



Agenzia nazionale per le nuove tecnologie,
l'energia e lo sviluppo economico sostenibile

ENEAGRID Site Report

OpenAFS Workshop 2023 - 12-14/6/2023

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Introduction and outline

Since **1998 AFS/OpenAFS** is one of the main components of **ENEAGRID**, the distributed infrastructure integrating the computational resources of ENEA (the Italian National Agency for New Technologies, Energy and Sustainable Economic Development).

With **CRESCO (Computational RESearch centre on COMplex systems) project** in **2008** an ENEA Linux cluster entered in Top500 and since then the updated **CRESCO HPC clusters** are the core of current ENEA HPC resources, dedicated to simulation and modeling activities in fields as material science, climate research, nuclear technology, plasma physics, biotechnology, efficient combustion and many others.

OpenAFS is also used in other contexts in ENEA in the nuclear fusion domain for internal activities and in collaborations with CINECA, the main italian HPC institution.

Outline

- ENEAGRID and CRESCO HPC Clusters

- enea.it cell, history and status

- Other OpenAFS cells related with ENEA

- eufus.eu for the EUROFUSION Gateway at CINECA

- fusion.e.it

- Motivation, developments and issues

ENEAGRID and HPC CRESCO Clusters

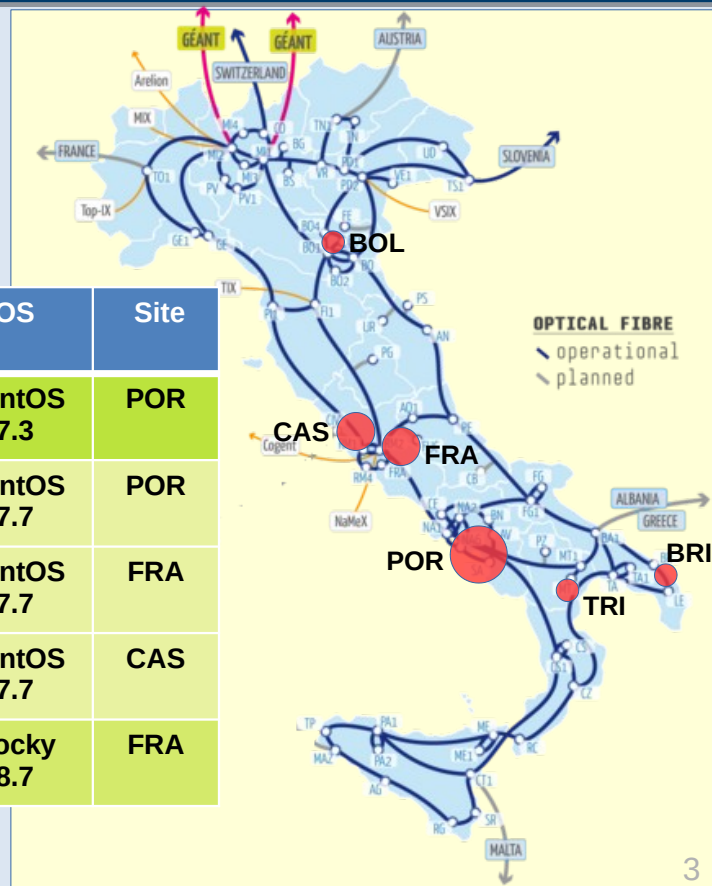
ENEA has 12 sites in Italy, 6 of them with relevant ICT resources.

Portici (**POR**) the main HPC site, Frascati (**FRA**) & Casaccia (**CAS**) medium sites; Bologna (**BOL**), Brindisi (**BRI**), Trisaia (**TRI**) small sites; connection by GARR, the Italian NREN.

OpenAFS / LSF / GPFS: HOMEs, projects and software in AFS

Kerberos 5

HPC Clusters	Cores Nodes	Peak Rate	CPU	RAM node	net	GPFS	OS	Site
CRESCO6	20832 / 434	1.4 PF	Intel SKL 8160	192 GB	OPA	3.8 PB	CentOS 7.3	POR
CRESCO4	1536 / 96	30 TF	Intel E5/2670	64 GB	QDR		CentOS 7.7	POR
CRESCO4F	1024 / 64	20 TF	Intel E5/2670	64 GB	QDR	48 TB	CentOS 7.7	FRA
CRESCO4C	512 / 32	10 TF	Intel E5/2670	64 GB	QDR	33 TB	CentOS 7.7	CAS
CRESCO5F	320/10	~100 TF	AMD EPYC 7313+A100	256 GB	EDR	134 TB	Rocky 8.7	FRA



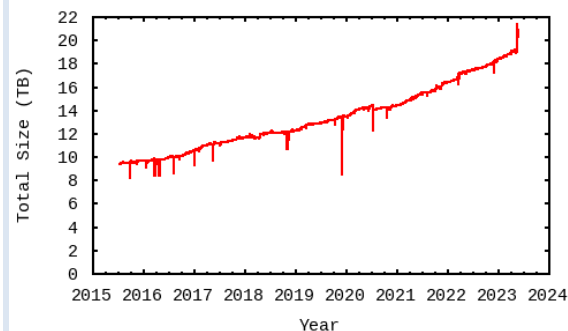
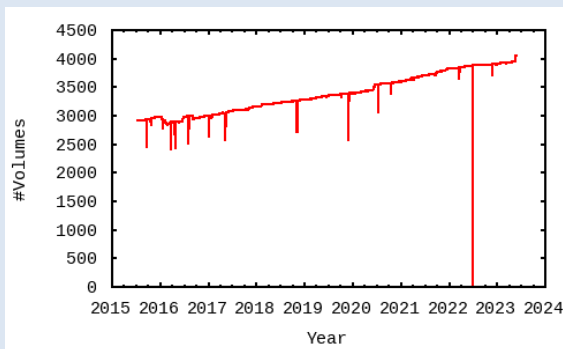
enea.it AFS cell: history and status

Since 1998 the cell architecture has been based on many dbservers: 3 db servers in the main site at that time, Frascati, and 4 in the other sites (clone dbservers) and one or more file servers in all sites.

- 1998 AFS Transarc, mostly AIX in a multiplatform scenario (AIX, IRIX, Linux,...)
- 2006 Migration to OpenAFS and linux, with CASPUR and Andrei Maslenikov support
- 2007 switched to Kerberos 5, ENEA.IT domain creation, DB servers also Kerberos KDC.
- 2011 Kerberos 4 support completely removed
- 2014 DES encryption removed from afs/enea.it service key
- 2015 AFS native backup centralized in Portici site
- 2017-2018 fully kerberized LSF setup
- 2022 Virtualized DB servers(#6) & KDCs(#7), CentOS 7.9. Kerberos V5 MIT 1.15.1, OpenAFS 1.6.24.1

2023 - enea.it ~4000 volumes ~21.2 TB

- 10 file servers, SuperMicro disk servers, RAID6
- OpenAFS 1.6.24.1
- #8 CentOS 7.9
- #2 CentOS 6.5 (BOL TRI Sites)

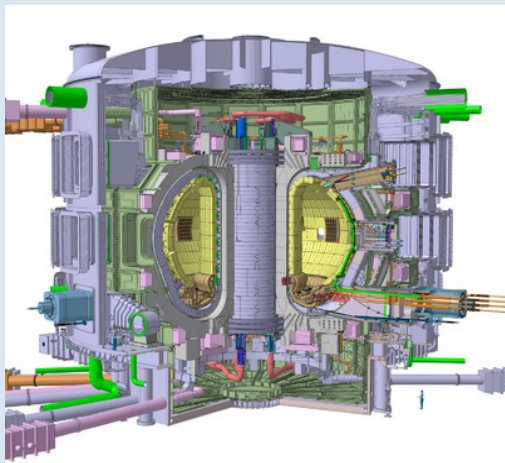


HPC for Nuclear Fusion: ENEA-CINECA-EUROFUSION

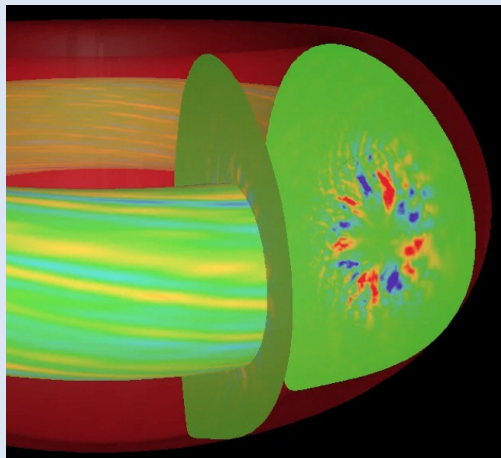
Since 2009 ENEA has provided HPC and storage resources exclusively dedicated to European R&D for Nuclear Fusion Energy

- 2009 ENEA Gateway HPC cluster in CRESCO POR (1 TFlops) OpenAFS cell: *efda-itm.eu* (Andrei Maslennikov support)
- 2016 – now: ENEA/CINECA : HPC for EUROfusion (10 PFlops peak) + new Gateway OpenAFS cell: *eufus.eu* (last job of Andrei)
- 2024 – 2029: ENEA/CINECA : HPC for EUROfusion (50 PFlops HP-Linpack) + Gateway OpenAFS cell: *eufus.eu*

ITER



Plasma Modelling



CINECA Supercomputer “MARCONI”



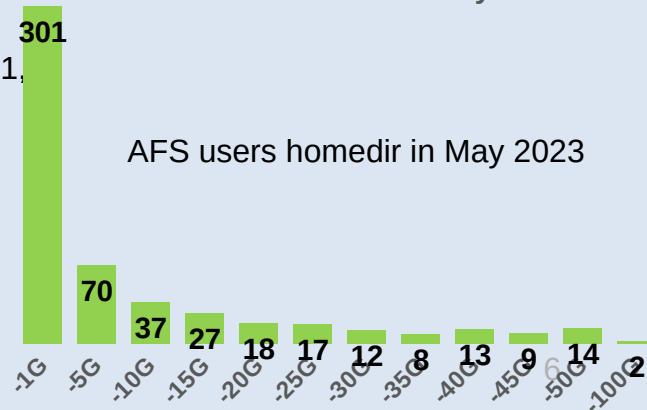
eufus.eu AFS cell: history and status

Since 2017 the Gateway cluster is in CINECA Data Center premise (Bologna Italy)

- 2017 ENEA/CINECA Gateway as partition of CINECA MARCONI Supercomputer
 - 3 dbservers of OpenAFS cell: *eufus.eu*
 - Kerbero5 and OpenLDAP as Authentication/Authorization Infrastructure (Single-Sign-On)
 - 20 Linux/OpenAFS clients as compute/login nodes
 - AFS native backup in CINECA site
- 2019 ENEA/CINECA Gateway as independent cluster from MARCONI Supercomputer.
 - OpenAFS cell architecture: *eufus.eu* unchanged
- 2020 ENEA/CINECA Gateway extension to 100 compute/login nodes
 - Virtualized DB servers(#3) & KDCs(#3), CentOS 7.4. Kerberos V5 MIT 1.15.1, OpenAFS 1.6.23.0
- 2023 Gateway HPC cluster eufus.eu ~1300 volumes ~10 TB
 - 2 file servers, SuperMicro disk servers (RAID 6)
 - ~500 users
 - AFS/SLURM integration not available yet



AFS USERS USAGE May. 2023



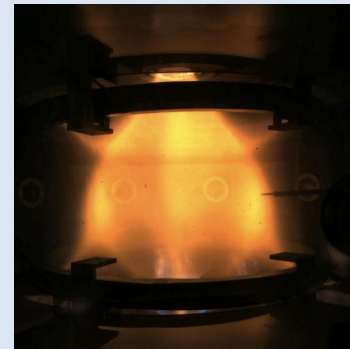
fusione.it AFS cell: history and status

Since 1998 the AFS cell fusione.it has been the main data repository for ENEA Fusion experiments based in Frascati. The high field **Tokamak FTU** (1989-2019) and since 2015 **ProtoSphera**, a Spherical Torus confining plasma not around a metal centerpost (as in Tokamaks), but around a plasma centerpost.

- 1998 AFS Transarc, mostly Alpha/CompaqTru64 client and servers (3 DB servers), migrated to Scientific Linux and OpenAFS in May 2002
 - ✓ **FTU Tokamak** experimental and elaborated data archive, 1989-2019;
 - ✓ Today is the data repository of **Protosphera** experiment;
- 2020 OpenAFS File Server Upgrade
 - ✓ a couple of new SuperMicro disk servers (~320 TB / RAID 6) and a new *backup* server was installed;
 - ✓ volumes migrated from the old Fibre Channel Storage infrastructure to the new file servers
- 2021 Three new HPE login/compute nodes, Virtualized OpenAFS DBs and Kerberos KDC
- 2023 Status fusione.it: ~3250 volumes ~17 TB
 - ✓ OpenAFS 1.6.24.1 and CentOS 7.9



FTU tokamak



ProtoSphera experiment

OpenAFS for ENEA: motivation, developments and open issues

Motivation

- Very good **reliability**!
- After many years there is **no easy replacement for OpenAFS**, but it must be complemented by a parallel file system, as GPFS (next LUSTRE), for HPC applications.
- Still a reliable data sharing tool for individual workstations, even if other tools are now available.
- RO replica and AFS ACL for collaboration and projects widely used in enea.it & fusione.it (less used in EUROFUSION)
- Simple High Availability solution for Web pages by duplicated Web servers in different sites (<https://www.afs.enea.it>)

Cell developments

- Migration to Rocky 8.x/OpenAFS 1.8.x => **new ENEA CRESCO8 in 2024 ~10PF**; a **new gateway for EUROFUSION**
- Decentralization of AFS backup for enea.it cell due to performance issues

Open Issues

- Performance problems over WAN ~10 MB/s instead than 100+ MB/s with local file servers
- A minor issue: at this moment no support for Rocky 9.x with the vanilla OpenAFS 1.8.9 from openafs.org site
- SLURM integration with Kerberos: to be addressed in ENEA for future systems, already relevant for EUROFUSION