EESSI

EUROPEAN ENVIRONMENT FOR SCIENTIFIC SOFTWARE INSTALLATIONS

ISC'26 tutorial - 22 June 2026

https://eessi.io

https://eessi.io/isc26-tutorial

Agenda

[14:00-14:05] Practical information for this tutorial

[14:05-14:30] Introduction to EESSI

[14:30-15:00] **Using EESSI (hands-on)**

[15:00-15:15] Installing software on top of EESSI

[15:15-15:45] **Installing software on top of EESSI (hands-on)**

[15:45-16:00] Using EESSI in Continuous Integration (CI) environments

[16:00-16:30] *(coffee break)*

[16:30-17:15] **Using EESSI for CI in GitHub Actions CI (hands-on)**

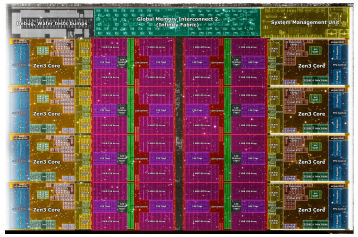
[17:15-17:45] Advanced topics (incl. MPI, GPU, using Spack on top of EESSI)

[17:45-18:00] Q&A + closing remarks

Practical information

- Tutorial website: https://eessi.io/isc26-tutorial
  - **Use this during the hands-on sessions!**
  - Includes code snippets or shell commands that you can copy-paste
- Prepared environment
  - Get access to a **temporary virtual machine to use during hands-on**
  - See instructions at https://eessi.io/isc26-tutorial/prepared-environment
  - Alternatively: use a system where EESSI is already available, see https://eessi.io/docs/systems

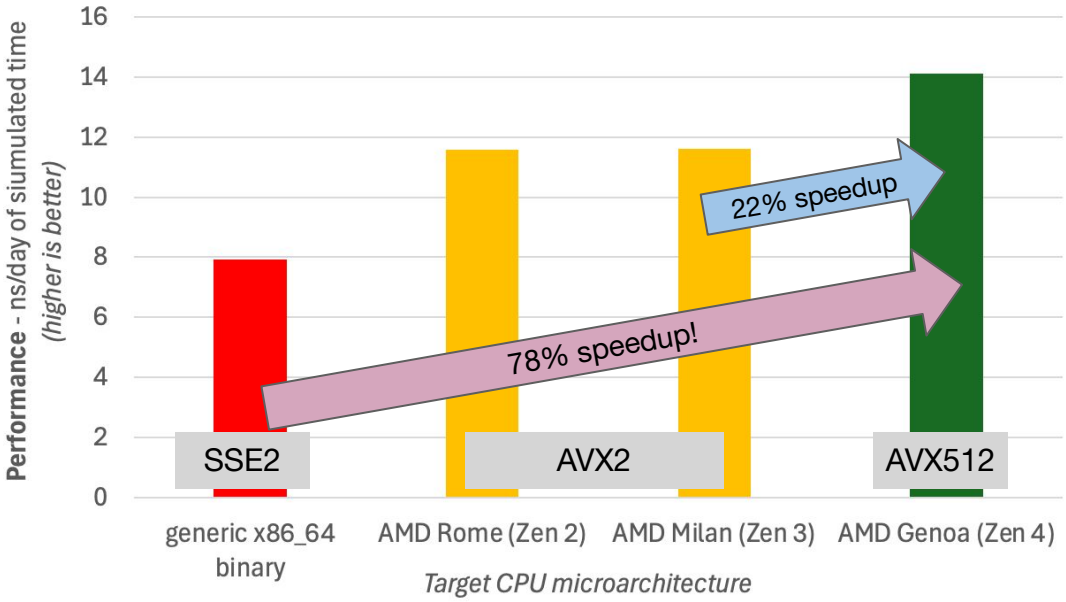
Software performance through vector instructions



- Modern microprocessors support **vector instructions**,
  a.k.a. SIMD (Single Instruction Multiple Data)
- Examples: AVX2, AVX-512, AVX10 (AMD, Intel), or SVE (Arm), …
- Parts of the microprocessor are dedicated to running these vector instructions
- If you run binaries that are not using these instructions,
  you're not using a significant part of what the CPU supports!
- … and **performance suffers** (potentially a lot)
- Downside: binaries that use vector instructions are less "portable"…
  `Illegal instruction` errors will occur if an unsupported (vector) instruction is run

Keeping the P in HPC

- Software should be optimized for (the CPU/GPU of) the system it will be run on
- This implies building software from source code, using specific compiler options, …
- Impact on software performance is often significant for scientific software!



- Barplot shows performance of different GROMACS binaries, **same source code & workload, same hardware & OS**
- GROMACS version 2025.2, Test Case B from PRACE UEABS v2.2
- 1 node, dual-socket, 2x 96-core AMD Zen4
- Hybrid run on 192 cores in total, 48 MPI ranks with 4 OpenMP threads each

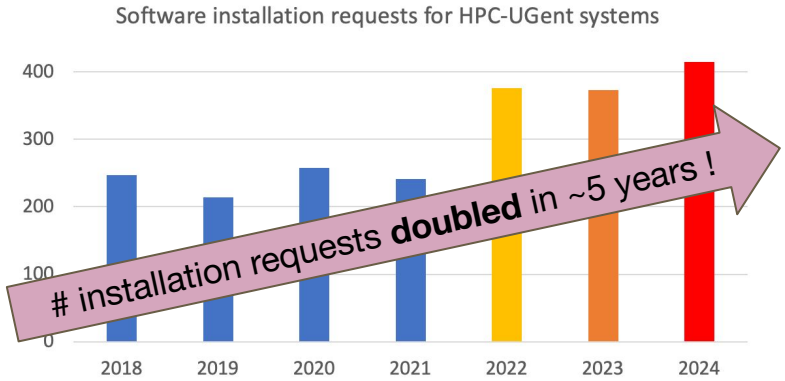
EasyBuild in a nutshell

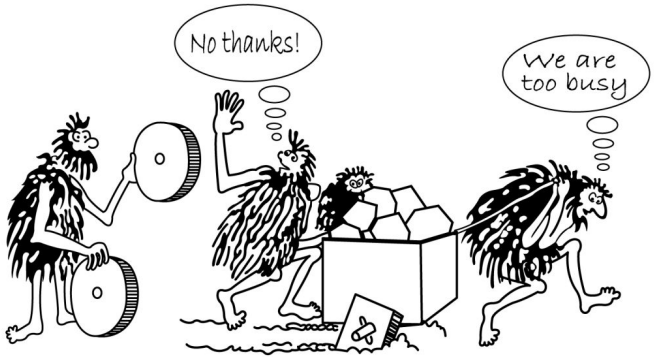
https://easybuild.io

- Tool to install (scientific) software on HPC systems, usually from source code
- Created by HPC team at Ghent University (Belgium) in summer 2009
- Open source software (GPLv2) since Nov 2012 (during SC'12)
- Easy installation (`pip install easybuild`), extensive documentation (docs.easybuild.io)
- Used to manage central software stack on VSC systems + LUMI, JUPITER, Deucalion, …
- Worldwide community grew around it, used all over Europe, Canada, US, Australia, …

The landscape of scientific computing has changed

- **Explosion of available scientific software applications** (bioinformatics, AI boom, …)
- Increasing interest in **cloud** for scientific computing (flexibility!)
- Increasing **variety in processor (micro)architectures** beyond Intel & AMD:
  Arm is ~~coming~~ here (see Fugaku, JUPITER, …), RISC-V is coming (soon?)
- In stark contrast: available (wo)manpower in HPC support teams is (still) limited
- **Software installation tools like EasyBuild and Spack are no longer sufficient…**





What if you no longer have to install

*a **broad range of scientific software***

from scratch on every laptop, HPC cluster,

or cloud instance you use or maintain,

without compromising on performance?

European Environment for Scientific Software Installations

- **Shared set of ready-to-use (optimized!) scientific software installations**
- Goal: **avoid duplicate work** across by collaborating on a shared software stack
- Uniform way of providing software to users, regardless of the system they use
- **Should work on any Linux OS and system architecture**
  - From laptops and personal workstations to HPC clusters and cloud
  - Support for different CPUs, interconnects, GPUs, etc.
- Focus on **performance**, **automation**, **testing**, **collaboration**
- Development effort funded through **MultiXscale EuroHPC Centre-of-Excellence**

EESSI
EUROPEAN ENVIRONMENT FOR SCIENTIFIC SOFTWARE INSTALLATIONS

https://eessi.io

inspired by the ComputeCanada software stack

Major goals of EESSI

- Providing a truly **uniform software stack**
  - Have access to the (exact) same software environment everywhere
  - Across HPC, cloud, laptop, Continuous Integration environments, …
  - **Without sacrificing performance** for “mobility of compute”
    (as is typically done with containers/conda)
- **Avoid duplicate work** for researchers, HPC support teams, sysadmins, …
  - Tools that automate software installation process
    (EasyBuild, Spack) are not sufficient anymore
  - Go beyond sharing build recipes => work towards a shared software stack
- **Facilitate** HPC training, development of (scientific) software, …

EESSI as shared software stack for HPC, and beyond

GROMACS
TensorFlow
python
OpenFOAM®
R
Bioconductor
OPEN SOURCE SOFTWARE FOR BIOINFORMATICS
QUANTUMESPRESSO
PyTorch
WRF
OpenCV
PETSc

Raspberry Pi

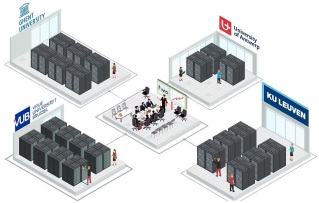
Laptops, PCs

CI

GitHub
GitLab

EESSI

Regional/national systems



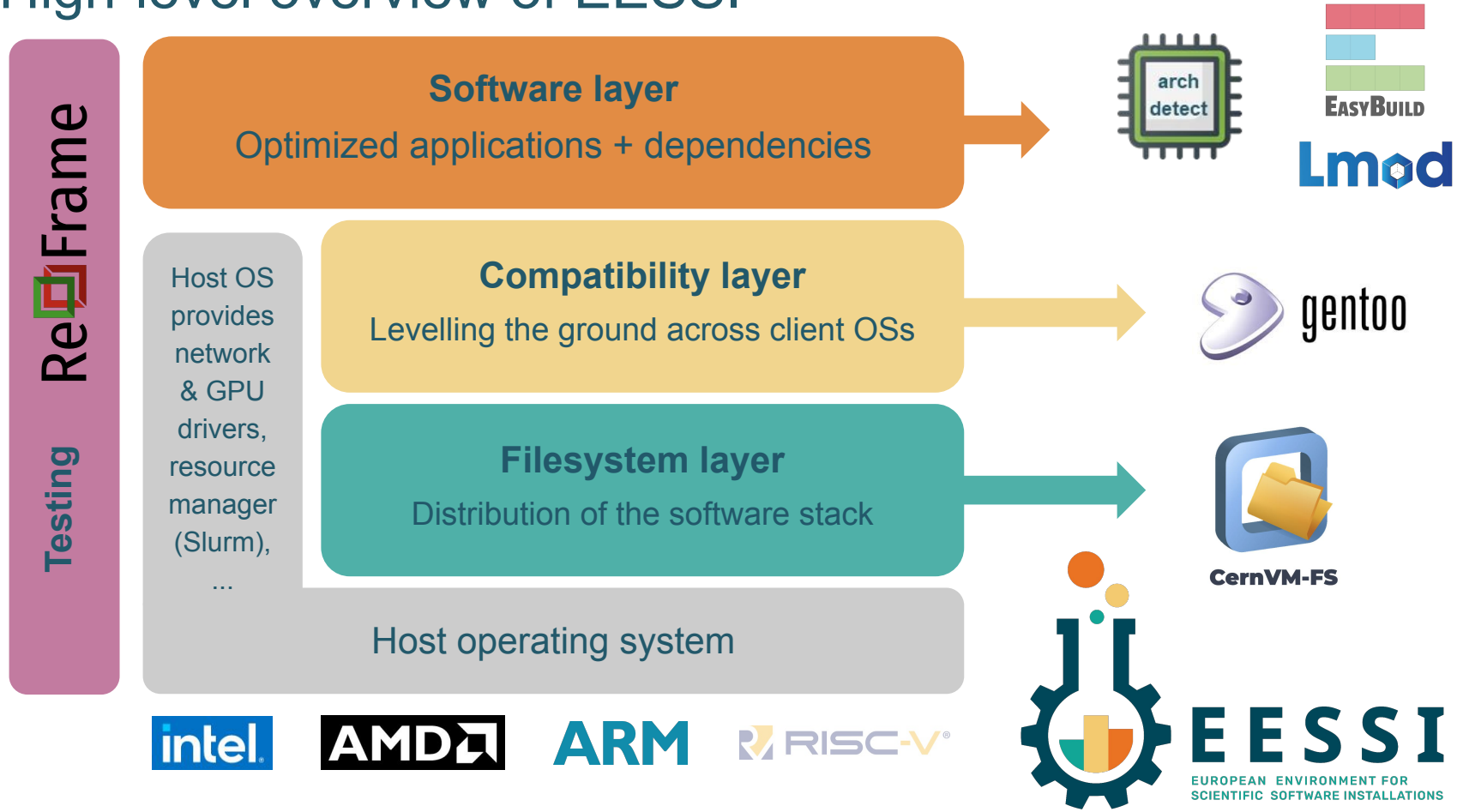
VLAAMS SUPERCOMPUTER CENTRUM

Cloud

aws
eosc

https://eessi.io

High-level overview of EESSI



EESSI is powered by open source software

gentoo linux™

Compatibility layer

Abstraction from the host operating system

CernVM-FS

Filesystem Layer

Global distribution of software installations (on-demand streaming)

ReFrame

Regression testing of software

EESSI

EUROPEAN ENVIRONMENT FOR SCIENTIFIC SOFTWARE INSTALLATIONS

EasyBuild.io
building software with ease

Optimized software installations for specific CPU microarchitectures

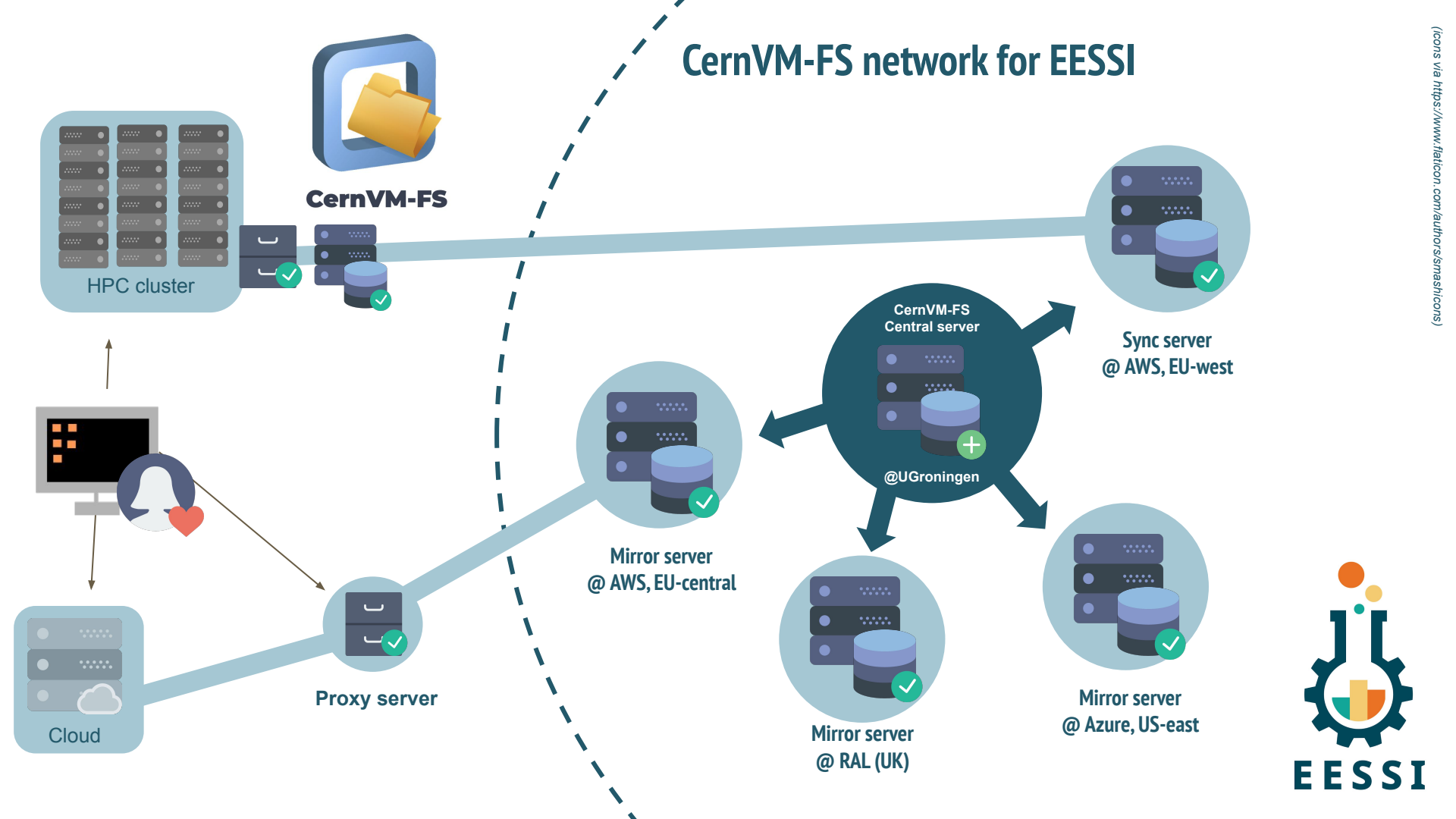
Intuitive user interface:

```
module avail,
module load, ...
```

Automatic selection of best suited part of software stack for CPU microarchitectures

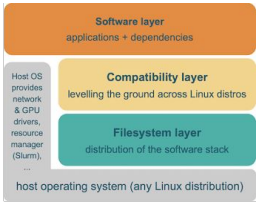
Magic Castle to create (ephemeral) clusters in the cloud

CernVM-FS network for EESSI



(icons via https://www.flaticon.com/authors/smashicons)

How does EESSI work?



- Software installations included in EESSI are:
  - Automatically **“streamed in” on demand** (via CernVM-FS)
  - Built to be **independent of the host operating system**

    “Containers without the containing”
  - **Optimized** for specific CPU + GPU generations
  - **Ready-to-use**: no explicit installation or updating required
- Initialization script **auto-detects CPU + GPU** of the host system

The EESSI User Experience

```
source /cvmfs/software.eessi.io/versions/2025.06/init/lmod/bash
module load GROMACS/2025.4-foss-2025b
gmx ...
```

EESSI provides **on-demand streaming**

of (scientific) software (like music, TV-series, …)

Overview of available software

An up-to-date overview of available software is available in the EESSI documentation: https://eessi.io/docs/available_software

Software available in EESSI

Overview of software available in EESSI's production repository `software.eessi.io`.

752 unique software projects (+ 3007 unique extensions)

name:GROMACS

GROMACS *(more details)*

https://www.gromacs.org

GROMACS is a versatile package to perform molecular dynamics, i.e. simulate the Newtonian equations of motion for systems with hundreds to millions of particles. This is a CPU only build, containing both MPI and threadMPI binaries for both single and double precision. It also contains the gmxapi extension for the single precision MPI build.

Available in EESSI versions: 2023.06 2025.06

Supported CPU families: AMD Intel Arm

Supported GPU families: NVIDIA

GROMACS

GROMACS is a versatile package to perform molecular dynamics, i.e. simulate the Newtonian equations of motion for systems with hundreds to millions of particles.

This is a GPU enabled build, containing both MPI and threadMPI binaries.

It also contains the gmxapi extension for the single precision MPI build.

homepage: https://www.gromacs.org

Available installations

GROMACS version	Supported CPU targets	Supported GPU targets	EESSI version	Module
2025.4	generic: aarch64, x86_64 Arm: a64fx, neoverse_n1, neoverse_v1, nvidia/grace AMD: zen2, zen3, zen4 Intel: haswell, skylake_avx512, sapphirerapids, icelake, cascadelake	*(none)*	2025.06	GROMACS/2025.4-foss-2025b
2025.2	generic: aarch64, x86_64 Arm: a64fx, neoverse_n1, neoverse_v1, nvidia/grace AMD: zen2, zen3, zen4 Intel: haswell, skylake_avx512, sapphirerapids, icelake, cascadelake	*(none)*	2025.06	GROMACS/2025.2-foss-2025a
2024.4	generic: aarch64, x86_64 Arm: neoverse_n1,	NVIDIA: cc70, cc80, cc90	2023.06	GROMACS/2024.4-foss-2023b-

Overview of available software

- EESSI provides **more than 2,000 software installations per supported CPU target**

  via `software.eessi.io` CernVM-FS repository, increasing every week

- **15 supported CPU targets** (x86_64 + Arm), support for RISC-V actively being explored

- **~750 different software packages** + another **~3,000 extensions**

  (Python packages, R libraries, …)

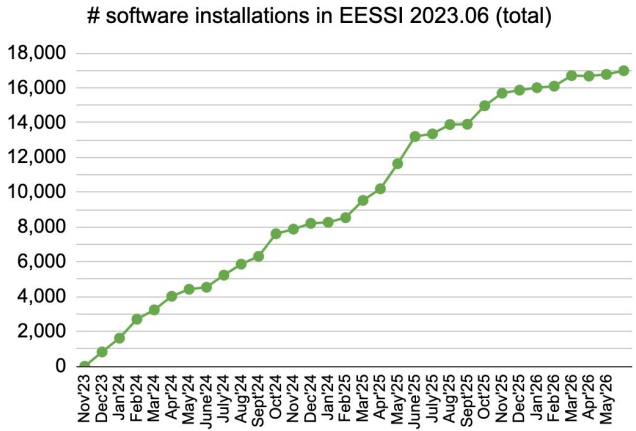
- ~30,000 software installations in total, see https://eessi.io/docs/available_software

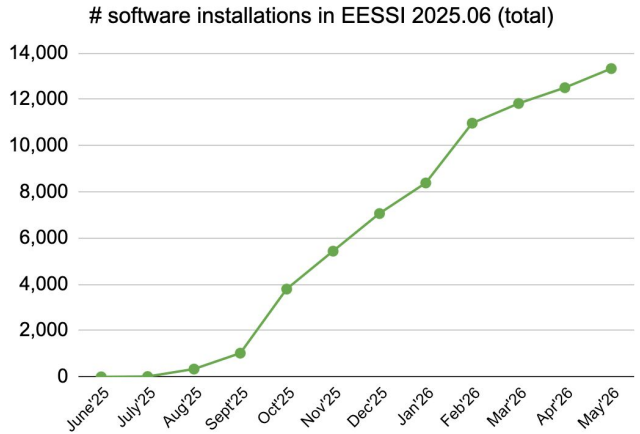
- Including GROMACS, LAMMPS, OpenFOAM, PyTorch, R, QuantumESPRESSO, WRF, …

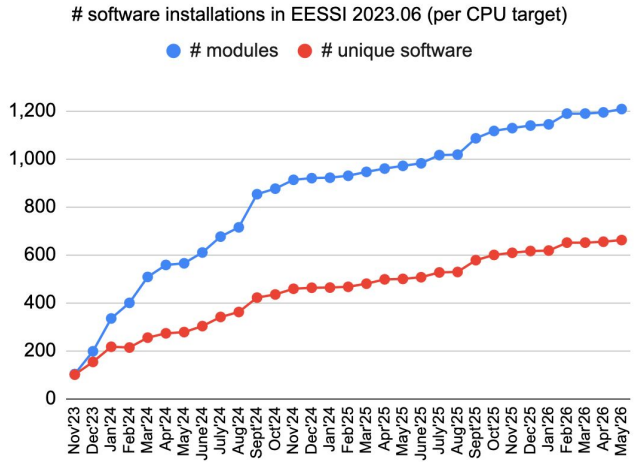
- EESSI 2023.06 provides software built with `foss/2023a` and `foss/2023b` toolchains

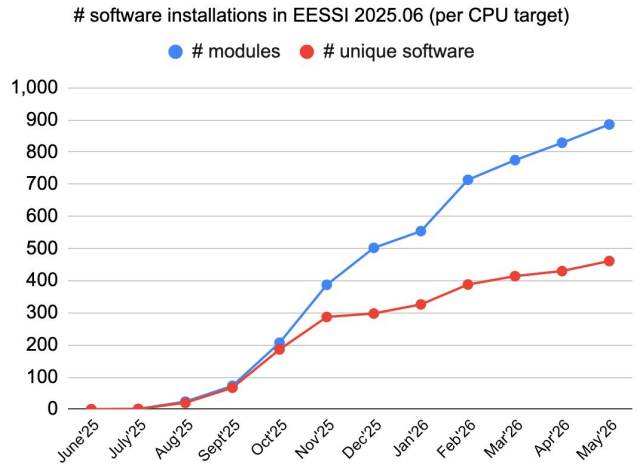
- EESSI 2025.06 provides software built with `foss/2024a`, `foss/2025a`, `foss/2025b` toolchains

Set of available software is growing steadily…









Supported CPU targets

eessi.io/docs/software_layer/cpu_targets

- AMD, Intel CPUs (`x86_64` CPU family)
  - 5 generations of Intel CPUs: Haswell, Skylake, Cascade Lake, Ice Lake, Sapphire Rapids
  - 4 generations of AMD CPUs: Zen2 (Rome), Zen 3 (Milan), Zen4 (Genoa), Zen5 (Turin)
- Arm CPUs (`aarch64` CPU family)
  - 4 different microarchitectures: Fujitsu A64FX, NVIDIA Grace, Neoverse N1 + V1
- Plus a generic fallback for both x86_64 and aarch64
- Host CPU is automatically detected, automatic fallback to best suited CPU target
- Support for RISC-V CPU family is a work-in-progress,
  see https://eessi.io/docs/repositories/dev.eessi.io-riscv

Supported GPU targets

eessi.io/docs/software_layer/gpu_targets

- NVIDIA (CUDA)
  - Different generations of NVIDIA GPUs, based on CUDA Compute Capability (CC), see also https://developer.nvidia.com/cuda/gpus
  - In EESSI 2023.06: CC 7.0 (V100, T4), 8.0 (A100 & co, incl. L40), 9.0 (H100/H200)
  - In EESSI 2025.06: CC 7.0, 8.0, 9.0, 10.0 (B100/B200/B300), 12.0 (B10, RTX PRO Blackwell)
  - GPU driver libraries (include `libcuda.so`) must be exposed to EESSI
  - See https://eessi.io/docs/site_specific_config/gpu
- AMD (ROCm)
  - Work-in-progress, initial installations for ROCm 6.4.1 have been deployed in EESSI 2025.06
  - Support for 8 different “generations” of AMD GPUs: `gfx90a` (MI250X, LUMI), …
- See also NVIDIA + AMD GPU support in EESSI talk @ EasyBuild User Meeting (slides, recording)

On which systems is EESSI available today?

- On various systems throughout Europe (and beyond):
  - **EuroHPC JU supercomputers** incl. Vega, Karolina, MareNostrum 5, Deucalion, Discoverer, MeluXina, LUMI, Leonardo, JUPITER (soon), …
    See also https://docs.my-eurohpc.eu/software-catalog/system-specific/about
  - **National HPC systems:** VSC Tier-2 & Tier-1 (Belgium), Snellius @ SURF (NL), EMBL + Univ. of Stuttgart (Germany), Sigma2 & Olivia in Norway, etc.
  - Overview of (known) systems that have EESSI available at https://eessi.io/docs/systems
- EESSI can be used in virtual machine in European Open Science Cloud (EOSC), see also https://eessi.io/docs/blog/2025/10/22/eosc

Getting access to EESSI: via CernVM-FS

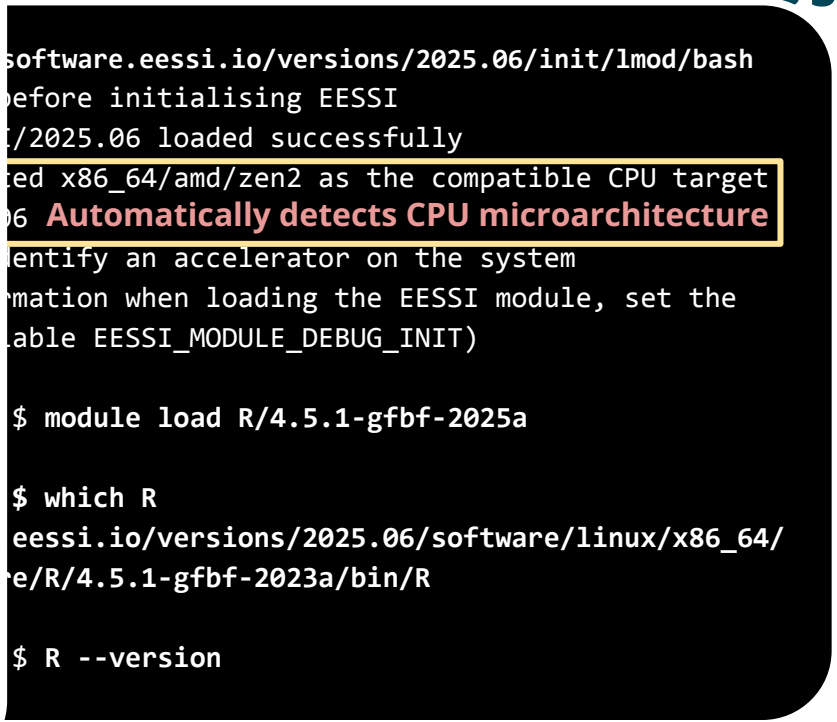
```
# Native installation via CernVM-Fs | see also https://eessi.io/docs/getting_access/native_installation
# Installation commands for RHEL-based distros like CentOS, Rocky Linux, Almalinux, Fedora, …

# Install CernVM-FS
sudo yum install -y
https://ecsft.cern.ch/dist/cvmfs/cvmfs-release/cvmfs-release-latest.noarch.rpm
sudo yum install -y cvmfs

# Create client configuration file for CernVM-FS
# (no proxy, 10GB local CernVM-FS client cache)
sudo bash -c "echo 'CVMFS_CLIENT_PROFILE="single"' > /etc/cvmfs/default.local"
sudo bash -c "echo 'CVMFS_QUOTA_LIMIT=10000' >> /etc/cvmfs/default.local"

# Make sure that EESSI CernVM-FS repository is accessible
sudo cvmfs_config setup
```

see also https://eessi.io/isc26-tutorial/getting-access

Getting access to EESSI: alternative mechanisms

- Via Singularity/Apptainer, using a container image that includes CernVM-FS
  - Using wrapper script: https://eessi.io/docs/getting_access/eessi_container
  - See also https://eessi.io/isc26-tutorial/eessi-getting-access/#eessi-via-a-container
- Via `cvmfsexec` (https://github.com/cvmfs/cvmfsexec)
  - Without admin privileges, requires support in Linux kernel of host system (user namespaces, …)
  - See https://eessi.io/isc26-tutorial/eessi-getting-access/#eessi-via-cvmfsexec
- By exporting the contents of EESSI to a SquashFS image, and mounting it in the right location

Live demo: Basic usage of EESSI



Script for running GROMACS with EESSI

eessi-demo.sh

```
#!/bin/bash

source /cvmfs/software.eessi.io/versions/2025.06/init/lmod/bash
module load GROMACS/2025.4-foss-2025b

# download input file + unpack (only if it's missing)
if [ ! -f ion_channel.tpr ]; then
  curl -OL https://repository.prace-ri.eu/ueabs/GROMACS/1.2/GROMACS_TestCaseA.tar.gz
  tar xfz GROMACS_TestCaseA.tar.gz
fi

# cleanup, to force new run
rm -f ener.edr logfile.log

# run GROMACS (downscaled to 1k steps instead of full run with 10k steps)
gmx mdrun -s ion_channel.tpr -maxh 0.50 -nsteps 1000 -g logfile
```

Running GROMACS with EESSI

```
macbook-pro $ lima shell eessi

lima $ ls /cvmfs/software.eessi.io
host_injections  init
README.eessi  versions

lima $ ./eessi-demo.sh
...
                    (ns/day)     (hour/ns)
Performance:           2.215        10.834
```

EESSI

```
$ ssh slurm-cluster-aws

aws $ P=aarch64-neoverse-v1-node
aws $ sbatch -p $P -c 8 eessi-demo.sh
113508
aws $ cat slurm-113508.out
...
                    (ns/day)     (hour/ns)
Performance:           7.758        3.094
```

```
$ ssh tier1.hpc.ugent.be

vsc $ qsub -l nodes=1:ppn=16 eessi-demo.sh
13001403
vsc $ cat eessi-demo.sh.*13001403
...
                    (ns/day)     (hour/ns)
Performance:          20.802        1.154
```

```
$ ssh login.deucalion.macc.fccn.pt

deucalion $ sbatch -p normal-arm eessi-demo.sh
Submitted batch job 7654321

deucalion $ cat slurm-7654321.out
...
                    (ns/day)     (hour/ns)
Performance:           8.960        2.678
```

Hands-on: Using EESSI

- Make yourself familiar with using EESSI:
  1. Get access to EESSI, or use a system where it readily is available, see https://eessi.io/isc26-tutorial/getting-access
  2. Set up your shell environment by initializing EESSI, see https://eessi.io/isc26-tutorial/usage
  3. Run one (or more) of the EESSI demos, see https://github.com/EESSI/eessi-demo

- **We will continue with the next topic (Installing software on top of EESSI) at 15:00**

- **Do not hesitate to ask for help!** *(raise your hand)*

Installing software on top of EESSI

- You can use the software available in EESSI to

  resolve dependencies of the software you need

- To “manually” install software on top of EESSI (by running gcc, make, etc.),

  first load the `buildenv` module

- To install software **with EasyBuild** on top of EESSI,

  first load the `EESSI-extend` module to correctly configure EasyBuild

- See also https://eessi.io/docs/using_eessi/building_on_eessi

- Using Spack to install software on top of EESSI is also possible (more on this later)

Hands-on: Installing software on top of EESSI

- Live demo of:
  - Manual software installation of top of EESSI, with the help of `buildenv`
  - Installing software on top of EESSI with EasyBuild, facilitated by `EESSI-extend`
- For step-by-step instructions to try this yourself,
  see https://eessi.io/isc26-tutorial/installing-on-top
- **We will continue with the next topic (Using EESSI in CI) at 15:45**
- **Do not hesitate to ask for help!** *(raise your hand)*

Using EESSI for Continuous Integration (CI)

- EESSI can be used in CI environments like:
  - GitHub: github.com/marketplace/actions/eessi
  - GitLab: gitlab.com/explore/catalog/eessi/gitlab-eessi
- EESSI can provide:
  - Different compilers to test your software with
  - Required dependencies for your software
  - Additional tools like ReFrame, performance analysis tools, …
- Other than CernVM-FS to get access to EESSI, no software installations required!
  - Everything that is actually needed is pulled in on-demand by CernVM-FS
- Significantly facilitates also running CI tests in other contexts (laptop, HPC, …)

Using the EESSI GitHub Action

We have an EESSI GitHub Action that provides EESSI+`direnv`:

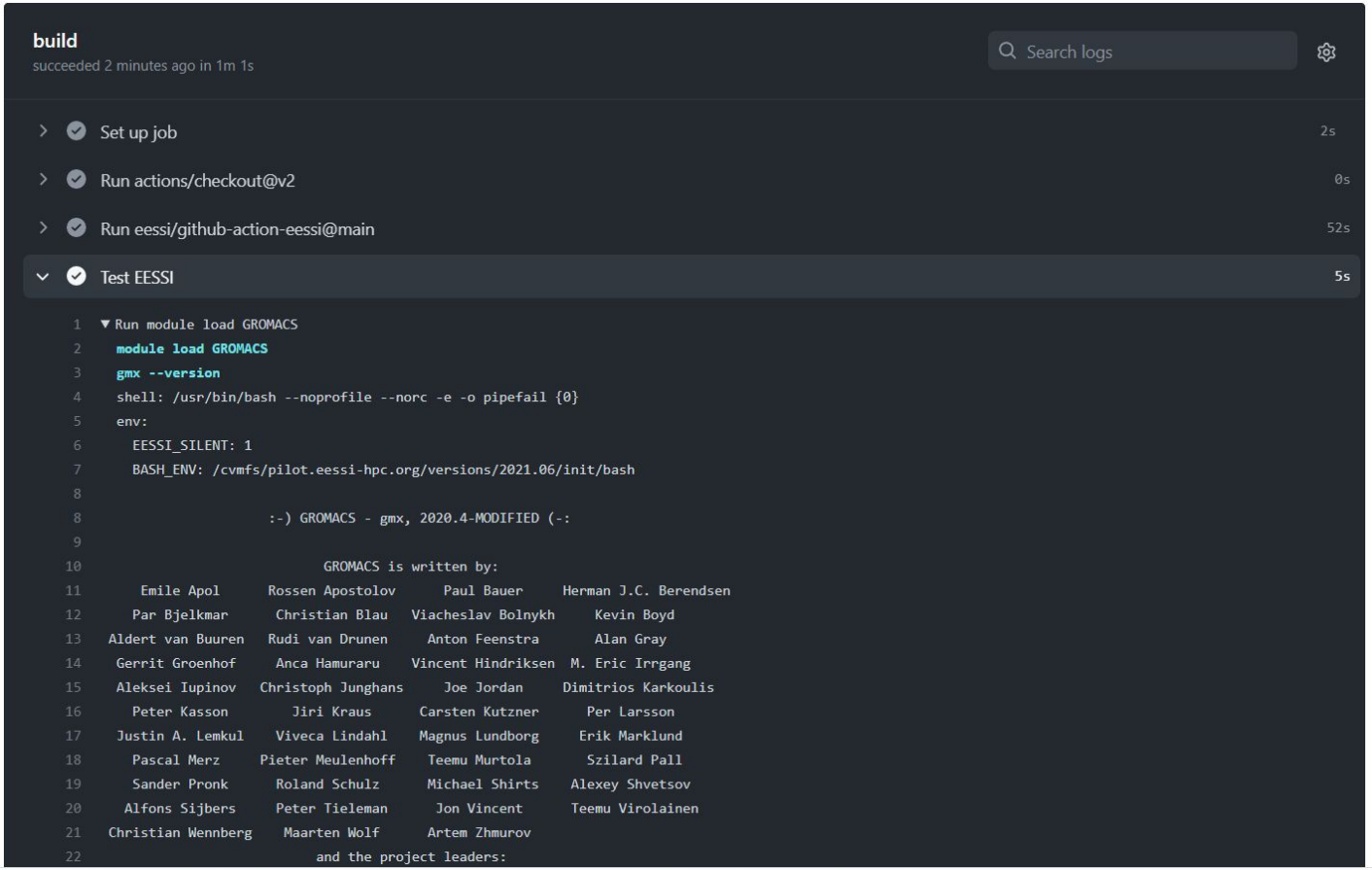
See it in action in the `github-eessi-action` repository:

github.com/EESSI/github-action-eessi

github.com/EESSI/github-action-eessi/blob/main/.github/workflows/tensorflow-usage.yml

```yaml
name: ubuntu_tensorflow
on: [push, pull_request]
jobs:
 build:
   runs-on: ubuntu-latest
   steps:
   - uses: actions/checkout@v3
   - uses: eessi/github-action-eessi@v3
     with:
       eessi_stack_version: '2023.06'
   - name: Test EESSI
     shell: bash
     run: |
       module load TensorFlow
       python -c 'import tensorflow; print(tensorflow.__version__)'
```

Using the EESSI GitHub Action



Coffee break

- Time to take a break…

- **We will resume at 16:30 with hands-on for using EESSI in CI**

- **Do not hesitate to ask us questions during the break!**

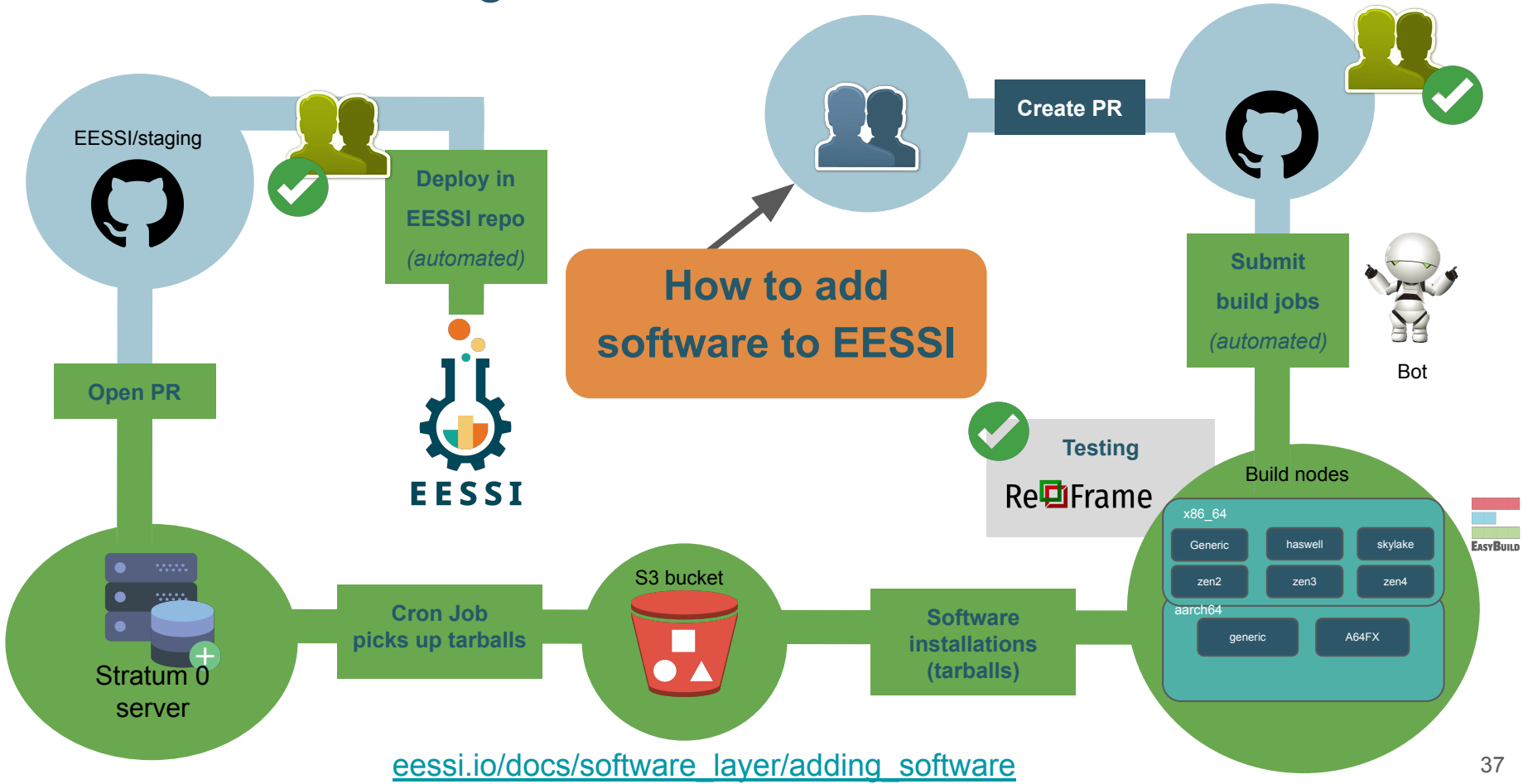
Hands-on: EESSI in CI

- **Try creating a GitHub Actions workflow that uses EESSI…**
- For step-by-step instructions, see https://eessi.io/isc26-tutorial/ci
- **We will continue at 17:15 with the next topic (Advanced topics: MPI, GPU, Spack)**
- **Do not hesitate to ask for help!** *(raise your hand)*

Advanced topics

- Adding software to EESSI
- Software testing in EESSI
- Running GPU-accelerated software through EESSI
- Building CUDA software on top of EESSI
- Using a tuned MPI library for improved performance
- Using Spack to install software on top of EESSI
- EESSI in the EuroHPC Federation Platform

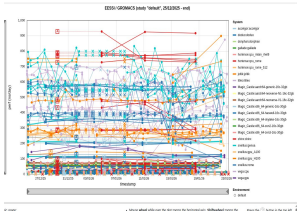
Workflow for adding software to EESSI



eessi.io/docs/software_layer/adding_software

Software testing in EESSI

- Smoke tests: sanity check commands are run by EasyBuild
  to check that installed software is not horribly broken while using EasyBuild
- Regression testing via EESSI test suite: https://eessi.io/docs/test-suite
  - Collection of **portable tests** for software available in EESSI
  - Running on selected (single node) tests when building new software (before deployment)
  - Periodically (daily/weekly) on about multiple different systems
  - Can also be used for other software stacks (that are built with EasyBuild)
  - Periodic runs of EESSI test suite are done to help to catch performance regressions
- Public dashboard with test results: https://dashboard.eessi.io



Running GPU-accelerated software through EESSI

- To *run* software on NVIDIA GPUs, you need:
  - **CUDA runtime libraries** (shipped through EESSI)
  - **GPU drivers** (not included in EESSI)
- **Host GPU driver libraries must be exposed to EESSI** in order to *run* GPU software
- `link_nvidia_host_libraries.sh` script creates symbolic links in a known path: `/cvmfs/software.eessi.io/host_injections/nvidia/<arch>/host/...`
- Must be run by an admin, write access to target of `host_injections` symlink is needed
- See https://eessi.io/docs/site_specific_config/gpu/#nvidia_drivers

Building CUDA software on top of EESSI

- To *build* CUDA software, you need a CUDA compiler
  - `nvcc` & co, part of full CUDA SDK
  - This **can not be provided by EESSI** (as specified in CUDA EULA)
- To build CUDA software on of EESSI, a **local installation of full CUDA SDK is needed**
  - `install_cuda_and_libraries.sh` script installs full CUDA SDK (with EasyBuild) under `/cvmfs/software.eessi.io/host_injections/nvidia/...`
  - This unbreaks symlinks in (partial) CUDA installations that are included in EESSI
  - Must be done by admin, write access to target of `host_injections` symlink is needed
- See https://eessi.io/docs/site_specific_config/gpu/#cuda_sdk

Using a tuned MPI library for improved performance

- EESSI (currently) only includes OpenMPI as MPI library
  - Also including MPICH-based MPI libraries are planned
- EESSI provides “fat” installations of OpenMPI: depends on UCX + libfabric
  - Supports different types of interconnect: Infiniband, Slingshot, Omni-Path, …
  - Can be “tuned” through environment variables (OpenMPI, UCX, libfabric)
- **On some systems, using a custom configured MPI library may be desirable/required**
  - A custom MPI library can be injected into EESSI, but must be ABI-compatible!
- Broader adoption of common ABI (see MPI 5.0 standard) will make things easier
- See performance results for this approach on Cray Slingshot-11: https://eessi.io/docs/blog/2026/05/11/EESSI-on-Cray-Slingshot-part2

Using Spack top of EESSI

- Spack can be made aware of software installations provided by EESSI,

  via a `packages.yaml` file that specifies them as “external packages”;

  see also https://spack.readthedocs.io/en/latest/packages_yaml.html#external-packages

- As a result, Spack can resolve dependencies via EESSI, rather than installing them (again)

- A proof-of-concept was implemented using QuantumESPRESSO,

  see https://eessi.io/docs/blog/2026/02/05/Spack-on-top-of-EESSI-best-of-both-worlds

- Scripts and detailed setup instructions available via https://github.com/lorisercole/spood

Using Spack top of EESSI

Hands-on demo - Part 1: Set up Spack
(note: patched version is currently required!)

See also https://github.com/lorisercole/spood#installation--use

```
git clone https://github.com/lorisercole/spack
cd spack
git checkout eessi
cd -
source spack/share/spack/setup-env.sh
spack --version
```

Using Spack top of EESSI

Hands-on demo - Part 2: Initialize EESSI (2023.06), get spood, run demo

```
git clone https://github.com/EESSI/spood
cd spood
source /cvmfs/software.eessi.io/versions/2023.06/init/lmod/bash
./quick_start.sh
```

Note: Here be dragons, see also https://github.com/EESSI/spood/issues/2

Key part is packages.yaml, which tells Spack about software installed in EESSI:

https://github.com/EESSI/spood/blob/develop/examples/ext_install/packages.yaml

Using Spack on top of EESSI


```
==> Installing quantum-espresso-7.5-zxky252cemgoipfhhqoolnlow2s7qfrd [17/17]
    [100%]   72.48 MB @   21.0 MB/s
==> No patches needed for quantum-espresso
==> quantum-espresso: Executing phase: 'cmake'
==> quantum-espresso: Executing phase: 'build'
==> quantum-espresso: Executing phase: 'install'
==> quantum-espresso: Successfully installed quantum-espresso-7.5-zxky252cemgoipfhhqoolnlow2s7qfrd
  Stage: 5.73s.  Cmake: 11.61s.  Build: 3m 4.04s.  Install: 1.35s.  Post-install: 1.04s.  Total: 3m 23.88s
[+] /tmp/vsc40023/EESSI-webinar/spood/demo_spood/opt/linux-cascadelake/quantum-espresso-7.5-zxky252cemgoipfhhqoolnlow2s7qfrd

 5. Verify the installation:
   $ ldd /tmp/vsc40023/EESSI-webinar/spood/demo_spood/opt/linux-cascadelake/quantum-espresso-7.5-zxky252cemgoipfhhqoolnlow2s7q

        linux-vdso.so.1 (0x00007ffc0293e000)
        libfftw3.so.3 => /cvmfs/software.eessi.io/versions/2023.06/software/linux/x86_64/intel/haswell/software/FFTW/3.3.10-GC
        libfftw3_omp.so.3 => /cvmfs/software.eessi.io/versions/2023.06/software/linux/x86_64/intel/haswell/software/FFTW/3.3.1
        libgomp.so.1 => /tmp/vsc40023/EESSI-webinar/spood/demo_spood/opt/linux-cascadelake/gcc-runtime-13.2.0-vvcl5hwifb2atnvu
        libgfortran.so.5 => /tmp/vsc40023/EESSI-webinar/spood/demo_spood/opt/linux-cascadelake/gcc-runtime-13.2.0-vvcl5hwifb2a
        libm.so.6 => /cvmfs/software.eessi.io/versions/2023.06/compat/linux/x86_64/lib64/libm.so.6 (0x000014efe6520000)
        libmvec.so.1 => /cvmfs/software.eessi.io/versions/2023.06/compat/linux/x86_64/lib64/libmvec.so.1 (0x000014efe6108000)
        libopenblas.so.0 => /cvmfs/software.eessi.io/versions/2023.06/software/linux/x86_64/intel/haswell/software/OpenBLAS/0.
        libgcc_s.so.1 => /tmp/vsc40023/EESSI-webinar/spood/demo_spood/opt/linux-cascadelake/gcc-runtime-13.2.0-vvcl5hwifb2atnv
        libc.so.6 => /cvmfs/software.eessi.io/versions/2023.06/compat/linux/x86_64/lib64/libc.so.6 (0x000014efe502f000)
        /cvmfs/software.eessi.io/versions/2023.06/compat/linux/x86_64/lib64/ld-linux-x86-64.so.2 (0x000014efe6912000)

============  End of Demo  ============
```

Using Spack on top of EESSI (in CI)

Using Spack on top of EESSI can also be done in GitHub Actions (for example)

```yaml
steps:
- uses: actions/checkout@v6
- uses: eessi/github-action-eessi@v3
  with:
    eessi_stack_version: '2023.06'
- name: Build and test our code
  run: |
    # from a Python virtual environment
    git clone -b releases/v1.1 https://github.com/spack/spack.git

    # apply patch
    cd spack
    curl -L "https://github.com/spack/spack/compare/develop...lorisercole:spack:eessi.diff" | git apply -3

    # activate spack
    source ./share/spack/setup-env.sh
    # now go back
    cd ..
    ./quick_start.sh demo_dir
  shell: bash
```

See for example https://github.com/EESSI/spood/blob/develop/.github/workflows/test_build.yml

Using Spack on top of EESSI: next steps

- Make sure that Spack doesn't need to be patched anymore,
  cfr. https://github.com/spack/spack/pull/51873 and
  https://github.com/spack/spack/compare/develop...lorisercole:spack:eessi
- More testing: other `spack install` commands, functional & performance tests, …
- Auto-generate the `packages.yaml`, and ship it in EESSI repository;
  see also https://github.com/EESSI/spood/pull/6
- Come up with a maintainable way of mapping software names from EESSI to Spack
- Figure out how to deal with variants concept of Spack packages
- `EESSI-extend` module for Spack?

EESSI in the EuroHPC Federation Platform

- Ghent University was invited into the consortium led by CSC.fi
  that is currently developing the **EuroHPC Federation Platform (EFP)**
- EFP will be the “one-stop shop” for people to access & use EuroHPC systems
- For entire EuroHPC ecosystem: supercomputers, AI factories, quantum computers
- **EESSI is being integrated into EFP as base for the Federated Software Stack**
- First version of EFP became operational in April 2026
- All new EuroHPC projects are onboarded through EFP
- **More info via https://my-eurohpc.eu , see also BoF session at ISC’26 (Wed 10:45-11:45)**
- Recordings of first EFP webinar series available via https://my-eurohpc.eu/training

EESSI won an HPCWire Reader's Choice award!

eessi.io/docs/blog/2024/11/18/hpcwire-readers-choice-awards-2024-for-eessi

EESSI webinars (spring 2026)

- Topics:
  - Introduction to EESSI
  - Building software on top of + contributing to EESSI
  - Using EESSI for Continuous Integration
  - Introduction to CernVM-FS
  - Using EESSI as a base for a central software stack
- Slides + recordings available via https://eessi.io/docs/training-events/2026/webinar-series-2026Q2

EESSI Happy Hours sessions

Come join us 🍹👯🥳

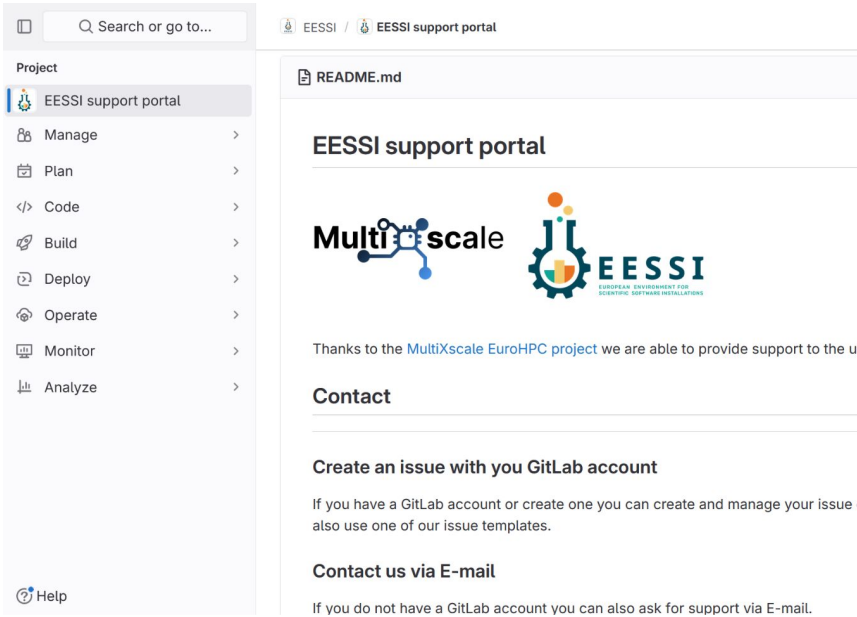
Every Monday at 14:00 CEST, we organise an EESSI Happy Hour

- Online, via Zoom
- Free to join for anyone interested in EESSI
- Features a short presentation or demo on a particular topic (10-15min)
- Open floor for discussions, questions, …
- Recorded, but also more informal (off the record) towards the end
- See also https://eessi.io/docs/training-events/happy-hours-sessions

Getting support for EESSI

eessi.io/docs/support

- Via GitLab, or via email: `support@eessi.io`
- Report problems
- Ask questions
- Request additional software
- Get help with contributing to EESSI
- Suggest enhancements, additional features, …
- Confidential tickets possible (security issues, …)



Dedicated support team, thanks to EuroHPC Centre-of-Excellence Multiscale

Upcoming events

- **EESSI Birds-of-a-Feather session at ISC'26**
  - Thursday 24 June'26, 09:00-10:00 CEST
  - Quick status update of EESSI
  - Interactive poll, discussions, Q&A: join us!

EESSI BoF session @ ISC'24

- **EESSI hackathon** after **EuroHPC User Days 2026** in Dublin
  - Most likely on Fri 25 Sept 2026
  - Topic: **Adding (your) software to EESSI**
  - Details will be announced soon…

EESSI hackathon @ EuroHPC User days 2025

MultiXscale

Website: multixscale.eu

Facebook: MultiXscale

Twitter: @MultiXscale

LinkedIn: MultiXscale

BlueSky: MultiXscale

Co-funded by the European Union

EuroHPC Joint Undertaking

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Website: eessi.io

GitHub: github.com/EESSI

Documentation: eessi.io/docs

Blog: eessi.io/docs/blog

Getting support: eessi.io/docs/support

Join the EESSI Slack (see link on EESSI website)

YouTube channel: youtube.com/@eessi_community

Paper (open access): doi.org/10.1002/spe.3075

EESSI support portal: gitlab.com/eessi/support

Bi-monthly online meetings (1st Thu, odd months, 2pm CE(S)T)

Please rate the tutorial!