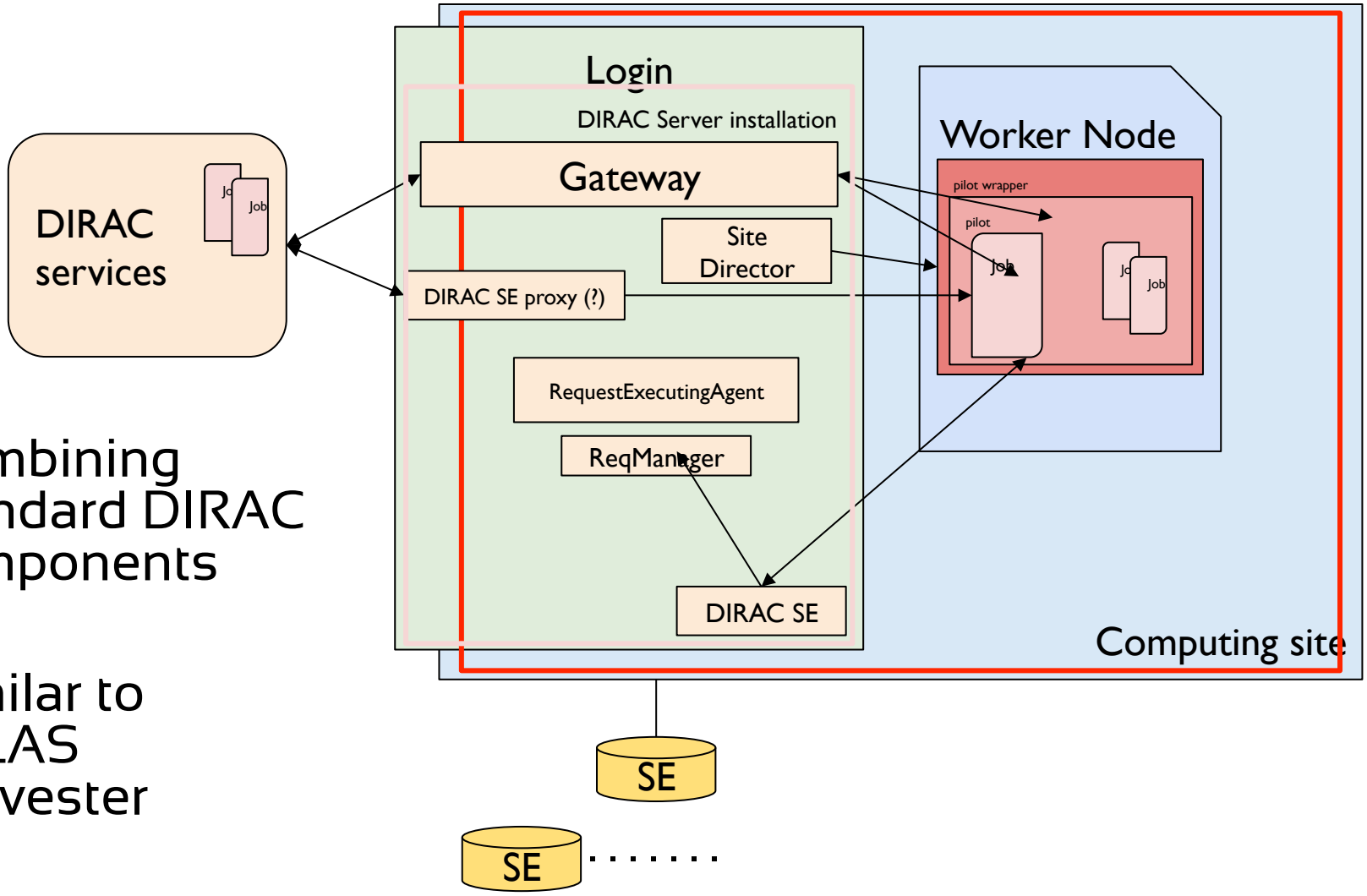
1. WNs have outbound connectivity
2. LHCb CVMFS endpoints mounted on the WNs
3. x86, SLC6 or CC7 "compatible"

→ This has been the case for CSCS, SDumont, OSC

When some of the requirements above are not met, we can try to go around them, but this requires dedicated work (and anyway it may not be possible, case by case)

HPC: Possible integration scenario

- Combining standard DIRAC components
- Similar to ATLAS Harvester

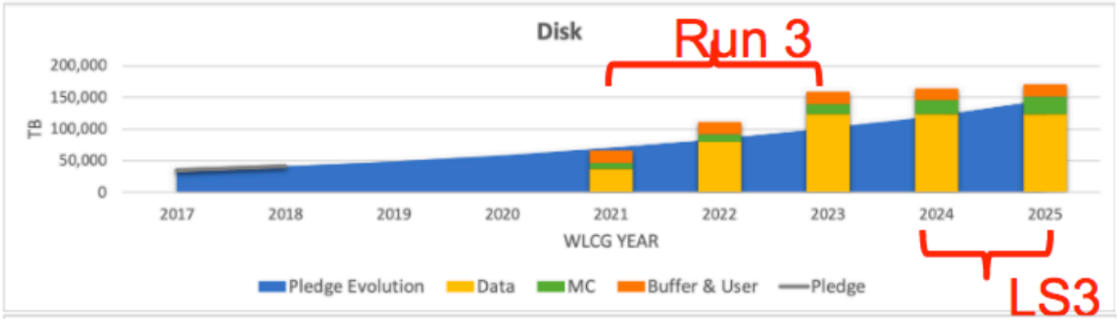


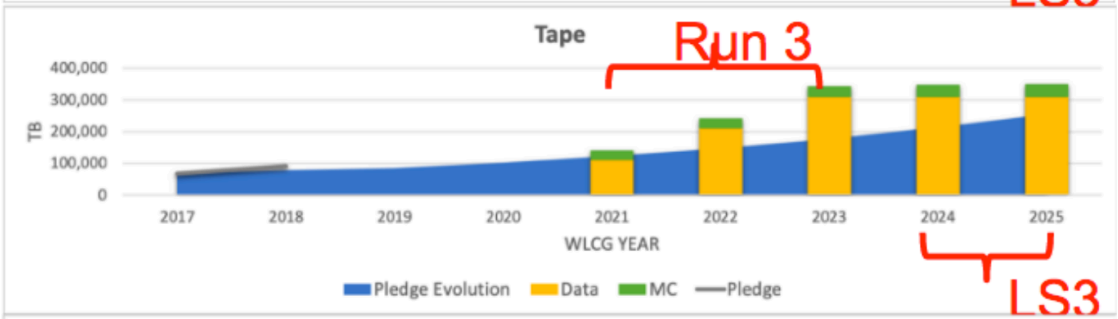
Resources needs in 2019-2021

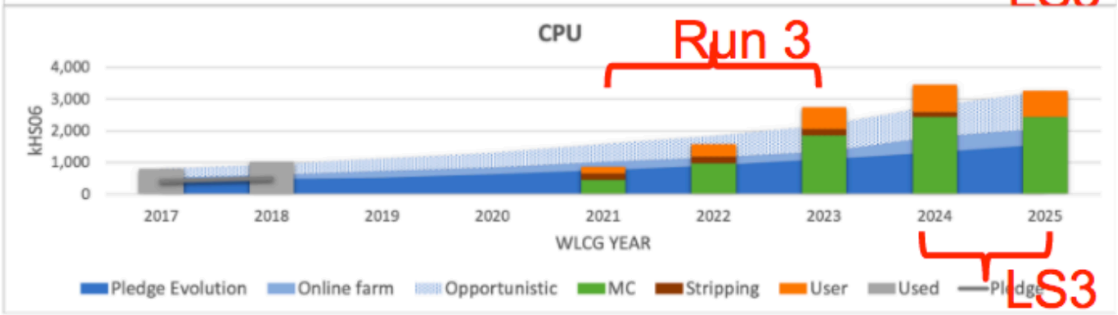
LHCb		2019			2020		2021	
		CRSG	Pledged	Pledged / CRSG	Request	2020 req./ 2019 CRSG	Request	2021 req. / 2019 CRSG
WLCG CPU	Tier-0	86	86	100%	98	114%	125	145%
	Tier-1	271	268	99%	328	121%	409	151%
	Tier-2	152	193	127%	185	122%	229	151%
	HLT	10	0	0%	10	100%	50	500%
	Sum	519	547	105%	621	120%	813	157%
Others		n/a	0	n/a	10	n/a	50	n/a
Total		**519**	**547**	**105%**	**631**	**122%**	**863**	**166%**
Disk	Tier-0	14.1	13.40	95%	17.2	122%	19.5	138%
	Tier-1	27.9	29.00	104%	33.2	119%	39	140%
	Tier-2	6.8	4	59%	7.2	106%	7.5	110%
	Total	**48.8**	**46.4**	**95%**	**57.6**	**118%**	**66**	**135%**
Tape	Tier-0	35	35.00	100%	36.1	103%	52	149%
	Tier-1	50.9	53.10	104%	55.5	109%	90	177%
	Total	**85.9**	**88.1**	**103%**	**91.6**	**107%**	**142**	**155%**

- Increase in 2020 due to generation of large simulated samples to tune the reconstruction and selection algorithms to be run in the HLT

Resources needs in 2021-2025







Model assumptions						
L ($cm^{-2}s^{-1}$)	2×10^{33}					
Pileup	6					
Running time (s)	5×10^6 (2.5×10^6 in 2021)					
Output bandwidth (GB/s)	10					
Fraction of Turbo events	73%					
Ratio Turbo/FULL event size	16.7%					
Ratio full/fast/param. simulations	40:40:20					
Data replicas on tape	2					
Data replicas on disk	2 (Turbo); 3 (FULL, TurCal)					
Resource requirements						
WLCG Year	Disk (PB)		Tape (PB)		CPU (kHS06)	
2021	66	1.1	142	1.5	863	1.4
2022	111	1.7	243	1.7	1.579	1.8
2023	159	1.4	345	1.4	2.753	1.7
2024	165	1.0	348	1.0	3.467	1.3
2025	171	1.0	351	1.0	3.267	0.9

Conclusions

- Computing Upgrade TDRs are approved
- Smooth running of LHCb Computing project, most of the computing resources is for the MC production
- Smooth running of the french sites (T1, T2, T2-D)
- Successful in using opportunistic resources
  - Not much HPC usage
- Significant increase in the resources needs in 2020-2023
  - Flat needs afterwards till 2025