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2017 10th RO-LCG Conference

IFIN-HH's contribution to advanced scientific computing infrastructure

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IFIN-HH

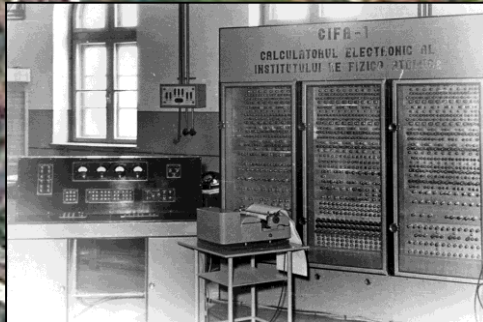
IFIN-HH: OVERVIEW



With a contribution of almost 10% of the national scientific output, IFIN-HH is one of the most important public R&D organizations in Romania. The institute is dedicated to the research and development in physical and natural sciences, mainly Nuclear Physics and Nuclear Engineering, and in related areas including Astrophysics and Particle Physics, Field Theory, Mathematical and Computational Physics, Atomic Physics and Physics of Condensed Matter, Life and Environmental Physics. In all these fields, IFIN-HH conducts theoretical and experimental research.



Nuclear reactor VVR-S (1957)



First Romanian electronic computer (CIFA-1, 1956)

Group I

1 HTC site
~3300 cores, .9 PB

Group II

3 HTC sites, 4900 cores, 1.6 PB
26.7 TFLOPS DP CPU + 25 TFLOPS DP GPU



Advanced Computing Centre (2019)



ELI-RO-NP (2019)

IFIN-HH: RESEARCH AREAS

- ELI-RO-NP subunit
- 10 R&D departments
- 7 major facilities
- 10 certified laboratories

Large-scale collaborations:

- ELI



- WLCG



Basic Physics Research

- Nuclear Physics and astrophysics
- Particle physics and field theory
- Atomic physics and condensed matter physics
- Mathematical physics
- Life and environmental physics
- Computational physics

Applied Physics Research

- Advanced detection systems
- Nuclear safety, radiation protection and radioactive products
- Radioecology and nuclear biomedicine
- Nuclear techniques and applications
- Advanced communication systems



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DFCTI's MISSION

- Development, implementation, management and operation of the advanced computing and data communication infrastructure @ IFIN-HH
- Planning and provision of resources and services for the support of the (inter)national scientific collaborations.
- R&D in scientific domains that require numerical methods (complex systems)

Domains of technical expertise:

- Networking: routing, switching, WAN (Cisco levels: CCNA, CCAI)
- Network optimization. Network security
- Distributed data storage (SAN)
- Distributed (Grid) and parallel computing
- Cluster optimization
- Software development



DFCTI: SERVICES and FUNCTIONS

- ❑ Management of grid operations and monitoring, within the Operations Centre of the National Grid Initiative (NGI-RO)
DFCTI coordinates NGI-RO (consortium of institutions that provide HTC infrastruct.)
- ❑ Offline computing for three LHC experiments: ALICE, ATLAS, LHCb
DFCTI coordinates the Romanian Tier 2 Federation
- ❑ HTC and HPC integrated infrastructure for automation of biomolecular modeling
Management of the Romanian Node for Computational Biology (RoNBio)
- ❑ Infrastructure for simulations/modeling necessary for ELI-NP's experimental groups: Intense light - nuclei interaction EPOCH (PIC); GEANT 4, ROOT, FLUKA
- ❑ IaaS provider within the EGI Federated CLOUD (through CLOUDIFIN)



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R&D @ DFCTI

Modeling and simulation for:

Computational biology

- Topics: drug resistance of bacteria; membrane structure of Gram negative bacteria
- Molecular dynamics and docking simulation studies, on CPU and GPU, with e.g. NAMD, VINA LC

Physics of condensed matter and nanostructures

- Topics: Thermoelectric and transport properties of nanodevices
- Modeling with SIESTA and TranSIESTA packages

HPC for nuclear & particle physics

ROMANIAN TIER 2 FEDERATION (RO-LCG)



Consortium of 5 institutions



IFIN-HH, Bucharest-Magurele (through DFCTI)



Institute for Space Sciences, Bucharest-Magurele

NIRD for Isotopic & Molecular Technologies, Cluj



"Alexandru Ioan Cuza" University, Iasi

University "Politehnica" of Bucharest



RO-LCG's MISSION

To provide high-availability offline computational support for the ALICE, ATLAS and LHCb experiments, within the WLCG collaboration, through the deployment, operation, maintenance and coordination of the grid infrastructure.

WLCG = Worldwide LHC Computing Grid = the best example of a production grid

<http://wlcg.web.cern.ch/>

RO-LCG / DFCTI's CONTRIBUTIONS TO WLCG IN 2017



- ❑ With 35,516,000 CPU hours run between 01.01-26.09.2017, that represent > 3.6% of the total CPU time provided by 32 Tier2s for ALICE, ATLAS and LHCb, **RO-LCG ranks 7th worldwide**
- ❑ The same ranking holds for the number of the processed grid jobs (12,479,000 jobs, that is 5% of their total number) and the wall-clock time consumed by the grid jobs (44,989,000 hours, representing 3.7% of the total)
- ❑ Regarding the dedicated disk capacity, the main LCG site, RO-07-NIPNE, **ranks 2nd worldwide** among the Tier2-with-Data sites that provide storage for the LHCb user analysis.
- ❑ In 2017 RO-07-NIPNE began the implementation of structural changes for increasing the efficiency and lowering the operational costs by:
 - successfully introducing the EOS storage management solution for ALICE analysis;
 - supporting with storage the Monte Carlo simulations on two other ATLAS *diskless sites* (RO-14-ITIM and RO-16-UAIC);
 - first implementing within RO-LCG the HTCondor Compute Element (for ATLAS MC8 simulations and analysis), replacing the CREAM CE.

SUPPORT FOR NON-HEP USER COMMUNITIES

❑ GRIDIFIN provides:

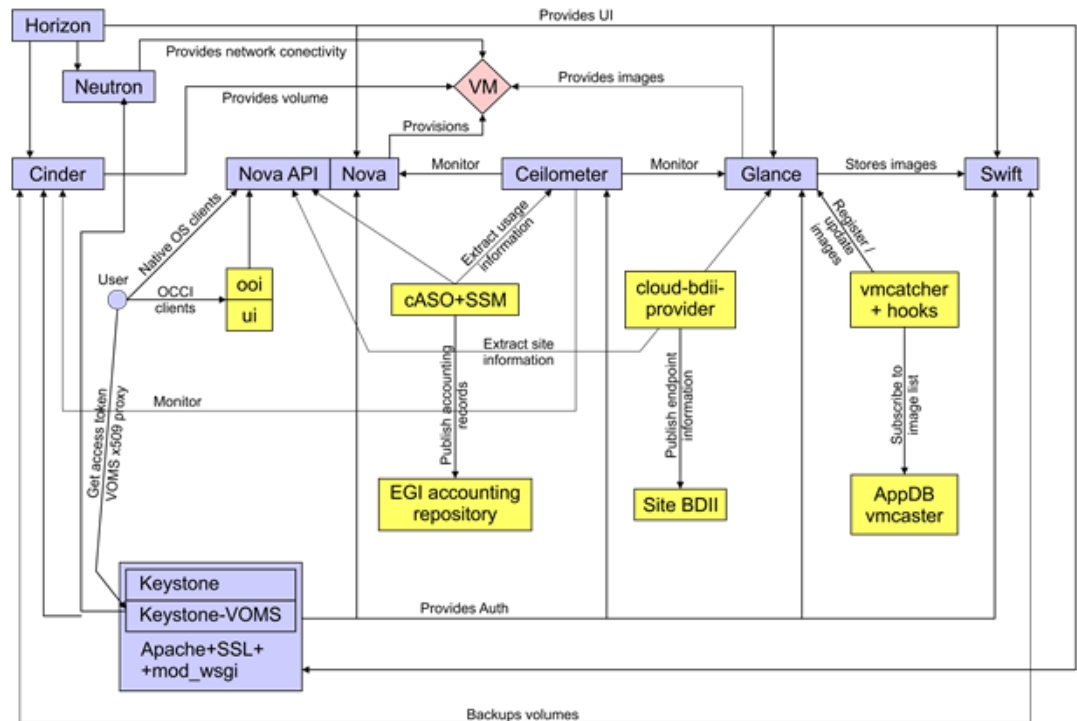
- 17 TFLOPS DP for ELI-NP research groups, through the *eli-np.eu* VO
- support for the computing biology community (*ronbio.ro* VO)
- condensed matter physics (*ifingrid.ro* VO)

❑ CLOUDIFIN - cloud site implemented for the support of the 'long tail of science' groups

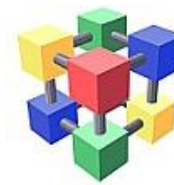
Certified for the participation in the *EGI Federated Cloud*

Programming VM images for *eli-np.eu* users. e.g. attaching volume with specific software - ROOT and GEANT, for ELI-NP users

Figure: Services provided by OpenStack platform with EGI extensions =>



PROSPECTS FOR RO-LCG



□ Evolution towards the HL-LHC

LHC	Run 2			LS 2		Run 3			LS 3		Run 4	
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
LHC	PHASE 1							HL-LHC installation		PHASE 2		
ALICE	resource upgrades				data-taking increase							
ATLAS								major resource upgrades		data-taking increase		
LHCb	resource upgrades				data-taking increase							
WLCG	CWP				TDR							
Magurele	CCA commissioned								1 Tbps			

The increase of the WLCG storage and computing capacities cannot keep up with the demand. One seeks new solutions regarding the optimization of the resource usage, the coupling between the available computing and data sources, the improvement of the data transfer management and accessibility. A 'network-driven' model is proposed.

□ Adapting the support infrastructure to the new WLCG requirements

- Commissioning of the new Advanced Computing Centre (2019) => cost reduction for national funding institutions (ELI-NP and new CERN resources hosted together)
- Successive upgrades of the GEANT data connection with multiples of 400 Gbps up to ~ 1Tbps => integration in the HEP data cloud / 'lake'

□ Adapting RO-LCG's computing architecture to the new experiments' computing models and standards regarding efficiency and cost

- ❑ The Advanced Computing Centre (CCA) will provide offline computing for ELI-NP, starting with 2019

Overall requirements

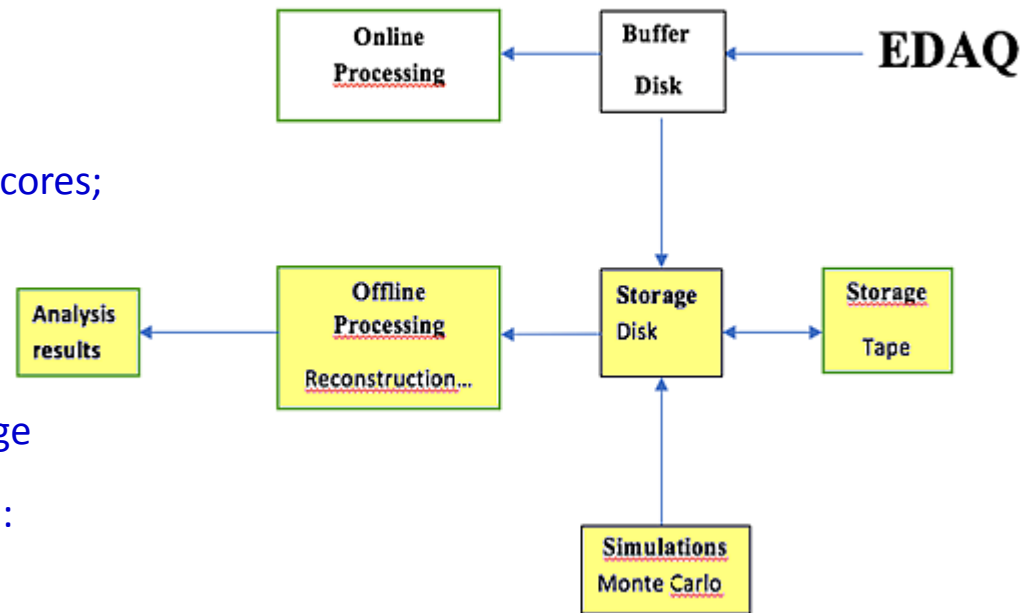
@ ELI-NP facility:

- Buffer Disk: ~300TB
- Online Processing cluster: ~1000 CPU cores;

@ CCA

- Disk Storage unit: ~ 7PB; mid-term storage
- Offline Processing, Analysis & Simulation: ~10000 CPU cores
- Tape Storage unit: 7PB, extensible; long-term storage

ELF (ELI-NP Local Facility)





Grid, Cloud and High-Performance Computing in Science
Sinaia, 26.10.2017



**THANK YOU
FOR YOUR ATTENTION !**