Software & computing report 2024

Frédéric Derue, LPNHE Paris

ATLAS France CAF-user meeting

28th november 2024

- **CAF and other S&C involvement in France**
- **ATLAS S&C this year**
- **Other news**

Computing ATLAS France (CAF)

ATLAS France web site
https://atlas-fr.pages.in2p3.fr
https://atlas-fr.pages.in2p3.fr/fr/Collaboration/CAF/

- **CAF mandate**
  - ensure French S&C activities & resources provided to ATLAS meet expectation
  - ensure French physicists get adequate computing infrastructures & resources for analysis
- **CAF makes the link between**
  - French physicists
  - French T1 & T2s sites
  - other T2s in the FR-cloud : China, Hong Kong, Japan, Morocco, Romania
  - ATLAS S&C
  - other projects LCG-FR

- **CAF members**
  - 1 representative/lab
    APC (G. Marchiori),
    CPPM (A. Duperrin → T. Theveneaux-Pelzer since mid Oct.),
    IJCLab (L. Duflot),
    IRFU (E. Chapon, A. Formica),
    L2IT (J. Stark),
    LAPP (S. Jézéquel),
    LPC (R. Madar & L. d'Eramo (dep.)),
    LPNHE (F. Derue, chair),
    LPSC (P-A. Delsart)
  - **CC-IN2P3 representatives**
    E. Fédé : Technical responsible for T1
    A. Vedaee + S. Voisin (since Oct) : ATLAS support at T1
  - LCG-FR representatives (de facto)
    L. Duflot, D. Bouvet
  - ATLAS-IN2P3 & IRFU resp. ex-officio
    L. Serin & F. Déliot

S&C responsibilities & appointments

- **ATLAS S&C responsibilities**
  - International Computing Board (ICB): F. Derue (IN2P3), A. Formica (CEA)
  - members of CAF in sites with T2 are also scientist in charge of their local T2
  - ongoing appointments related to S&C as appearing in *glance*

Appointment	OTP	Member	Affiliation	Start date	End date	Status
Conditions Evolution Coordinator // Activities and Detector Projects // Software and Computing // ATLAS Database and Metadata (ADAM)		ANDREA, Formica	Saclay CEA (France)	2021-01-01	2025-09-30	active
Convener of subgroup: Upgrade Tracking // Activities and Detector Projects // Physics // Combined Performance Groups // Tracking CP group		ALEXIS, Vallier	L2IT (France)	2023-10-01	2025-09-30	active
ICB Scrutiny Group Member // Activities and Detector Projects // Software and Computing // General		ANDREA, Formica	Saclay CEA (France)	2024-04-01	2027-03-31	active
LAr Phase-II Online Software // Activities and Detector Projects // Liquid-Argon Calorimeter (LAr) // Upgrade Phase-II Electronics // Online Software		OLIVIER, Arnaez	Annecy LAPP (France)	2024-04-01	2026-03-31	active
Muon Database Coordinator // Activities and Detector Projects // Muon Spectrometer // Database		ANDREA, Formica	Saclay CEA (France)	2024-03-01	2026-02-28	active
Online Core Software Coordinator // Activities and Detector Projects // Liquid-Argon Calorimeter (LAr) // Upgrade Phase-II Electronics // Online Software		FATIH, Bellachia	Annecy LAPP (France)	2024-04-01	2026-03-31	active
Online SW Calibration Integration Coordinator // Activities and Detector Projects // Liquid-Argon Calorimeter (LAr) // Upgrade Phase-II Electronics // Online Software		OLIVIER, Arnaez	Annecy LAPP (France)	2024-04-01	2026-03-31	active
Physics Metadata Coordinator // Activities and Detector Projects // Software and Computing // ATLAS Database and Metadata (ADAM)		PIERRE ANTOINE, Delsart	Grenoble LPSC (France)	2021-05-01	2025-09-30	active

- **Other S&C responsibilities**
  - DS IN2P3 Calcul Intensif : S. Crépé-Renaudin (LPSC)
  - WLCG/LCG-FR: member of CoDir / scientific director L. Duflot (IJCLab)

S&C Institutional Commitments

Information taken from *OTP report*

→ either Activity= «Computing & Software »

2024 (prel.)

ATLAS OTP · OTP ATLAS
- Commitment Report - 2024 - Class 2, Class 3, Class 4 and Upgrade Construction

System	Activity	Task Id	Task	Requirement Id	Requirement	Funding Agency	Institution Id	Institution	Description	Committed [FTEs]	Allocated [FTEs]	Task Requirement [FTEs]	Committed Fraction of Requirement [%]
General Tasks	Computing/ Software	534123	Dataset-level Metadata Catalogues and Infrastructure (AMI)	558077		France IN2P3	52	Grenoble LPSC	Support and developemnt for AMI.	2.70	0.87	0.95	285
PIXEL	Computing/ Software	531773	Software Development/ Maintenance and Physics Performance	555533		France IN2P3	40	Marseille CPPM	Performance studies and software developmen	0.80	0.08	6.26	13
PIXEL	Computing/ Software	531773	Software Development/ Maintenance and Physics Performance	555533		France IN2P3	107	Paris LPNHE	Offline software, rad damage, performance studies.	0.15	0.03	6.26	2
PIXEL	Computing/ Software	531773	Software Development/ Maintenance and Physics Performance	555533		France IN2P3	353	APC Paris		0.15	0.00	6.26	2
General Tasks	Computing/ Software	12347	TAG/EI and Conditions/ Metadata Database Development	12350	Conditions Database	France CEA	127	Saclay CEA	Develop and maintain the conditions database infrastructure	0.65	0.20	1.50	43
General Tasks	Computing/ Software	64	Reconstruction	552677	Jet/ETmiss combined reco.	France IN2P3	52	Grenoble LPSC	JET-Athena-Reconstruction	0.20	0.00	1.75	11
PIXEL	Computing/ Software	531773	Software Development/ Maintenance and Physics Performance	556392	Rad Damage Coordinator	France IN2P3	353	APC Paris		0.50	0.20	1.40	36
General Tasks	Computing/ Software	12347	TAG/EI and Conditions/ Metadata Database Development	552547	TAG, EventIndex and Conditions Metadata	France IN2P3	104	IJCLab	Develop and operate the EventIndex (Hadoop)	1.00	0.10	1.99	50
Total Commitments:	8								FTEs:	6.15	1.48	26.36	23

Some of these commitments (e.g part of AMI) are also in-kind contributions

→ either appears the key-word « software » in other Activities

System	Activity	Task Id	Task	Requirement Id	Requirement	Funding Agency	Institution Id	Institution	Description	Committed [FTEs]	Allocated [FTEs]	Task Requirement [FTEs]	Committed Fraction of Requirement [%]
Muon	Data Preparation	528951	Barrel optical alignment	551723	Alignment experts	France CEA	127	Saclay CEA	M&O, software, DQ	2.00	0.50	0.55	365
LAr	Detector Operation	22547	Home stations	22550	Back end test station (Annecy)	France IN2P3	9	Annecy LAPP	online software test station	0.10	0.05	0.10	100
LAr	Detector Operation	22512	LAr online software	22513	LAr Online SW development	France IN2P3	9	Annecy LAPP	LAr online SW maintenance and development, TDAQ version migration	1.00	0.79	12.03	8
TILE	Detector Operation	20569	Tile calibration systems maintenance	554143	Laser	France IN2P3	36	Clermont-Ferrand	Maintenance of Laser 2 non-optical hardware and TileLasII software package	0.10	0.00	0.23	44
DAQ/HLT	Detector Operation	530933	DataFlow	555216	SW maintenance and	France IN2P3	40	Marseille CPPM	Node-level dataflow management software maintenance	0.15	0.00	0.25	60
LAr	Data Preparation	22747	Reconstruction,EDM,Validation	291594	Validation / RTT tests	France IN2P3	40	Marseille CPPM	Software validation (J. Toth)	0.20	0.10	0.40	50

Software & computing FTEs involvement

	Software					ADAM	Computing				
	Core	Upgrade	Data/ Detector	Reco/ Ana	Total [S&C+AS]	Total	C2	C3	C4	Other	Total
APC		0.10	0.40	0.50	0.97 [0.97]		0.05				0.05
CC-IN2P3									3.30		3.30
CPPM	0.10		1.17	0.96	2.23 [1.41]			0.05	0.65		0.70
IJCLab	0.40	1.10		0.30	1.80 [0.70]	0.20	0.16	0.05	0.30	0.40	0.91
IRFU		0.30	0.20		0.50 [0.50]	0.60		0.05	0.75		0.80
L2IT	0.04	1.91	0.40		2.35 [0.51]						
LAPP			0.24	0.05	0.29 [0.05]		0.02	0.02	0.97		1.01
LPC			0.15	0.30	0.45 [0.05]				0.70		0.70
LPNHE		0.20	0.65	0.45	1.30 [0.27]		0.11	0.45	0.75		1.31
LPSC				0.24	0.24 [0.24]	1.95		0.05	0.08		0.13
Total	**0.54**	**3.61**	**3.21**	**2.80**	**10.13 [4.70]**	**2.76**	**0.34**	**0.67**	**7.50**	**0.40**	**8.51**

Software & computing FTEs involvement

- **Computing (8.5 FTE)**
  - 7.5 FTE for FR-T1/2 (Class 4)
  - 0.67 FTE for FR-cloud support & management (Class 3)
  - 0.34 FTE for shifts (Class 2)
    - 0.5 in 2023
  - 0.4 FTE for other (WLCG)

- **Software (10.1 FTE)**
  - 4.7 FTE are labelled as S&C or Analysis Support for ATLAS OTPs
    - 4.2 in 2023
  - 0.5 FTE SW core (0.2 in 2023)
  - 3.6 FTE Upgrade (2.9 in 2023)
  - 3.2 FTE data/detector (2.8 in 2023)
  - 2.8 FTE reco/analysis (3.0 in 2023)

- **ADAM (2.8 FTE)**
  - WG management 0.2 FTE (0.34 in 2023)
  - EventIndex, CondDB ... 0.8 FTE (0.8 in 2023)
  - AMI 1.75 FTE (1.8 in 2023)

⇒ slow erosion of our involvement, **no/not enough new blood**

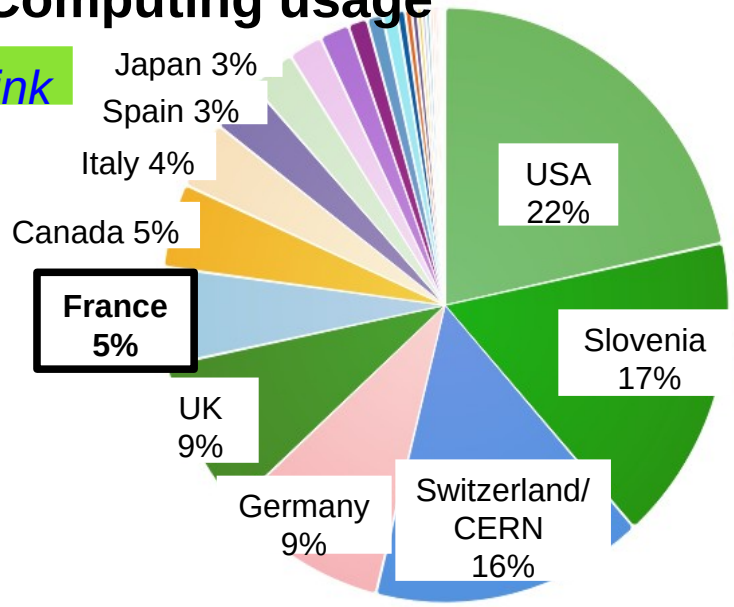
⇒ several new positions (CR + Univ.) with ML flavour, do not really reflect in OTPs

These numbers include (in general) contributions to other projects on computing to LCG-FR, DOMA-FR, ESCAPE 2

ATLAS resource usage

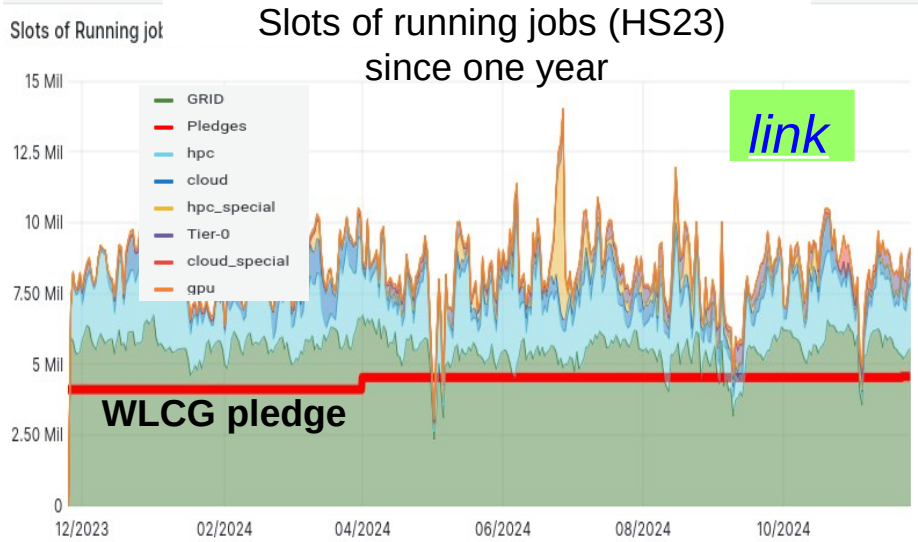
- **Computing usage**

link



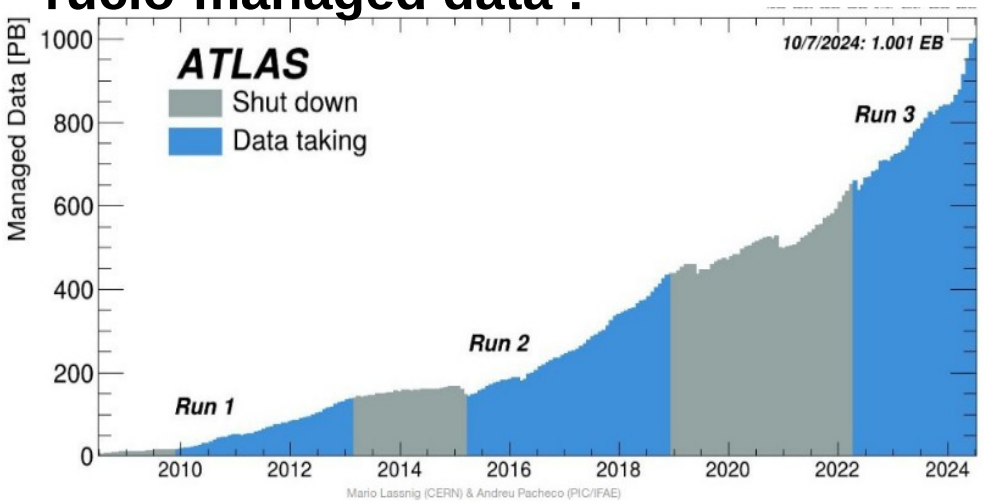
Slots of running jobs (HS23) since one year

link



- **Smooth computing operation**
  - 6-800k jobs/d on grid
    HLT farm, HPC, cloud, gpu
  - cpu on grid=68%, hpc=20%
  - Wallclock successfull jobs : 91%

- **Reached 1 Exabyte of rucio-managed data !**

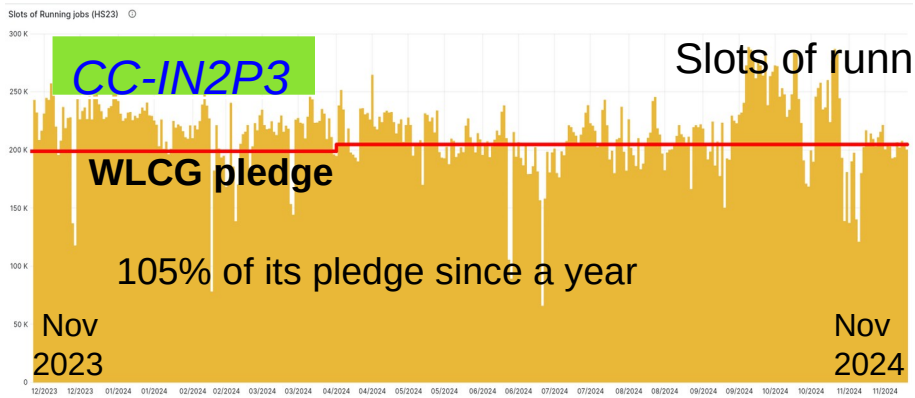


WLCG CPU/storage in France

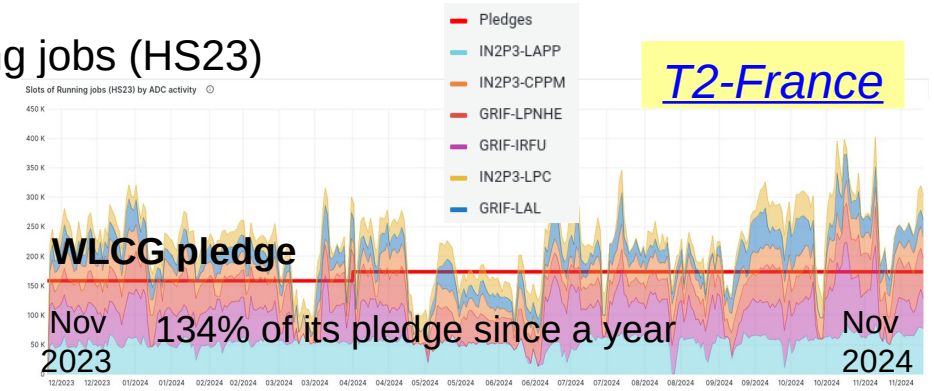
- **Pledges (see *cric*)**
  - CPU
    - CC : 13.5% of T1s, +4% in 2025
    - T2s : 7.5% of T2s, +7% in 2025
  - Storage
    - CC : disk=13.5%, tape=15.6% of T1s
      in 2025 : +14% for disk, +24% for tapes
    - T2s = 9.5% of T2s, +9.5% in 2025

Site	CPU Pledge 2024 (HS23)	Disk Pledge 2024 (TB)	Tape Pledge 2024 (TB)
IN2P3-CC	204660	22005	65540
GRIF	69527	7221	-
IN2P3-CPPM	24000	2200	-
IN2P3-LAPP	55000	7000	-
IN2P3-LPC	25000	2914	-

- **CPU realized**
  - CPU : CC : 15% of T1s, T2s : 15% of T2s



Slots of running jobs (HS23)



- French pledges (in%) remain at same level as last years
- + « local » resources in Lyon and labs.
- no HPC cpu resources in France
- recent increase of price of TB/cpu ⇒ need of R&D

CPU/GPU usage at CC-IN2P3

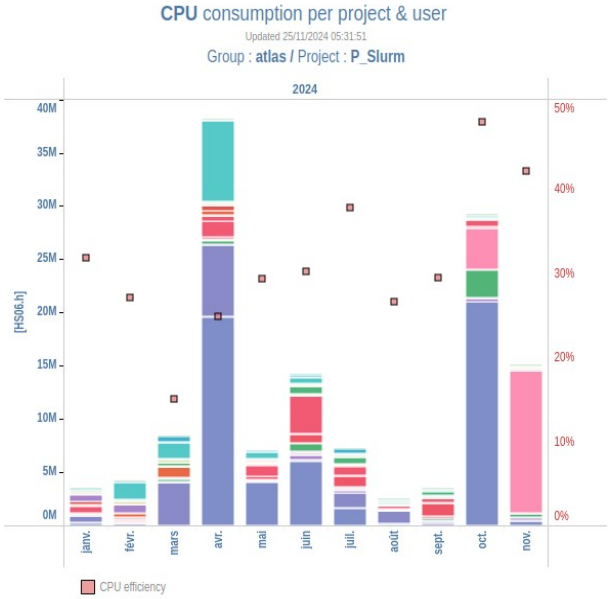
The analysis model of ATLAS is to send jobs on grid
Thanks to CC-IN2P3 we can use our own resources on local batch system

- **local batch system**
  - batch system based on Slurm
  - typical pledge ~500 jobs but up to 3500 jobs
  - no priorities within ATLAS jobs first arrived first served

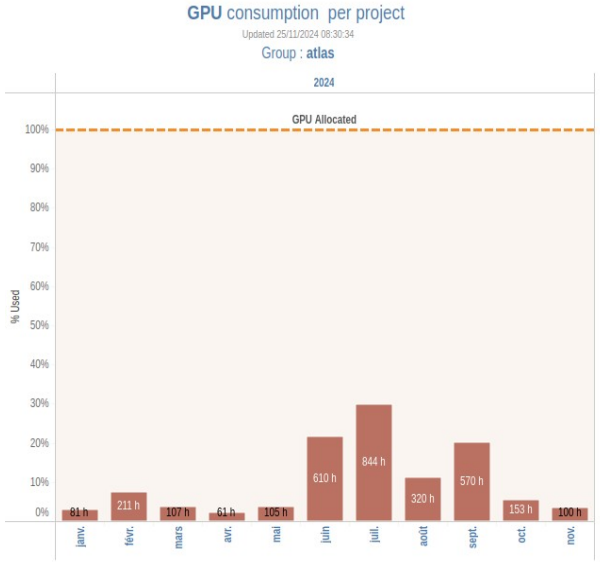
https://portail.cc.in2p3.fr/

Each user should log here and check its own infos !

- **CPU usage**
  - 7.4% of ATLAS CPU usage
  - less than last year (~9%), more than 2 years ago (~4%)



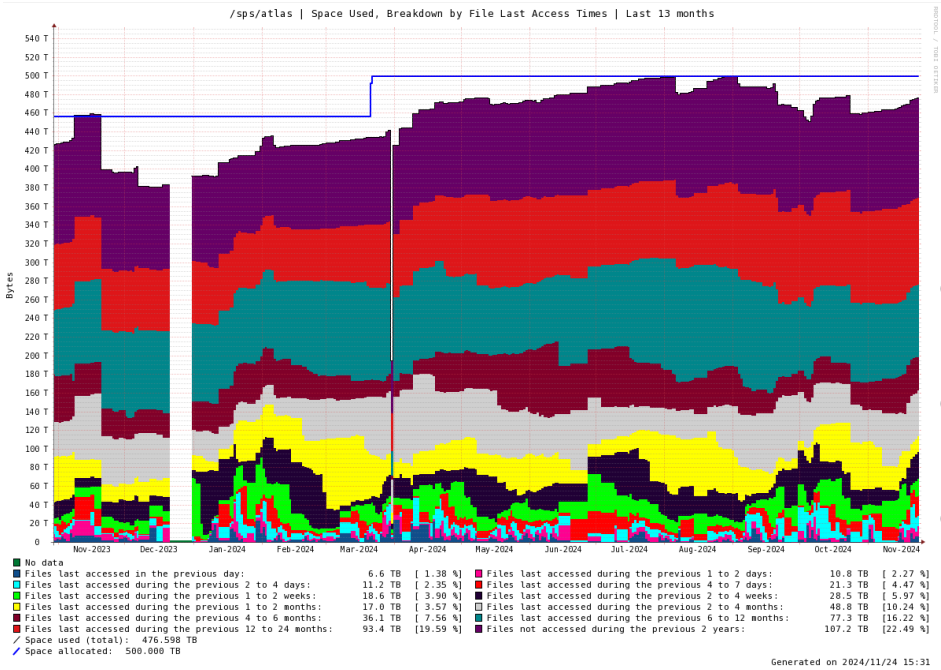
- **GPU usage**
  - 12% of our request (4 GPU-year)
  - 16 users



Requests to CC-IN2P3 for cpu/gpu on batch for 2025 is the same as in 2024

Storage usage at CC-IN2P3

- **semi-permanent sps (see link)**



	Total (TB)	Free (TB)
sps	500	25
LGD	525	75
LGT	457	20

- data not accessed since 1-2 year 98 TB, since >2 years 106 TB
- could be moved to hpss but cleaning would be much better !
- list of main users (*link*) + check with your CAF contact

…. for 2025 CC-pledge, ask for 200 TB more to favour CC users, and decrease correspondingly (in euros not in TB) disk grid-pledge

- **IN2P3-CC_LOCALGROUPDISK (LGD)** [*current*]
  - 525 TB allocated, 448 TB used
  - list of main users https://rucio-ui.cern.ch/r2d2/manage_quota + check with your CAF contact

…. for 2025 CC-pledge, ask for 100 TB more

- **TAPE**
  - from Grafana/r2d2 : 250 TB allocated on IN2P3-CC_LOCALGROUPTAPE (LGT)
  - received « old » data from sps, but also use of hpss

Network status

https://wlcg-cric.cern.ch/core/netsite/list/

Tier 1	2024	2028
IN2P3-CC LHCOPN	200	400
IN2P3-CC LHCONE	200	400

LHCONE, in particular at IN2P3-CC not used only by LHC experiments but also CTA, Belle2, DUNE, Auger... which need also to access RAW data

Tier 2 sites	2024	2028
GRIF-IRFU	100 (+10)	200
GRIF-IJCLab	100 (+20)	200
GRIF-LPNHE*	2*10	100
IN2P3-CPPM**	10	100
IN2P3-LAPP***	2*20	100
IN2P3-LPC****	100	100

* GRIF-LPNHE still at 2*10 Gbps,
  - lab switch (from Telecom@CCIN2P3) has 4 ports 40/100 Gbps and many 10/25 Gbps switches
  - each link between NRD-DSI and LPNHE is a pair of single-mode fiber UDP of 700 m, able to do 25, 40 and 100 Gbps
  - between NRD-DSI and LPNHE 6 pairs allocated, 3 in prod.

  ==> 2025 : expect 40 Gbps from Renater + optical modules to be added to the lab switch

  ==> 2027 : expect 100 Gbps

** IN2P3-CPPM is saturating with 10 Gbps, expected to upgrade to 40 Gbps « asap »

*** IN2P3-LAPP is not directly on LHCONE but to CC-IN2P3 through regional network, its traffic to/from LHCONE is included in needs of IN2P3-CC. It was upgraded to 2*20 Gbps just before DC24 (Feb. 2024)

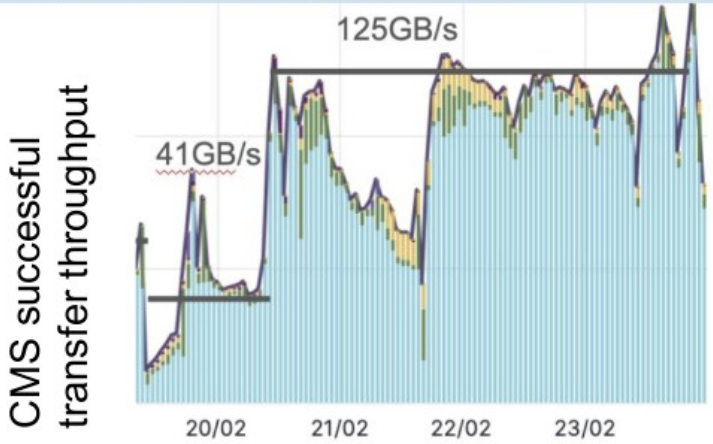
**** IN2P3-LPC upgraded to 100 Gbps since 7th June [*slides of Jean-Claude at LCG France*]

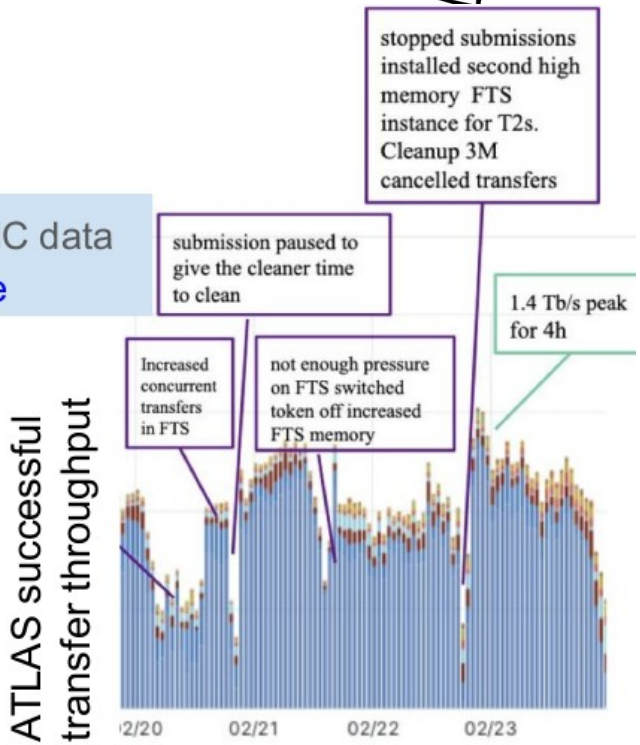
WLCG Data Challenge DC24

See reports by Laurent and Eric at LCG-FR site meeting in June [*agenda*]

- **WLCG Data Challenges**: established in 2021 to prepare for HL-LHC data rates. DC24: ATLAS, CMS, ALICE, LHCb, BelleII (poster) and Dune

Year	% of HL-LHC
2021	10
2024	25
2026?	50
2028?	100





- **Observed bottlenecks (ATLAS, CMS)**
  - scalability of FTS, Rucio and token handling, risk to overload storage systems
  - Data Movement Manager prototype interface between Rucio and the software defined networking (SDN) service SENSE by ESNet.
    Dynamic provision of network path
- **DC26**
  - 2*DC24 rates (50% HL-LHC), tokens estabished and battle tested, tape
  - intermediate mini challenges
  - FTS3 Token Support for a Proxy-less WLCG World

News from software

See Review at last S&C week

- **Core software** *slides*
  - great progress on a number of topics in the recent months, e.g
    - various improvements in RNTuple (as part of the ROOT 7 migration effort)
    - pile-up digitization in AthenaMT is going through physics validation
    - asynchronous Algorithm scheduling in Athena is now available in nightlies

- **Simulation** *slides*
  - Person power shortage in core software and digitization

- **Upgrade/Reconstruction** *slides*
  - Upgrade Software is now (as of October 1st) officially merged with Reconstruction
  - Great progress on demonstrators (⇒ see afternoon talk for ACTS)
    - new TWiki with info on demonstrator projects and general reco R&D projects: *https://twiki.cern.ch/twiki/bin/viewauth/AtlasComputing/RecDevelopments*

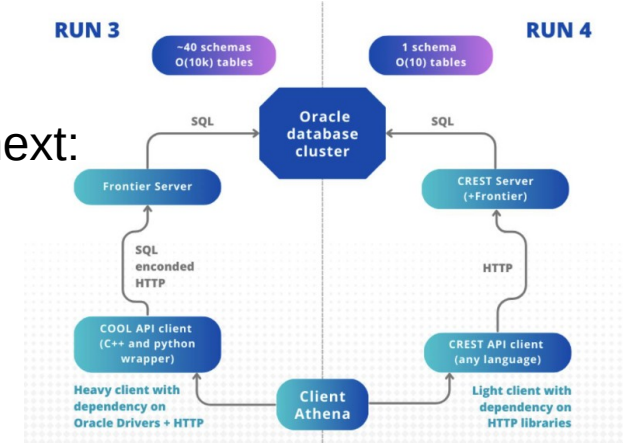
- **AMG** *slides*
  - Analysis projects focusing on the deployment of the Run 4 model, particularly PHYSLITE, and enabling the use of python and columnar data operations

- **PMG** *slides*
  - Assessment of CPU costs using Run-3 MC setup

ATLAS Database and Metadata (ADAM)

See Review at last S&C week : slides

- **Database & conditions**
  - Finalize the prototype for CREST deployment, partial COOL data migration and Athena jobs testing, next:
    - new CREST client (CrestApi) version
    - data migration/conistency
    - TriggerDB is accessible from CREST server directly
  - Time series data processing and storage evaluation for CREST usage (DCS data)
  - CREST HLT demonstrator … ongoing



- **Metadata**
  - AMI internal development (DB scheme, deployement) - delayed
    - Design of the new DB structure is ready, 80% of new structure in place - outlined in the last AM report in *June S&C week*. CHEP poster
  - AMI Tag evolution and deployement (delayed)
    - dependent on the completion of the new dataset DB structure
  - Tasks inside AMI
    - some tasks to collect metadata are considered heavy to maintain and AMI team is looking for some external help interested in taking over the development
    - other collaborations are using/develop AMI, e.g deployement of AMI using Kubernetes
    - ATLAS Dataset classification : https://cds.cern.ch/record/1070318

Sciences ouvertes

- **CERN Open data**
  - July 1: ATLAS *Open Data for Research* was released. *EP news article* from Sep.
  - *People did find it*, even outside of the CERN Community
  - bulking up documentation (incl. available resources)
    - NTuple maker from E&O not quite ready, but soon
  - considering a workshop *like the one CMS had* in 2024
  - *DPHEP Workshop* featured *a talk by ATLAS* and included news about the new Data Lifecycle ICFA Panel

- **Journées IN2P3** *https://indico.in2p3.fr/event/31614*
  - 16-17 décembre au CC-IN2P3

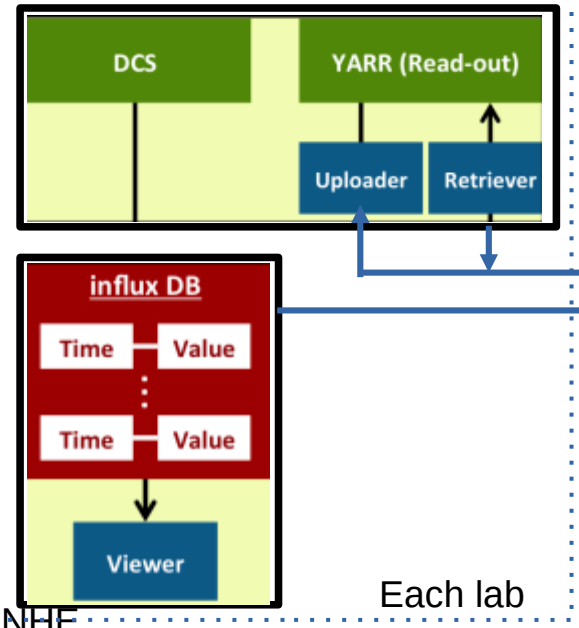
- **OpenLab : https://openlab.cern/**
  - partenariat public-privé entre le CERN, des organismes de recherche partenaires et des industries avec pour objectif d'accélérer le développement de technologies informatiques de pointe pour la recherche
  - Une trentaine de projets de R&D, phase précédente : traitement des données à l'échelle exascale : HTC, HPC
  - Openlab est entré dans une nouvelle phase et a défini deux axes de travail : "Sustainable Infrastructures" and "Emerging Technologies"
  - quelques projets déposés par l'IN2P3 dont un par G. Aad (THINK) pour instrumentation embarquée, et un (ML non HEP spécifique) par D. Rousseau

ITk localDB @ Paris cluster / mirror

DAQ PC
- DCS data : timestamped data of monitoring, control measurements of captors (temp., humidity, dust), power supply, logs
- located in acquisition rooms in each lab

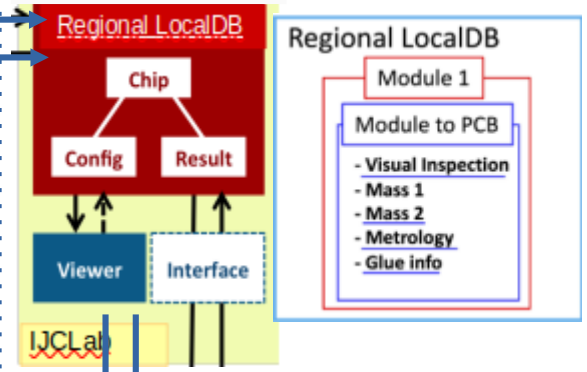
Visualization

- influxdb + viewer/grafana
- installed on PC @Saclay,
  1 VM/openstack cloud @ LPNHE,
  1 VM/openstack cloud @ IJCLab



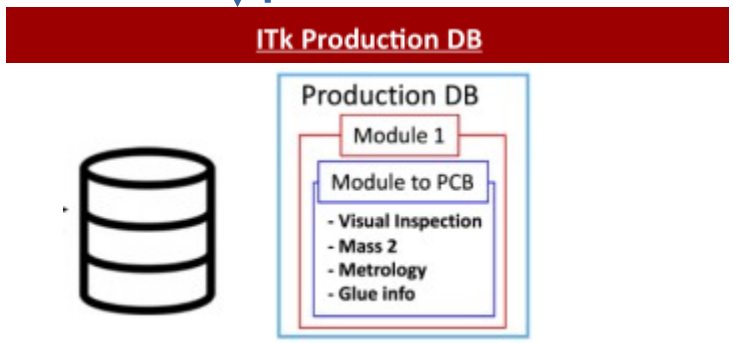
RegionalDB local

- localdb + mongodb
- 1 VM cloud openstack @ IJCLab



- **ITk localDB@Paris cluster**
  - localDB deployed in docker
  - mongoDB deployed on VM
  - require up to 20 TB of data in the next ~2 years

==> if it fails the production in the three labs stop !
recent examples : flood in Orsay in Oct.



- **ITk localDB mirror at CC ?**
  - need mirror of infra to avoid such failure
  - no experience in doing such mirroring ==> need help !

Points à discuter ...

- **Fonctionnement / Infrastructure grille**
  - Opération fonctionne (relativement) bien mais
    - moins de personnel dans les sites, beaucoup moins de « support » dans le nuage FR mais aussi au niveau d'ADC/DDM central Ops
    - c'est de plus en plus difficile et on commence à le sentir dans les performances des sites
  - Développement
    - quasiment plus du fait du vieillissement des équipes IT et du manque de chercheurs pour impulser des projets
    - besoin d'intéresser les jeunes chercheurs pour renouveler les équipes et les défis de la préparation pour le HL-LHC nécessitent que les expériences s'emparent à nouveau du sujet

    ⇒ nécessité de parler de ces sujets dans nos labos
    sans computing il n'y aura pas de résultats de physique
  - Articulation CC/plateformes
    - quels sont les besoins des labos/groupes ?
    - agilité proche des chercheurs pour les développements ou on centralise plus au CC ?
  - Bilan des besoins de développement
    - future analysis facility centralisée ?
    - utilisation des notebook ? IA?
    - accès au HPC, discussions IN2P3-IRFU, possibilité d'ouverture avec l'IDRIS via FITS
    - utilisation des différents type de hardware ?
    - développement logiciels ?
    - impact écologique
  - Position des expériences pour le calcul pour ESPPU
    - pas de contribution ATLAS

Points à discuter …

- **Discussions stratégiques**
  - Mondial / européen
    - EGI ⇒ discussion sur la stratégie futur en cours : lien avec WLCG, EOSC, développement technique financé par les projets Européens

  - National
    nouvelle Infrastructure de Recherche (IR)
    Mesonet (le mésocentre des mésocentres) *https://www.mesonet.fr/*
    + France Grilles / LCG-FR sites ?
    - fin de l'IR France-Grilles, Equipex Mesonet (~10 mésocentre HPC+autres). GENCI est associé mais les centres nationaux HPC ne font pas partie de Mesonet
    - discussions en cours pour/si rejoindre le projet

  - EOSC
    - ESCAPE dans les discussions des premiers noeuds qui pourraient rejoindre la fédération
    - soutien de l'IN2P3 et du CNRS à définir

Points à discuter …

- **Logiciels/Intergiciel/DB**
  - tout aussi important que les infras, notre meilleur levier pour relever les défis du LHC
  - coordination suffisante ?
    - ACTS est visible
    - autres développements software ? GNN4ITk au L2IT
    - coordination avec les développements dans Decalog/Reprises et les experts software

      ⇒ efficacité logiciels + formation aussi RI3
  - développement ATLAS intergiciel/DB
    - IN2P3 dans AMI (LPSC) + DB (IJCLab) mais participation de l'IJCLab transférée vers du Core software
    - IRFU dans ADAM – mais basé sur 1 personne (Andrea)

      ⇒ faible participation française ?
  - participation au TDR Computing ?

    cf *slides* à la S&C week

- **Appel à projets Thématiques Spécifiques en Intelligence Artificielle (TSIA) 2025**
  - https://anr.fr/TSIA-2025
  - pour recevoir les emails : MACHINE-LEARNING-L@IN2P3.FR

Conclusion

- **CAF group and activities**
  - business as usual – a bit of turnover in the CAF members !
  - also involved in support for FR-cloud !

- **LCG-France**
  - ensure the scientific and technical coordination of Tier sites in France
  - important contribution for grid sites funding (but there are also other sources …)

- **S&C in ATLAS France**
  - smooth operation of CC-IN2P3 as a Tier-1 and our Tier-2s
    but less person-power in sites, FR-support and ADC/DDM central Ops
    ⇒ life is harder and we can feel it !
  - level of resources for ATLAS-FR users reviewed by CAF in september
    - adequate level of resources of CC-IN2P3 as Analysis Facility in 2024
      (batch, sps, LGD) but (permanent) sps disk crisis due to absence of cleaning and good planification
      ⇒ increase of sps and LGD in 2025
    - CC-IN2P3 offers GPU farm, request of 4 GPU-year done for 2024
      ⇒ not really used, but also seen difficulties to “enter in queue”
    - many other resources also available in laboratories (Tier-2s, local batch/disk)

Conclusion

Tthis afternoon !

- **ACTS**
  - Status of ACTS activities (Corentin Allaire)
- **Practical use of GPUs**
  - Use of GPUs at CC-IN2P3 and elsewhere (Pierre-Antoine Delsart)
  - Use of GPUs at CCIN2P3 (Minori Fujimoto)
- **Analysis frameworks**
  - EasyJet (Georges Aad)

A BIG thanks to CC-IN2P3, all our Tier-2s colleagues,
& LCG-FR management for the operation, maintenance

and development of our computing infrastructure
R&D for storage/analysis evolution requires person power
– syst admins and physicists –
in order to use solutions which fit our needs !