Teratec

HACKATHON HPC 2025

OPTIMIZATION OF INDUSTRIAL CODES

Kick-Off Webinar

December 13, 2024

EVENT ORGANISED BY TERATEC, IN COLLABORATION WITH arm aws UCIT VIRIDIEN EDF

Daniel Verwaerde

Teratec Chairman

Agenda

4:00 PM: Welcome Address – *Daniel Verwaerde, Teratec*
4:10 PM: Presentation of Codes and Industrial Challenges:
4:10 PM: Code Aster – *Cyril Baudry, EDF*
4:25 PM: Code Serial – *Patrick Demichel, Viridien*

4:40 PM: Presentation of the Platform and Support:
Conrad Hillairet, ARM
Gilles Tourpe & Arthur Petitpierre, AWS
Benjamin Depardon, UCIT

5:15 PM: Q&A Session
5:30 PM: Webinar Closing

Timeline

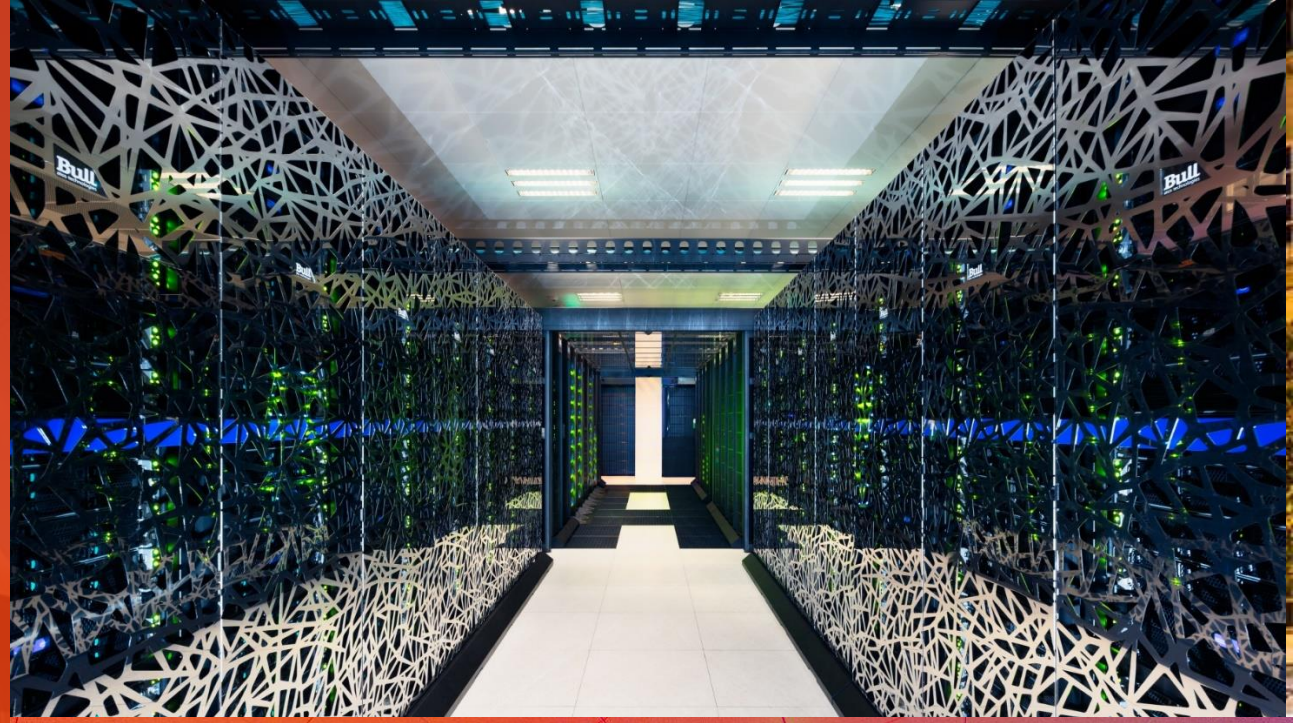
Machine access and technical support
Monday, January 20, 2025, 9 AM to Friday, January 25, 2025, 7 PM

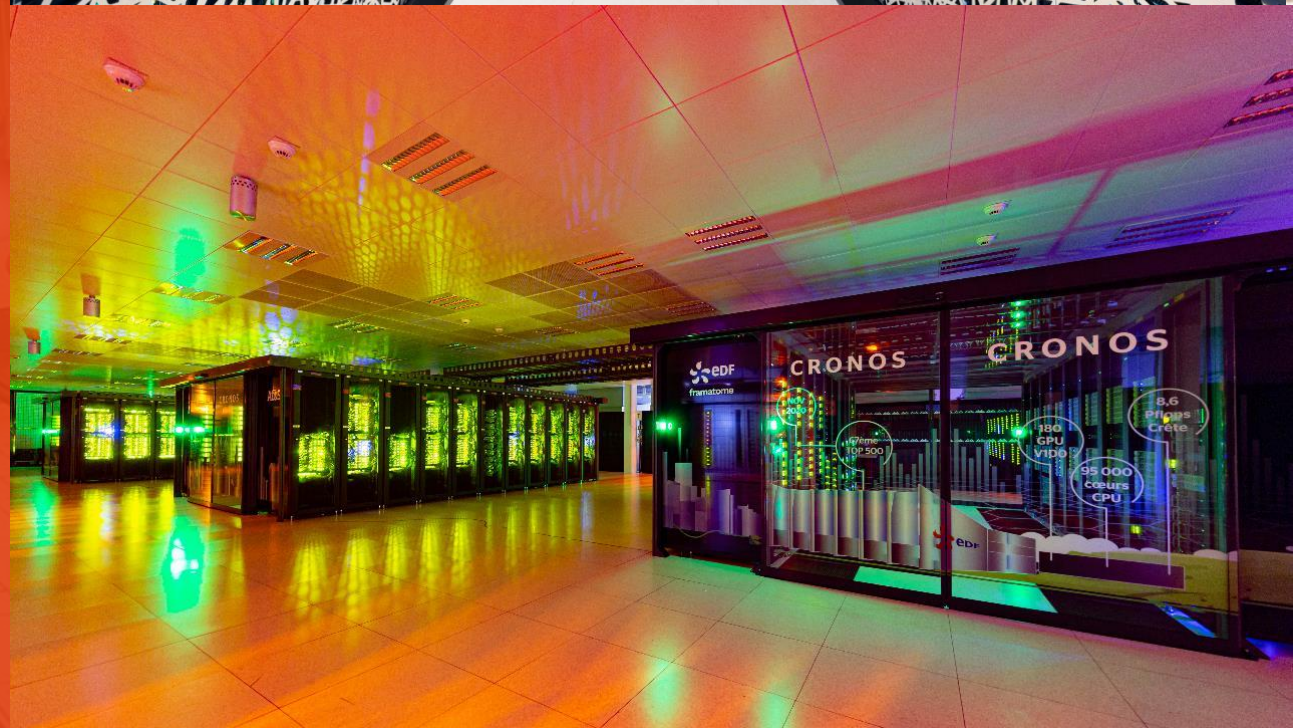
Teams registration	Kick-off webinar	1 week virtual competition	Awards Ceremony
September to November 25, 2024	**December 13, 2024**	**Monday, January 20, 2025, 9 AM to Monday, January 27, 2025, 9 AM**	**May 22, 2025 @ FORUM TERATEC**

Communication

- *Linkedin post*
- *Twice a week, starting from December 16*
- *Focus on teams and Schools*

Hackathon HPC 2025: Code_aster presentation





Cyril BAUDRY

Scientific Information System Architect, EDF R&D

HPC senior expert

2024/13/12

EDF IN BRIEF

- **EDF GROUP PRESENTATION**

OUR raison d'être:

EDF adopted its raison d'être in 2020 :

Building a net zero energy future with electricity and innovative solutions and services, to help save the planet and drive wellbeing and economic development.

KEY FIGURES

2022

40.3 million
customers around the world

143.5 billions euros
of sales

171 490
employees throughout the world

431.7 TWh
electricity generated by EDF Group

649 million euros
research and develoment budget

90 %
production free from CO2 emissions

The Group integrates all activities between upstream and downstream.

As a major player in the energy transition, EDF is present in production, transport, distribution, trading, energy sales and energy services..

Electricity generation

EDF produces safe, affordable and carbon-free electricity in power plnats which it designs and operates.

Transmission and distribution

The transmission and distribution networks carry electricity to the end customer while balancing supply and demand.

Energy supply

The EDF Group sells energy and energy services to nearly 40 million client sites around the world.

Optimisation and trading

This activity allows EDF to fulfil the energy supply commitments made to its customers by choosing between available resources.

R&D IN FIGURES (2023)

9 R&D centres
In France and abroud

44
nationalities

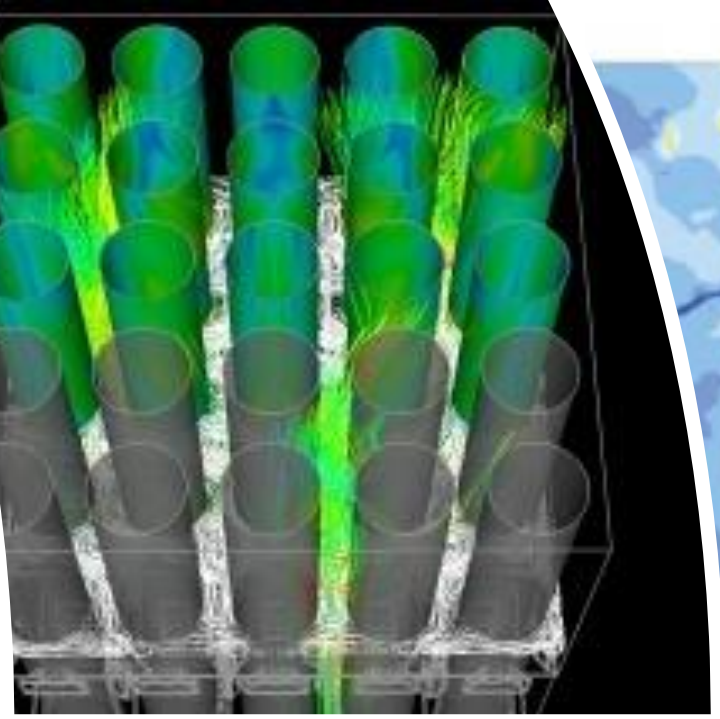
2 178 patents

11 petaflops
Computing capacity

21 joint
laboratoires

EDF POLICY : SOME CONTEXTUAL ELEMENTS TO INTEGRATE

- **Plants operated over 40 – 100 years**
  - Guarantee safety, minimize environmental footprint
  - Maintain assets
- **Fast changing operating conditions**
  - More competitive markets,
  - Tougher regulations, ageing, environment
- **New business models and services**
  - Data science, Open Data, Artificial Intelligence, Blockchain, ….
  - Cloud computing
  - Smart meters
- **Energy Transition**
  - Diversified energy mix (nuclear, renewables,…)
  - Products and services, energy-saving solutions, help customers to manage their consumption
  - A dual digital and energy transition for both society and the economy



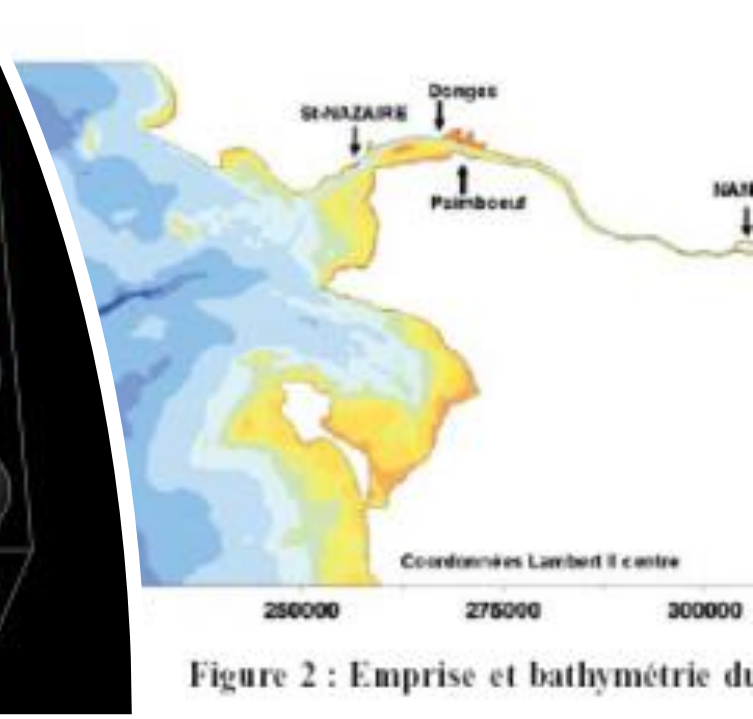
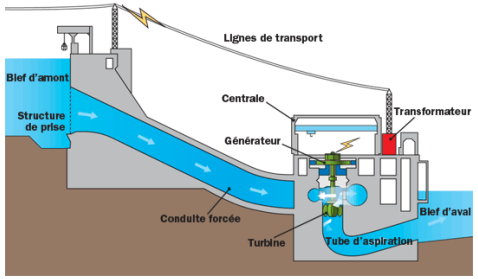
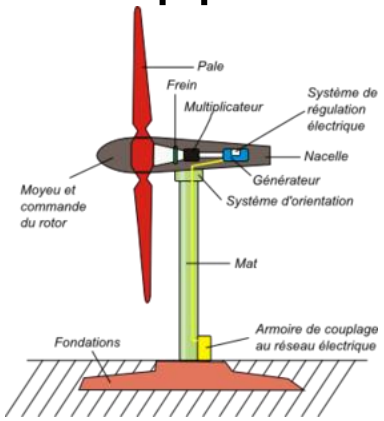


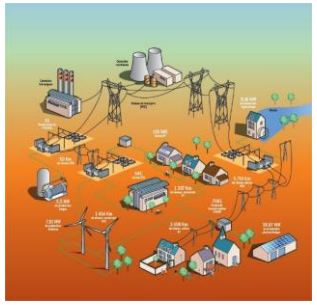
Figure 2 : Emprise et bathymétrie du

Main domains of HPC applications (both Physical Simulation and Data Analysis)





ENERGY PRODUCTION (Nuclear, Renewable, Hydraulic, Thermal, Environment)



Network / Smarties (smart-grids, smart-cities)

Marketing

Energy Management

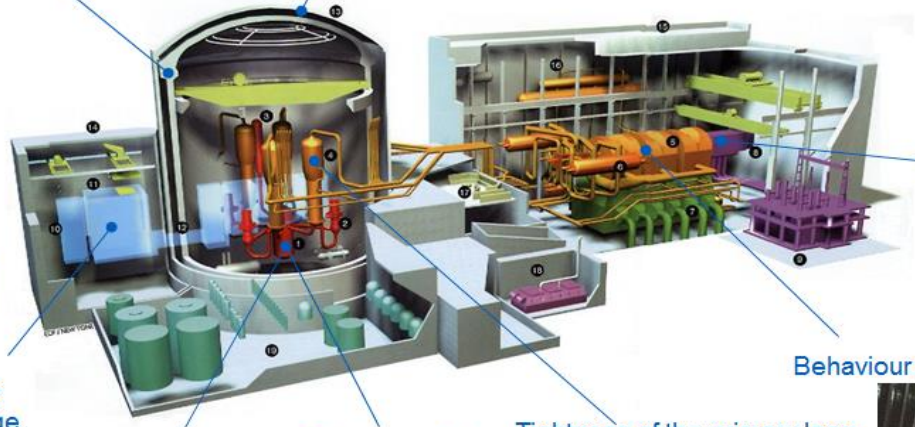
Nuclear : a particular domain

Tightness of the containment vessel

Resistance to impact (projectiles)

Seismic Analysis

Environmental impacts



Dismantling Waste Storage

Control of nuclear reactions

Behaviour of the pressure vessel

Tightness of the primary loop

Behaviour of turbines

- Guarantee safety
- Improve performances/costs
- Maintain assets
- Face unexpected events
- Ageing issues…

Benefits of the HPC :

- ✓ Less simplifying assumptions
- ✓ More information
- ✓ More calculation scenarios
- ✓ Take into account incertainties

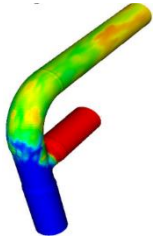
Simulation at EDF: a key element to support studies for their operation

Codes developed at EDF R&D

… a know-how in the state of international art and accessible by all thanks to the Open Source !

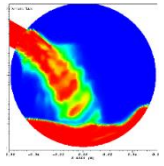
- *Code_Saturne* *((i.e. SALOME-CFD)*
  - general usage single phase CFD, plus specific physics
  - property of EDF, open source (GPL)
  - http://www.code-saturne.org

code_saturne



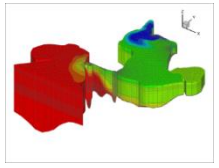
- NEPTUNE_CFD *'(i.e. SALOME-CFD)*
  - multiphase CFD, esp. water/steam
  - property of EDF/CEA/AREVA/IRSN

NEPTUNE



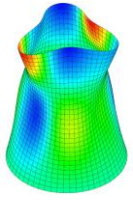
- SYRTHES
  - thermal diffusion in solid and radiative transfer
  - property of EDF, open source (GPL)
  - https://www.syrthes-software.org/

syrthes

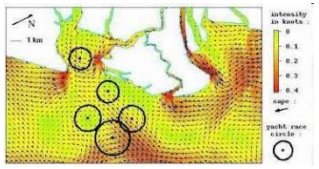


- *Code_Aster* *(i.e. SALOME-MECA)*
  - general usage structure mechanics
  - property of EDF, open source (GPL)
  - http://www.code-aster.org

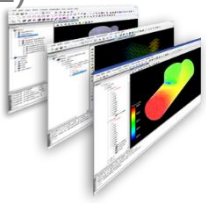
CODE_aster



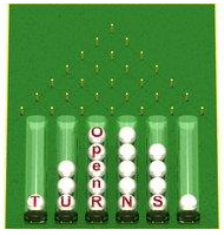
- TELEMAC system *(i.e. SALOME-Hydrau)*
  - free surface flows
  - Many partners, mostly open source (GPL, LGPL)
  - http://www.opentelemac.org



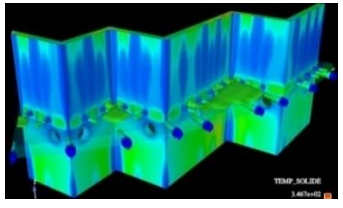
- SALOME platform
  - integration platform (CAD, meshing, post-processing, code coupling)
  - property of EDF/CEA/OpenCascade, open source (LGPL)
  - http://www.salome-platform.org



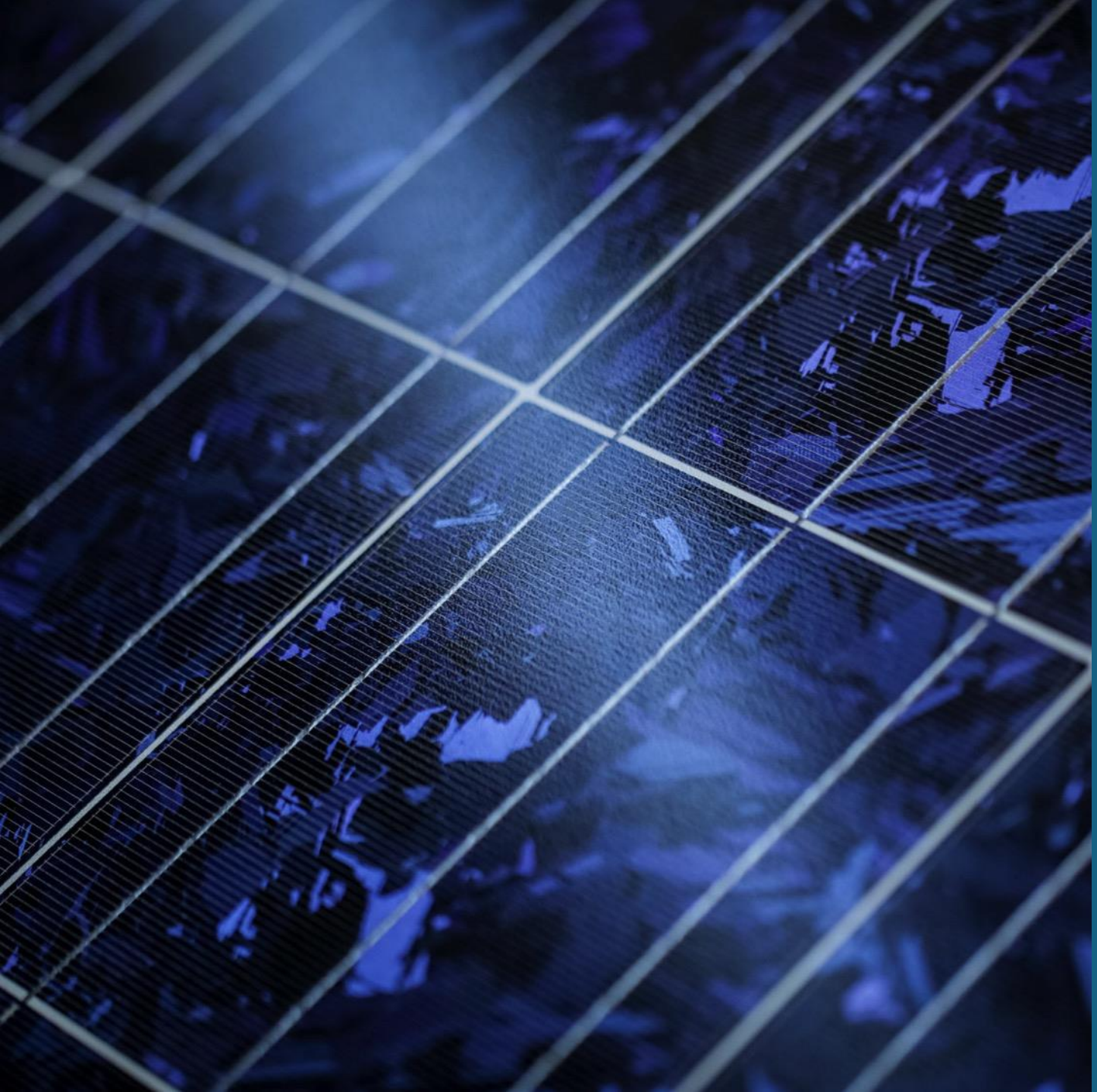
- Open TURNS
  - tool for uncertainty treatment and reliability analysis
  - property of EDF/CEA/Phimeca, open source (LGPL)
  - https://openturns.github.io/www/



- and many others…
  - Neutronics, electromagnetism
  - Component codes, system codes
  - Optimization codes,…



EDF



salome_meca : EDF R&D simulation platform for structural mechanics

CODE_aster

salome MECA

A SIGNIFICANT RANGE OF STUDIES

- Licenses are expensive
- Dependent on the software provider for specific applications
- Sometimes you don’t find the advanced method you need on the simulation market
- The workflow of study changes from a tool to another
- Different simulation environments generate compatibility issues
- Ensuring a 100 years-old archive of the numerical studies may be complicated

- Civil engineering
- Fracture mechanics
- Seismic analyses
- Soil mechanics
- Metallurgy
- Fuel Assemblies
- Rotation machines
- Vibrations and acoustics,
- .. And much more

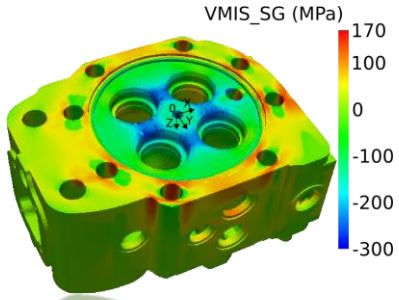
Every field has specific and different needs : functionalities, ergonomic, performance, etc.

Thus, *many* simulation softwares are employed

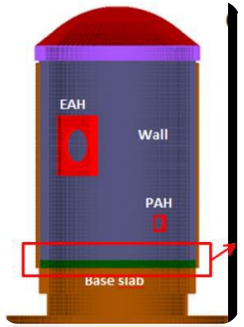
But…

FROM RESEARCH TO TECHNOLOGY TRANSFER

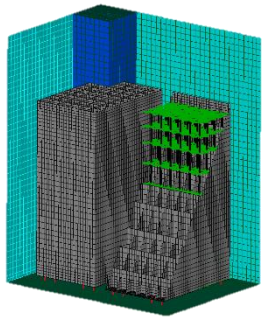
Cylinder heads cracking of 900 MWe reactors back-up diesel generators



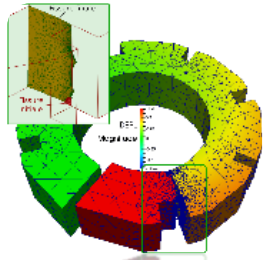
Behaviour of containment buildings



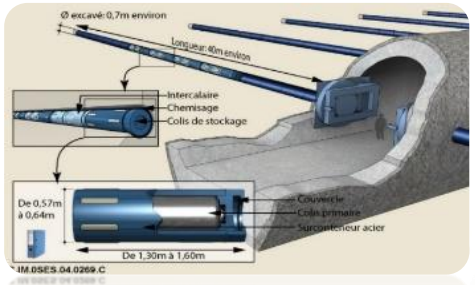
Behaviour of fuel racks under seismic loading

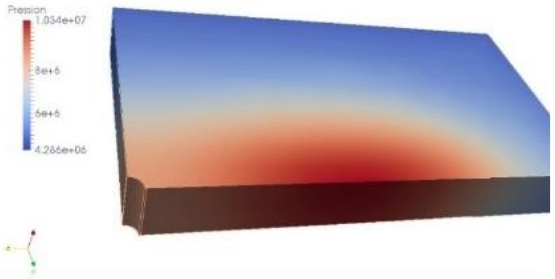


Analysis of cracking in graphite bricks (UK)

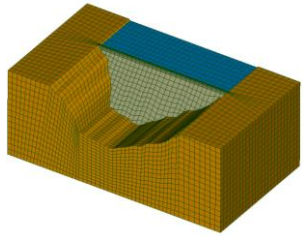


Optimization of sub-surface storage site for nuclear waste





Civil structures subjected to earthquakes

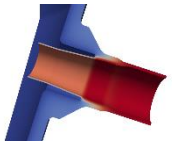


QUALITY INSURANCE

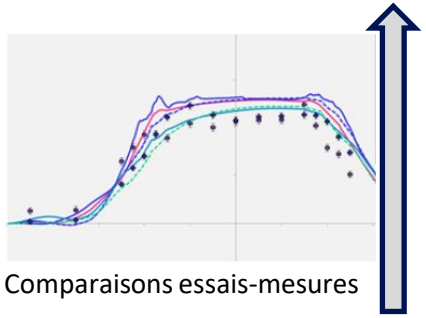
1M source code lines

25 000 documentation pages

4 200 verification testcases



420 validation tests



Specific facility or equipment project

Statement of need by an engineering unit
Technical requirement by an applied project

Opening of a ticket in the bugtracker

REX

Attribution to a developer by the PO

Macroscopic design

Design review

Coding

Writing and exécution of testcases

Edition of the documentation

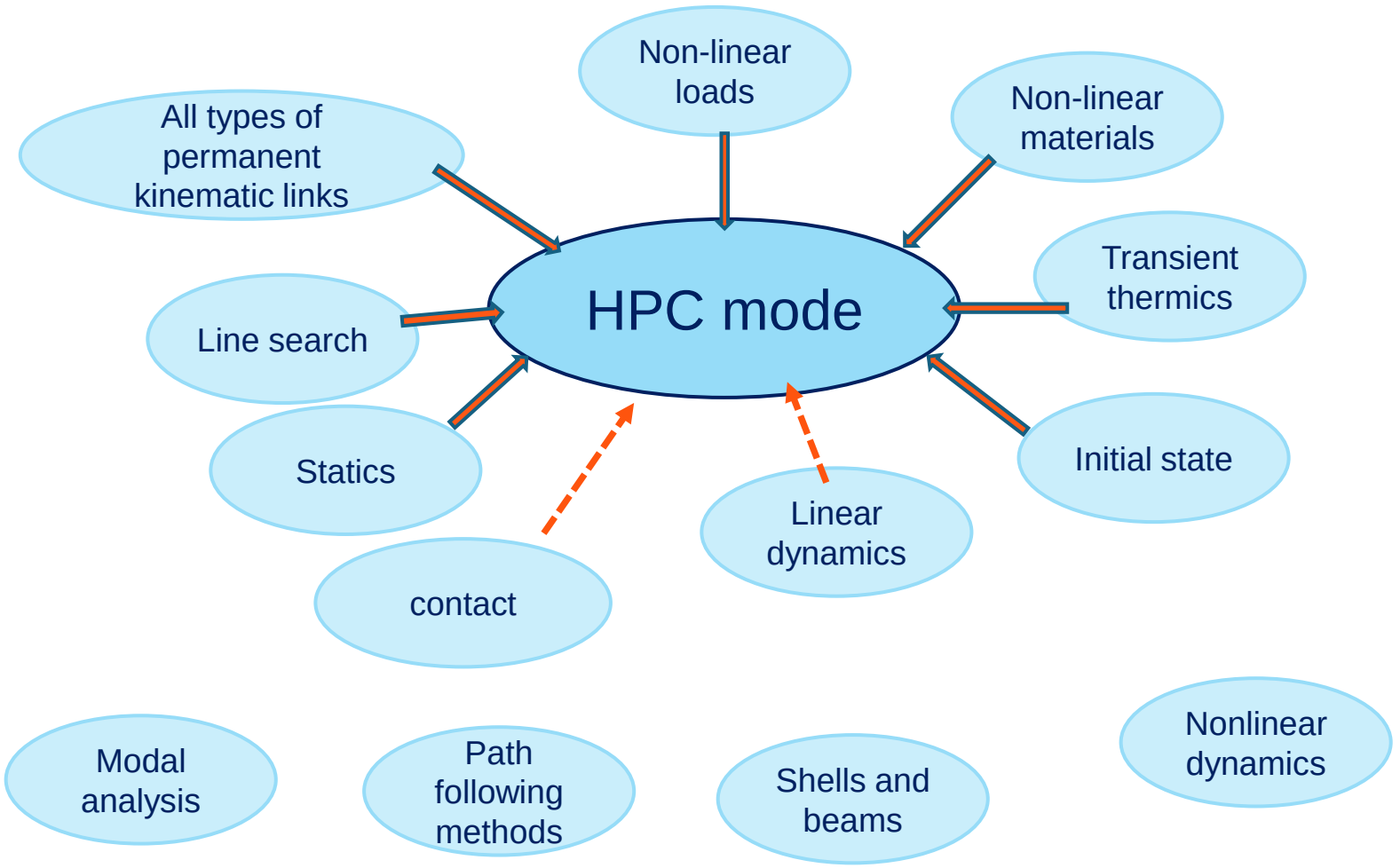
Code and doc review

Integration to the official repos

Gitlab

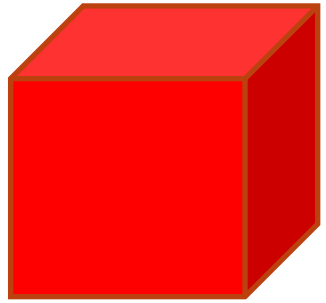
Qualified deployment for safety related studies (RUP)

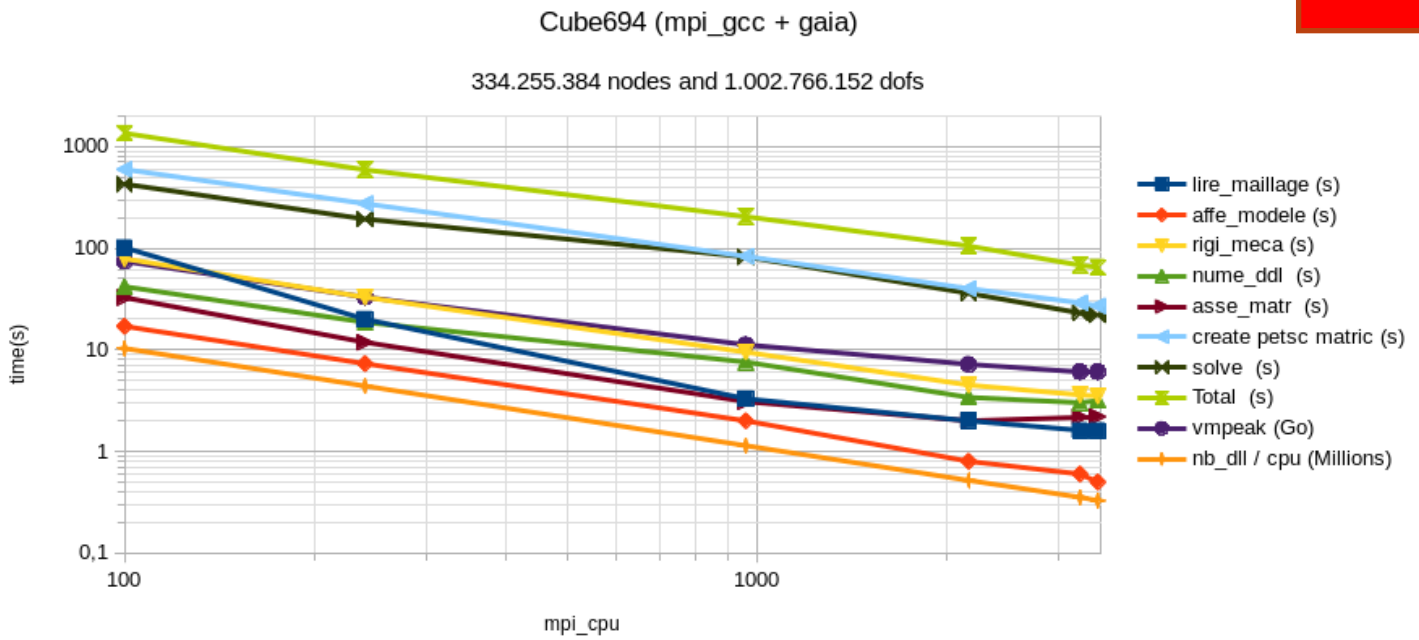
HPC COMPUTATIONS : SUPPORTED ANALYSES



HPC FUNCTIONALITIES : EXAMPLES AND RESULTS

- **Elastic cube over 1Md Dofs**
  - Demonstrates the efficience of data distribution
  - And scalability of all operations for a linear problem



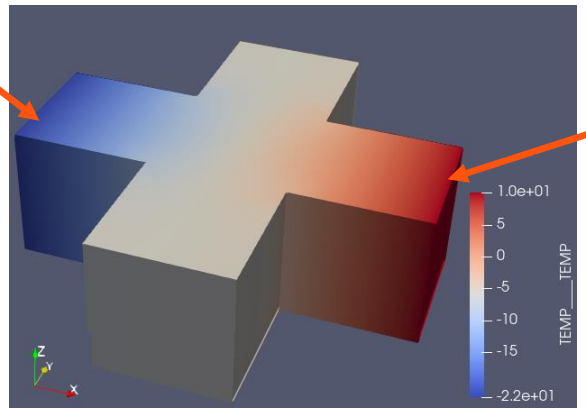


HPC FUNCTIONALITIES : EXAMPLES AND RESULTS

- **Linear thermomecanic computation**

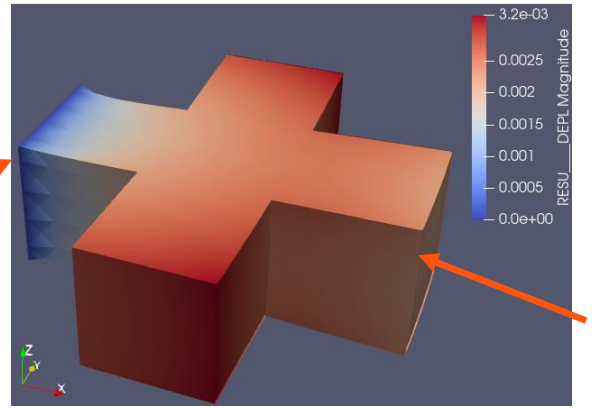
THERMAL : 4M dofs

Prescribed flux



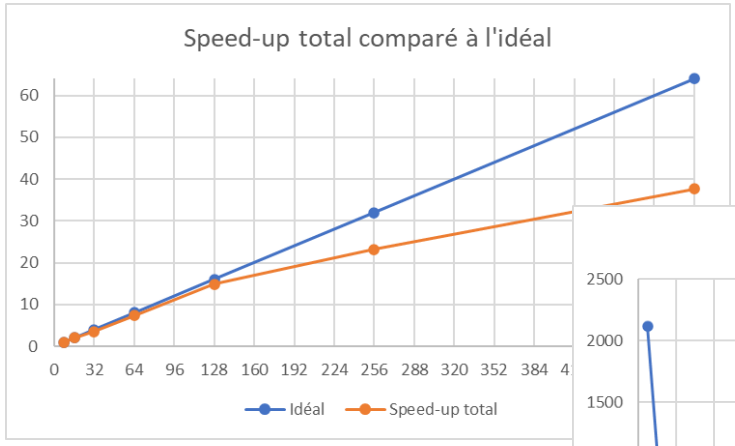
Prescribed temperature

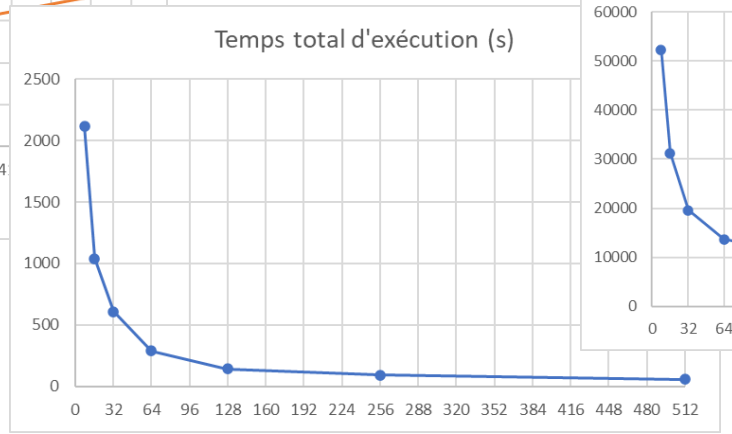
MECHANICAL : 50M dofs

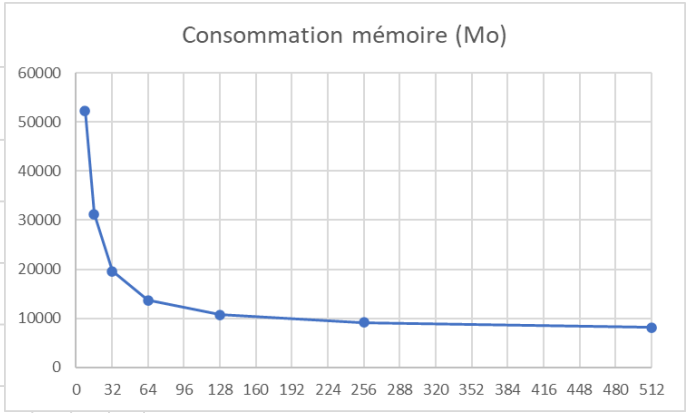


Prescribed displacement

Pressure

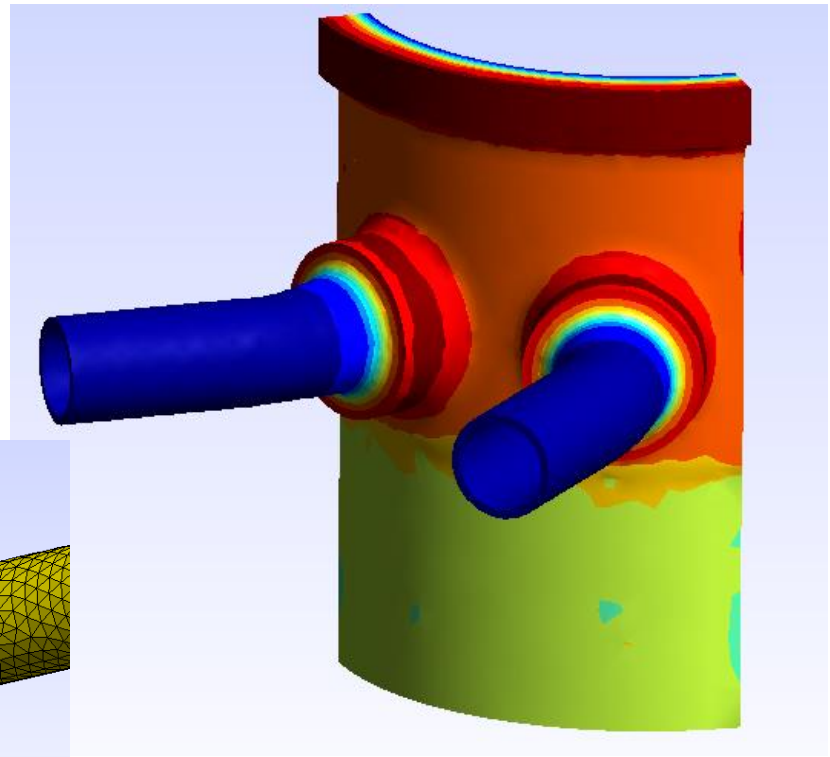


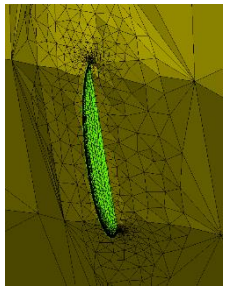


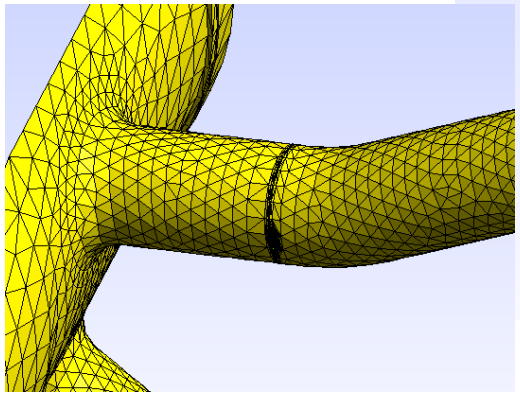


HPC FUNCTIONALITIES : EXAMPLES AND RESULTS

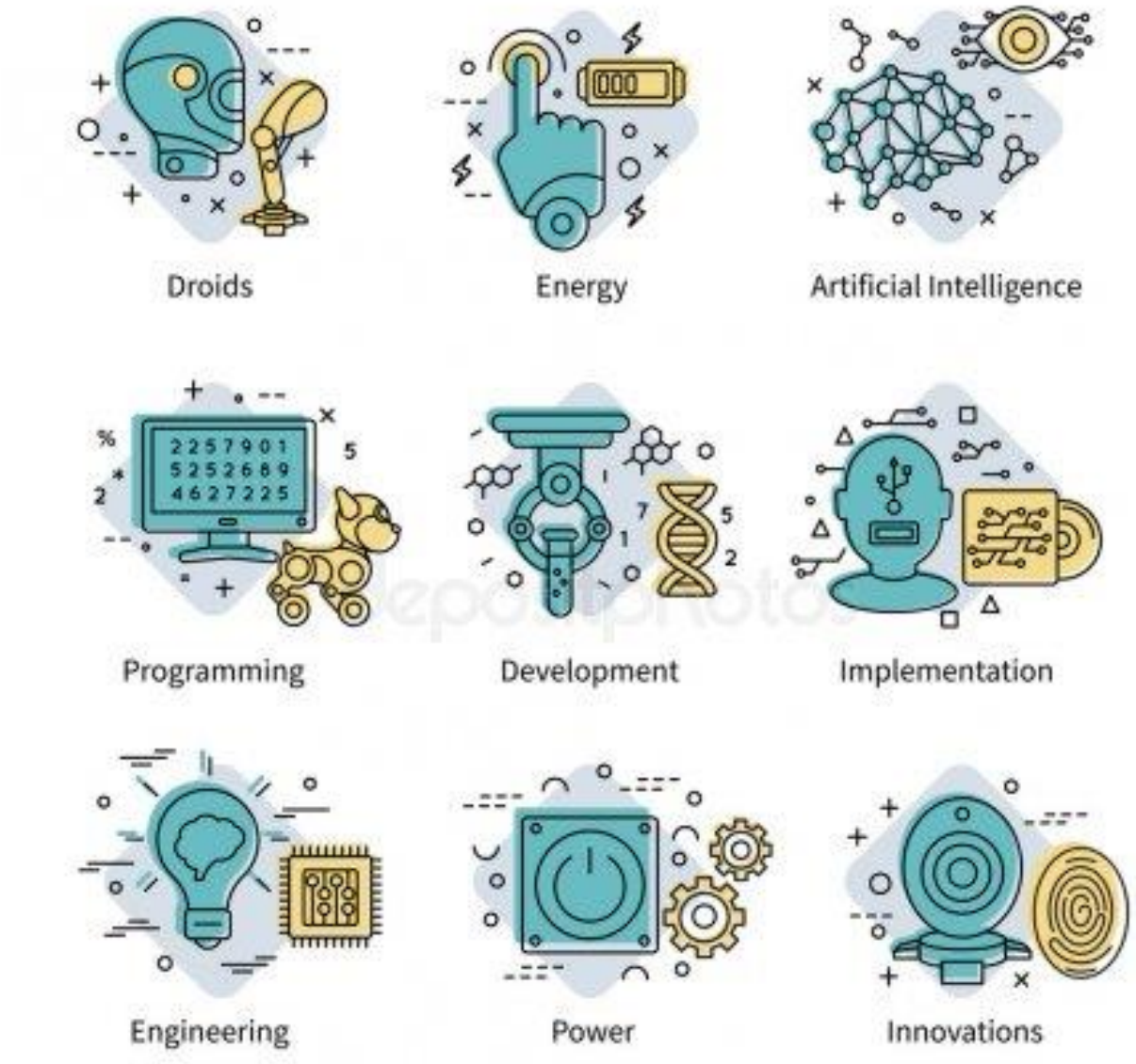
- **Thermal shock (elasto-plasticity) on a portion of vessel**
  - Transient linear thermics, then statical elastoplastic computation
  - 5M dofs thermics, 127M dofs mechanics
  - 1920 MPI processes
  - 0,24 s for each thermal time step
  - 90 s for each mechanical time step







Energy needs modelization, simulation … and more and more artificial intelligence !



Thanks you for your attention

Teratec

HACKATHON HPC 2025

OPTIMIZATION OF INDUSTRIAL CODES

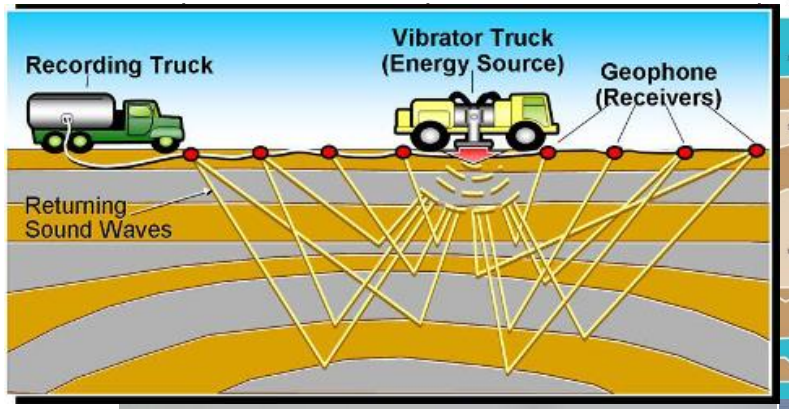
Black-Scholes Tuning

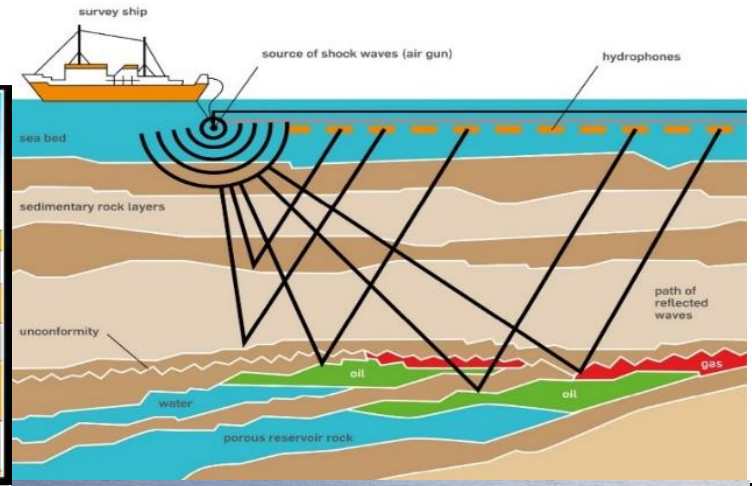
Hafsa Demnati
Patrick Demichel

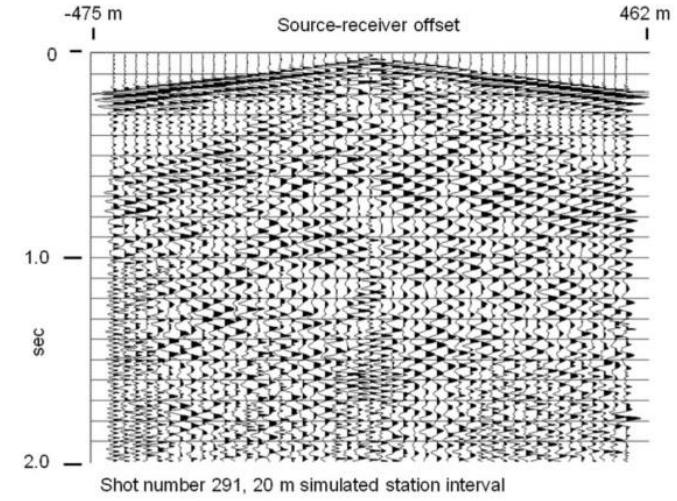
December 13th, 2024

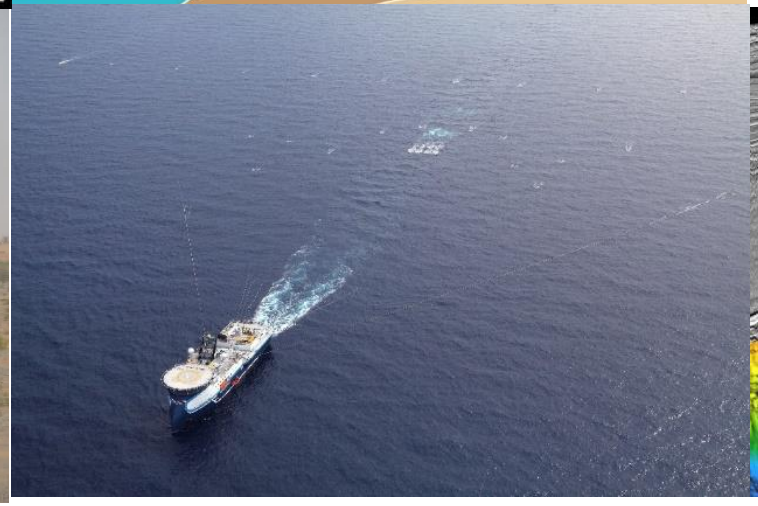
Core business: Geophysics

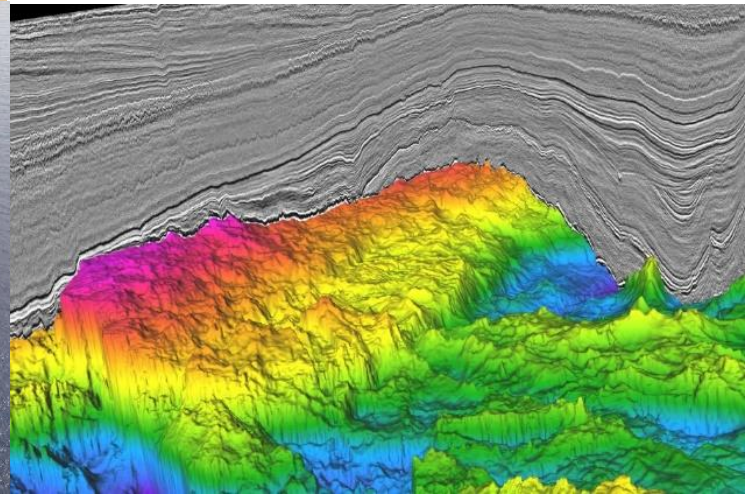
Core Business is Earth Sciences







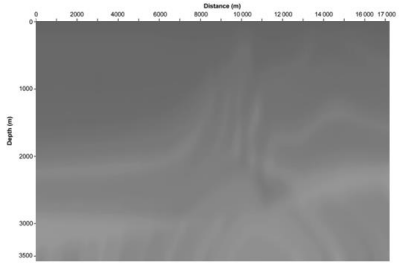




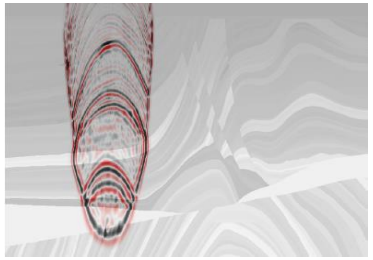
What is seismic imaging ? Why the HPC is so critical

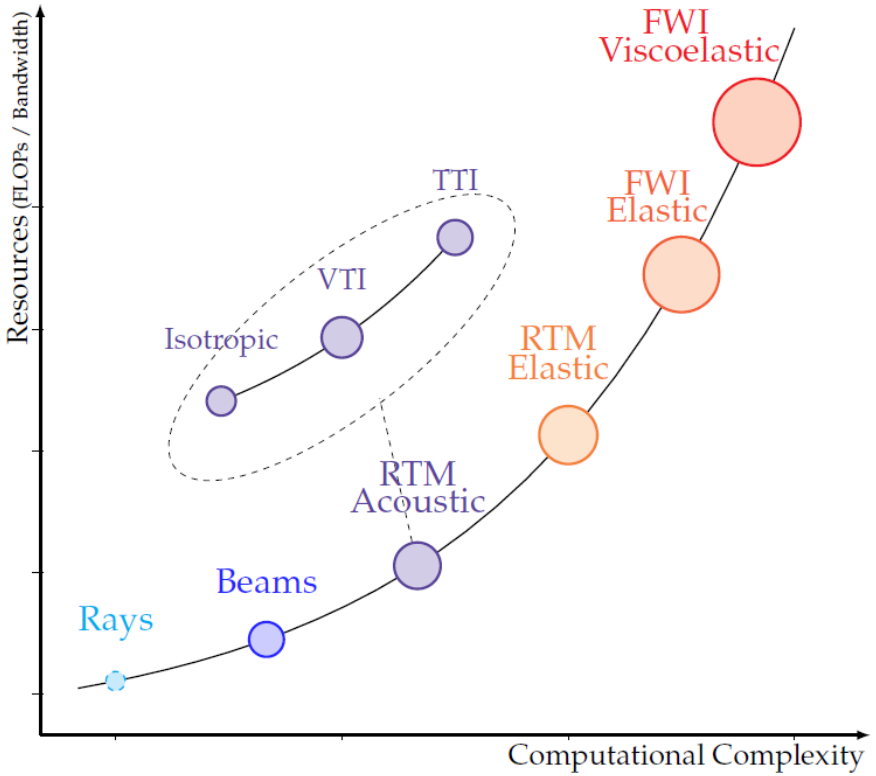
Inversion algorithms RTM,FWI…

Start with initial velocity/density model

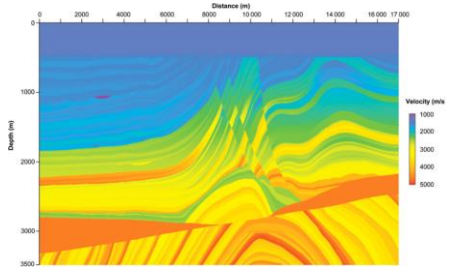


Propagate waves and record data « numerically »



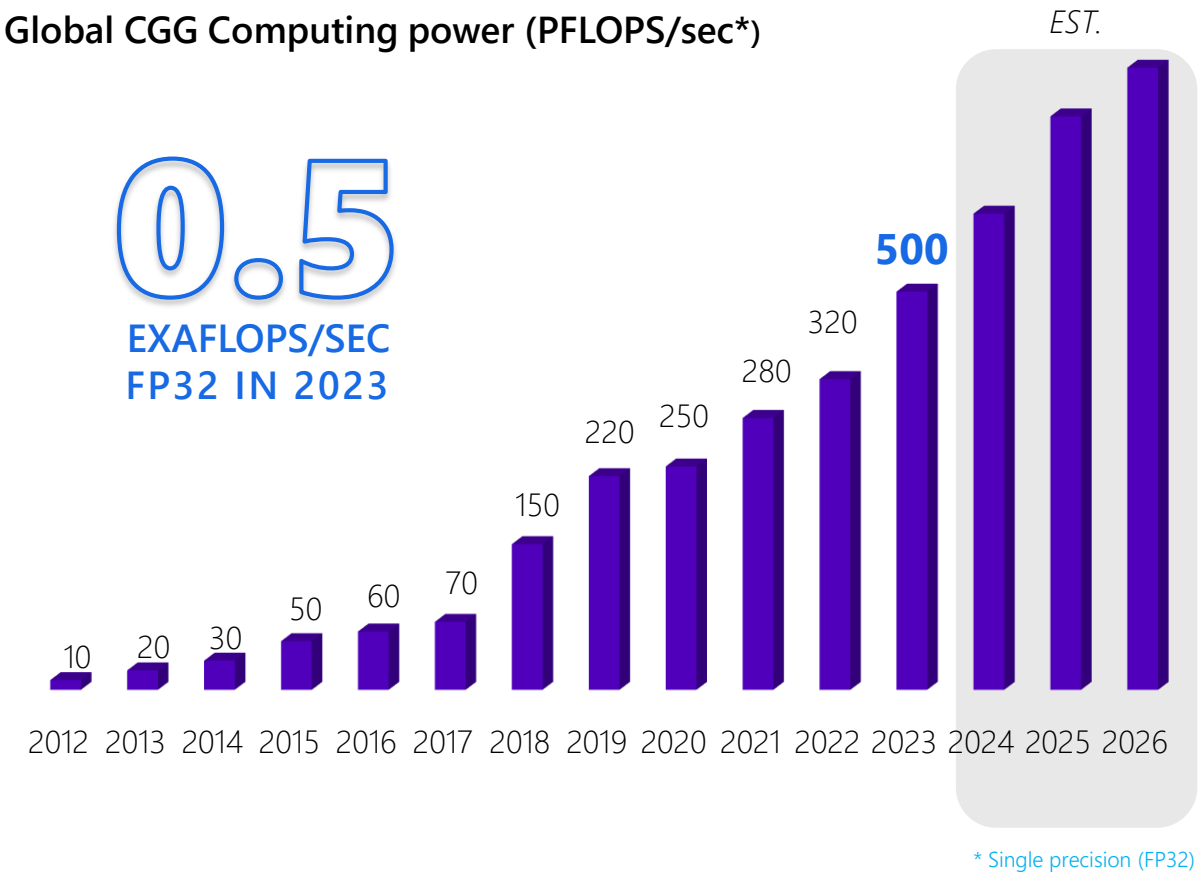


Compute differences between data acquisition (surveys) and numerical data
+ Compute gradient + update velocity/density model



High Performance Computing – a core industrial asset in CGG

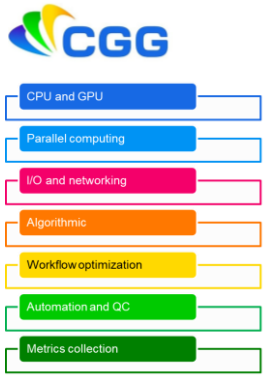
Global CGG Computing power (PFLOPS/sec*)

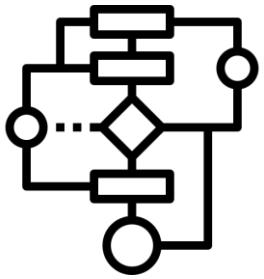


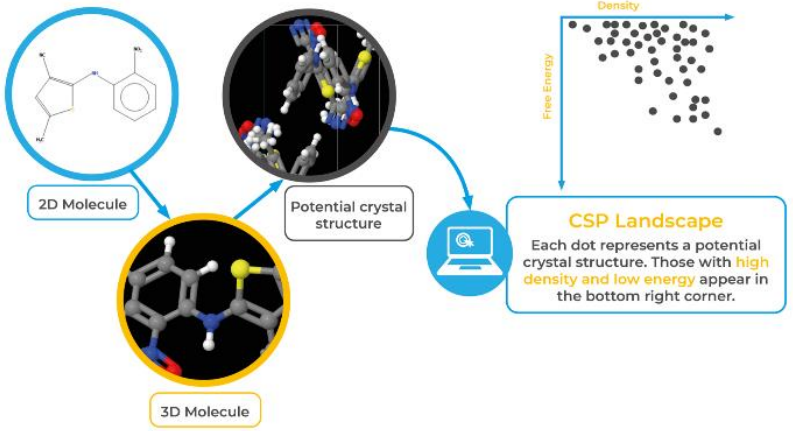
* Single precision (FP32)

- The largest compute power in Energy running the worlds most advanced algorithms for seismic data
- Highly-optimized HPC resources and digital platform

New business: Viridien now helps other customers to make breakthrough on extreme compute intensive challenges







40x * 50x = from months to hours

Extreme-scale AI and HPC computations require achieving significant leaps in performance, which can only be realized through the collaboration of experts from various fields.

Our partnership with CGG has proven to be a game-changer, thanks to the substantial enhancements we've made to our codes. This marks just the initial stages of our exciting journey.

Peter Doyle : CEO and cofounder of biosimulytics

15mn at 4:25 PM: Code Serial – *Patrick Demichel, Viridien*

The 2025 challenge is a classical algorithm used by banks and insurance companies to protect enterprises from the risk of price fluctuations of the core resources they need to purchase during long-term projects.

The code mimics real-world usage but has been adapted specifically for this Hackathon. It reflects exactly what an HPC expert would do if tasked with optimizing a production code.

We expect participants to focus on parallelization and tuning on the ARM architecture.
The objective is not only to achieve high performance but also to reach a precise quality objective.

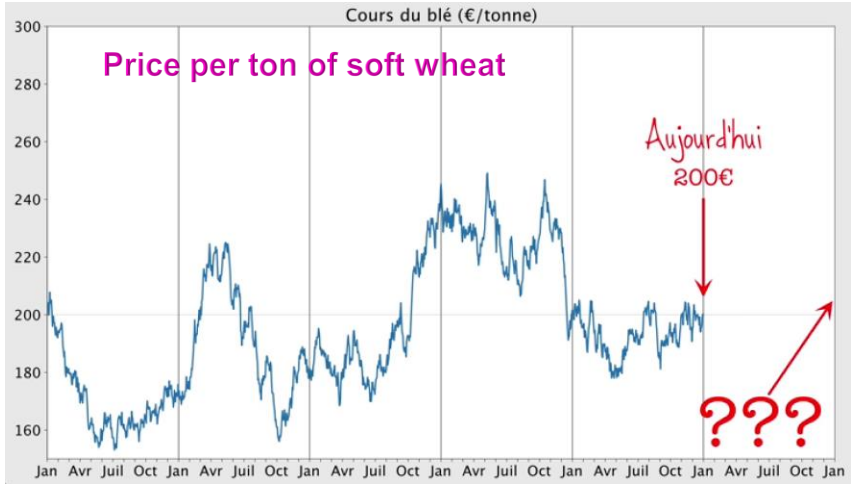
More details are provided in two documents that will be distributed at the start of the Hackathon.
We will also be available to assist throughout the week.

Basic products

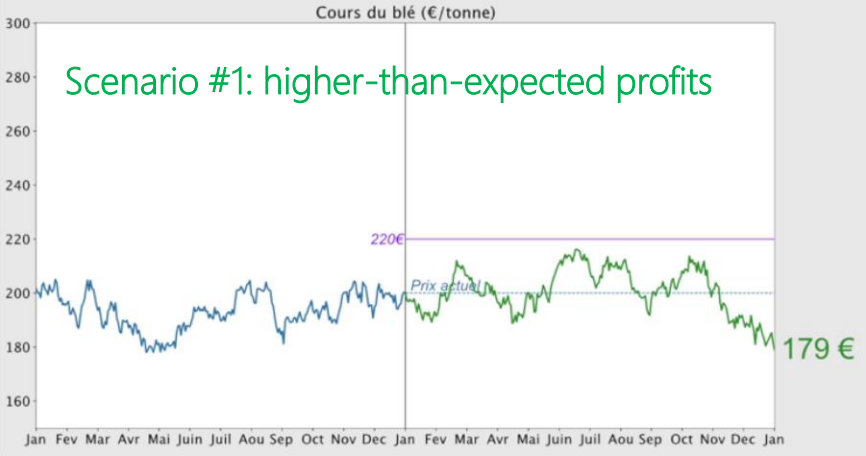
- Large fluctuations observed on commodity products

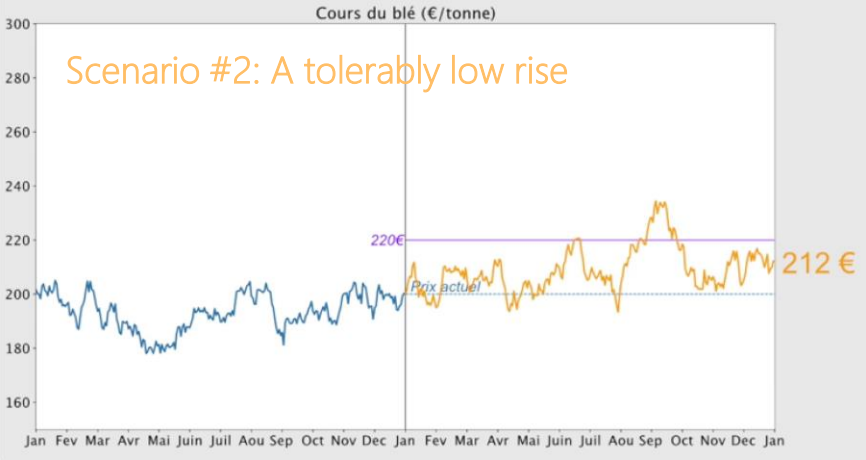
e.g: Order of 10K croissants to be delivered in 1 year for a reception.

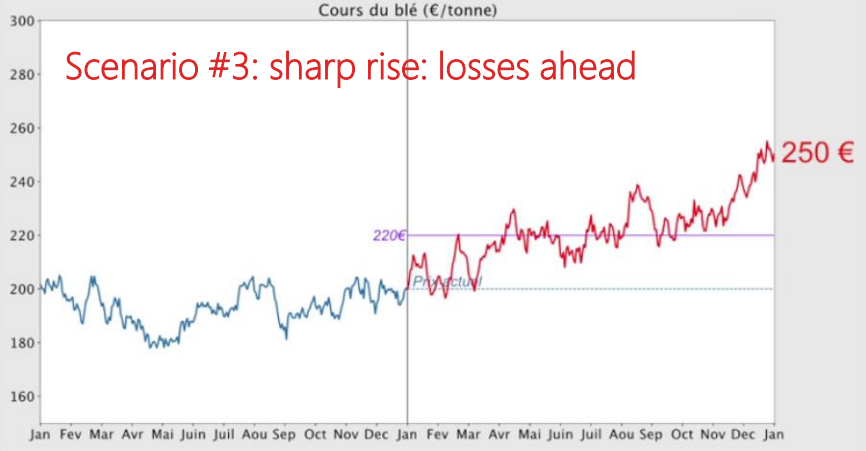
How to guarantee a price without losing money?

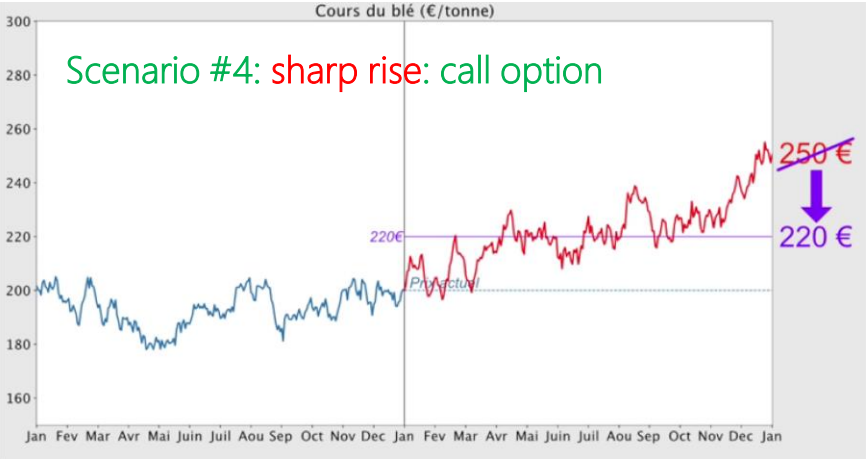


Several possible scenarios

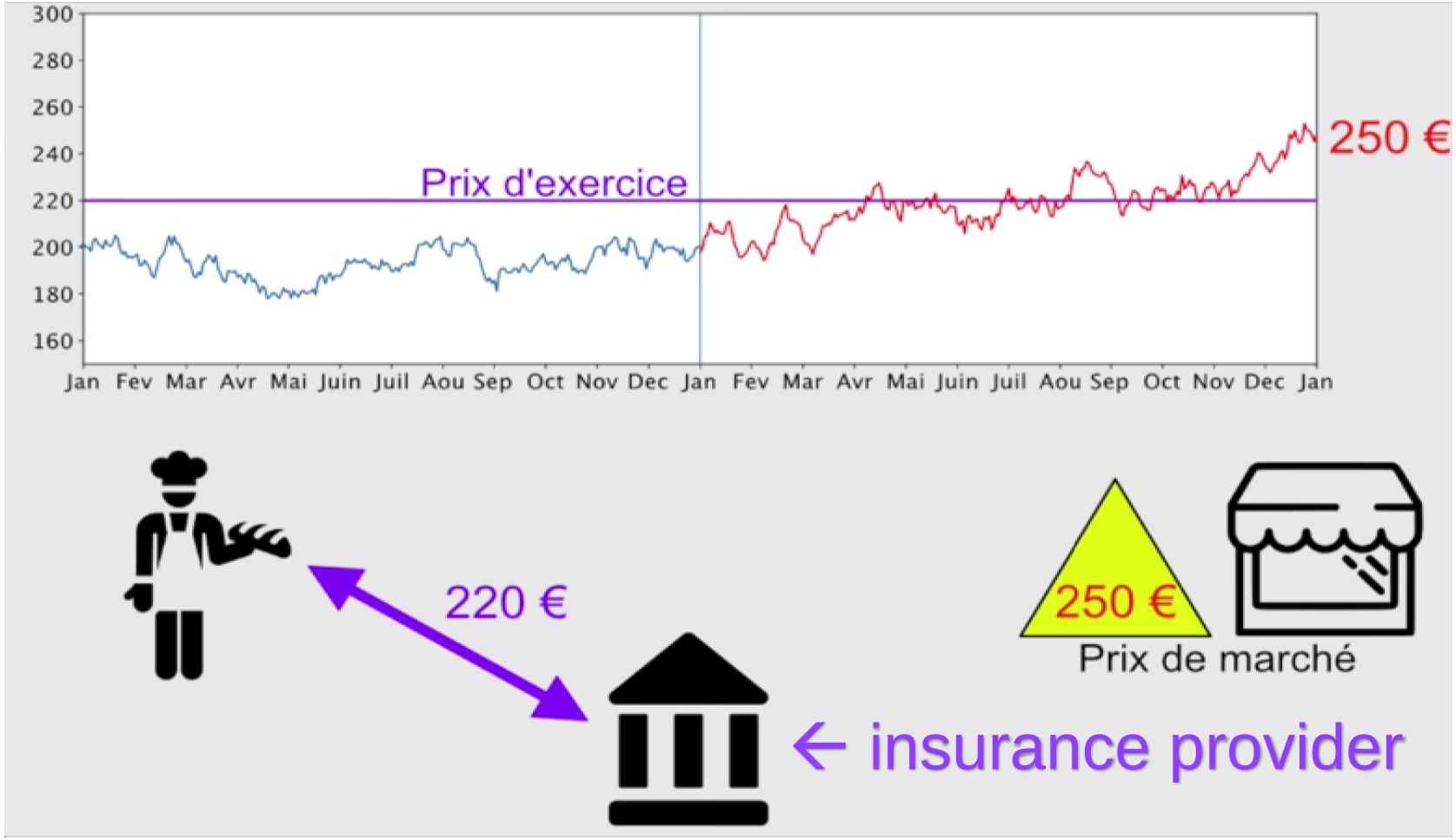




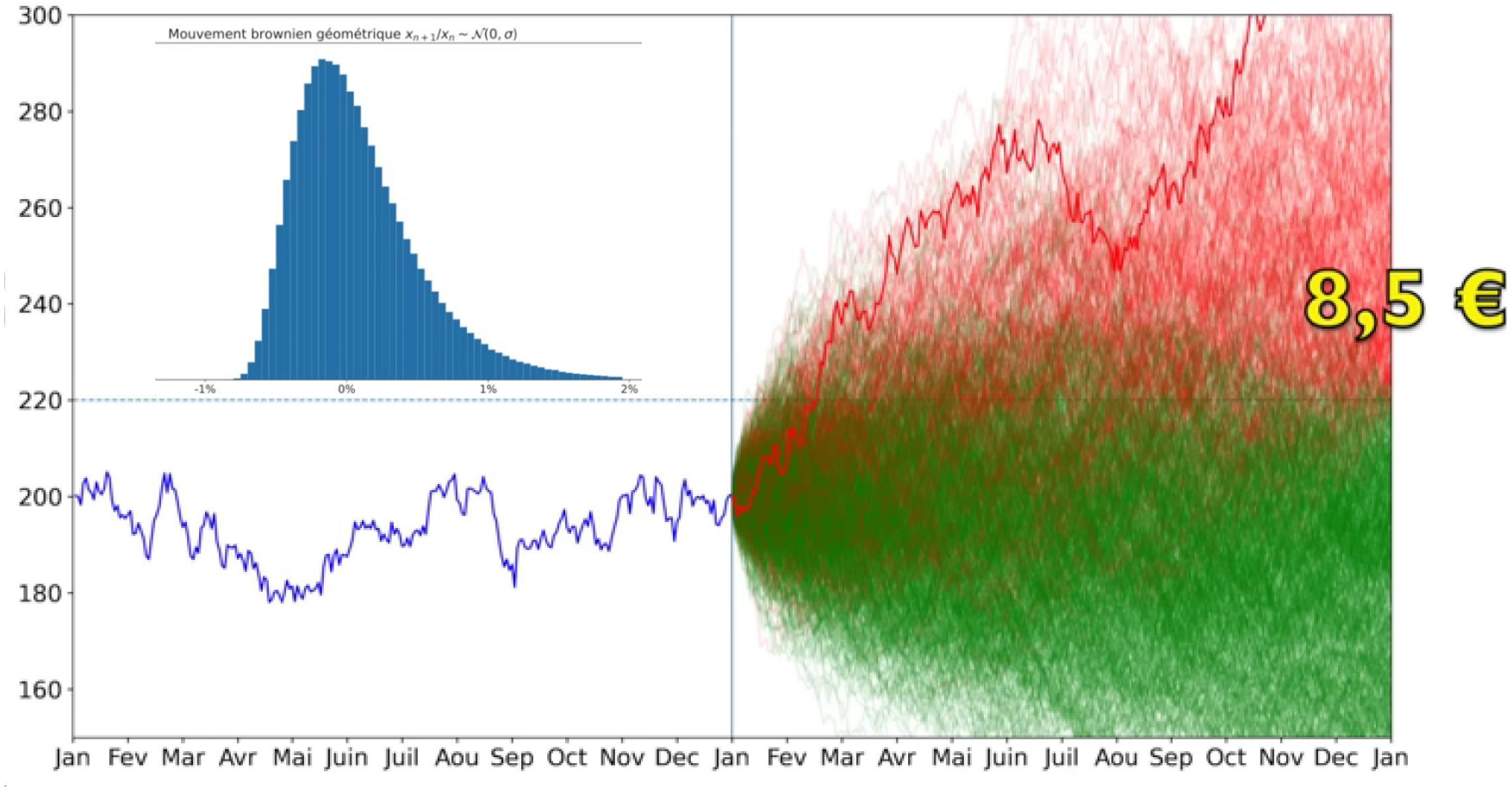




Call option exercised: price paid €220

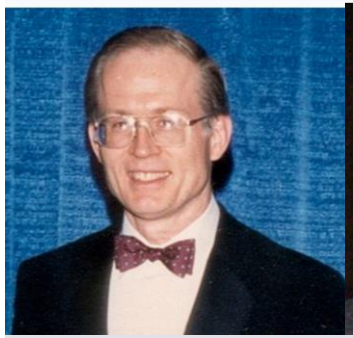


Example: option price for 220 euros



Can we eliminate the risk of waiting for the deadline?

Fischer Black



Myron Scholes

$$C = Se^{-qt}N(d_1) - Ke^{-rt}N(d_2)$$

The Black Scholes Equations

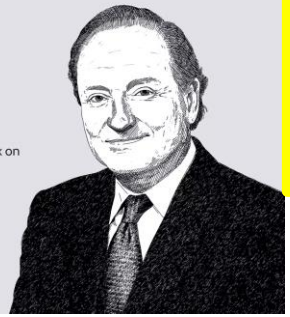
$$P = Ke^{-rt}N(d_2) - Se^{-qt}N(d_1)$$

Robert C. Merton

Born: July 31, 1944

American Economist

- Won the 1997 Nobel Prize in Economic Sciences for his work on the Black-Scholes model
- Former principal of Long-Term Capital Management
- Professor Emeritus at MIT



Investopedia

S = Underlying price ($)
K = Strike price ($)
σ = Volatlity (% p.a.)
r = Continuously compounded interest rate (% p.a.)
q = Continuously compounded dividend yield (% p.a.)
t = Time to expiration (% of year)

$$N(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{x} e^{\frac{-t^2}{2}} dt$$

$$d_1 = \frac{ln\frac{S}{K} + t(r - q + \frac{\sigma^2}{2})}{\sigma\sqrt{t}}$$

$$d_2 = d_1 - \sigma\sqrt{t}$$

In 1997, Robert Merton and Myron Scholes were awarded the Nobel Prize in Economics for their work, carried out with Fisher Black (who died in 1995), on the valuation of derivatives.

Expected performances for error reduction

Main goal: Analyze and tune the Black-Scholes application given to get the **best precision**.

Average error	Time expected (Arm)
0.001	10 hours
0.01	10 minutes

Estimated Time Based on Computed Error for Optimized Code

For safety, we propose two error thresholds to aim for:

- **0.005**
- **0.002**

Teratec Hackathon Edition #3

Conrad Hillairet – Staff HPC Engineer
conrad.hillairet@arm.com

13th December 2024

Arm Compute Platform is the Most Pervasive in History

CHANGING THE WORLD. AGAIN.

Arm Technology

280+ Billion

Arm-based chips shipped to date.

30.6 Billion

Arm-based chips shipped in FYE23.

18M+

Software developers on Arm.

The global leader in the development of licensable compute technology

R&D excellence for semiconductor companies and large OEMs.

Arm's power-efficient processor designs and software platforms enable advanced

Our technologies securely power products from the sensor to the smartphone and the supercomputer.

Arm delivers the foundational building blocks for trust in the digital world

Arm provides enhanced system-level security technologies such as Arm TrustZone and Arm Confidential Compute Architecture (CCA).

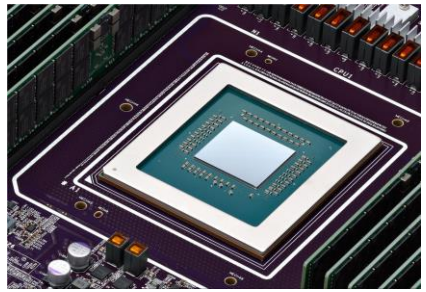

arm NEOVERSE
The Cloud to Edge Infrastructure Foundation
for a World of 1 Trillion Intelligent Devices

Arm HPC Ecosystem

Hardware

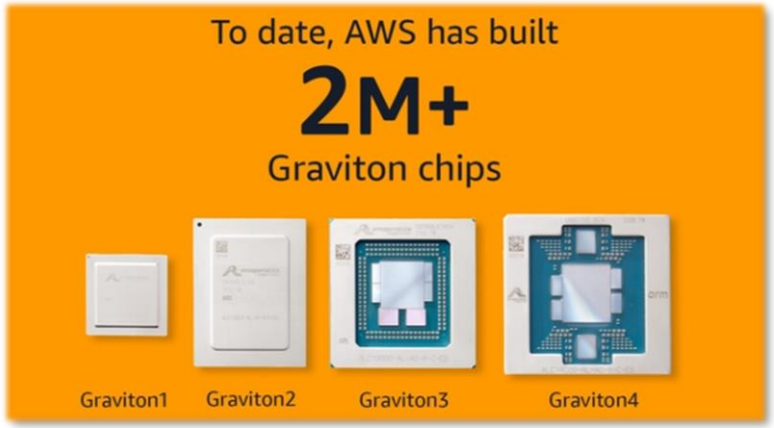
Benefit from the various solutions of all the partners of the Arm HPC Ecosystem

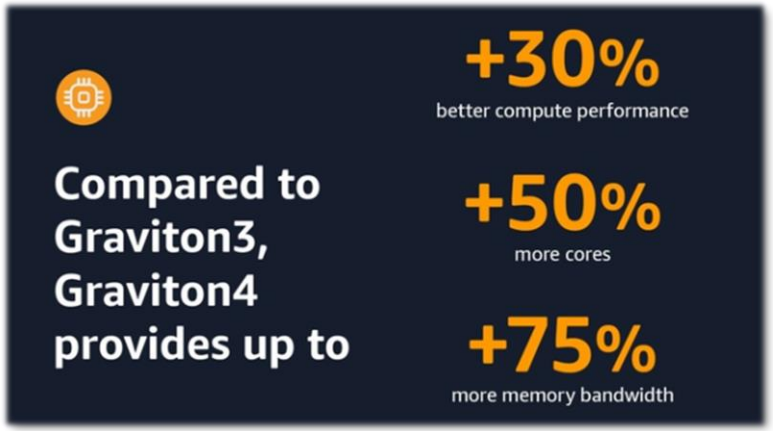
Azure Cobalt 100
AWS Graviton
Google Axion
NVIDIA Grace

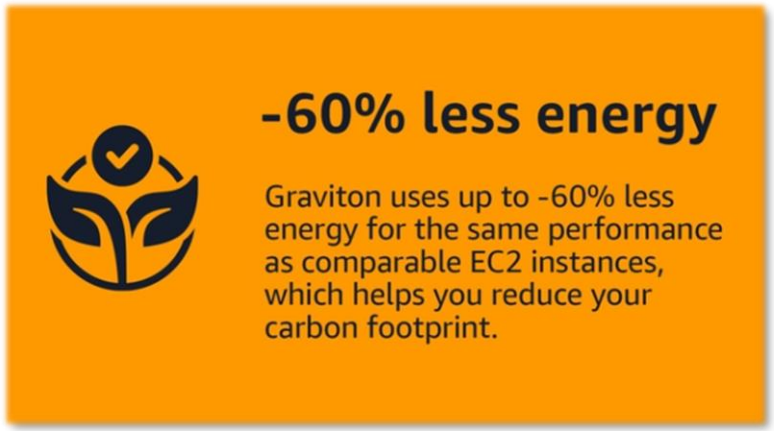


AWS Graviton 4 Processor

Based on Arm Neoverse V2



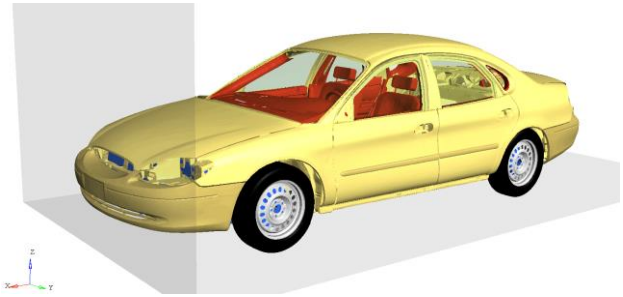


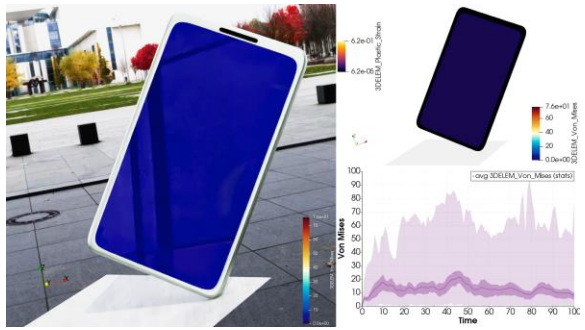


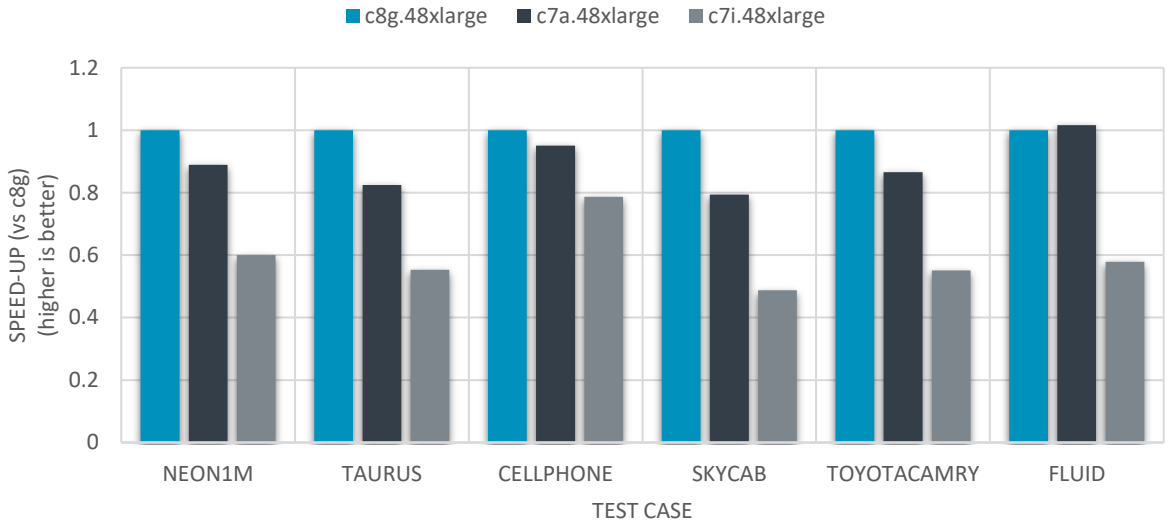
* From https://www.aboutamazon.com/news/aws/graviton4-aws-cloud-computing-chip

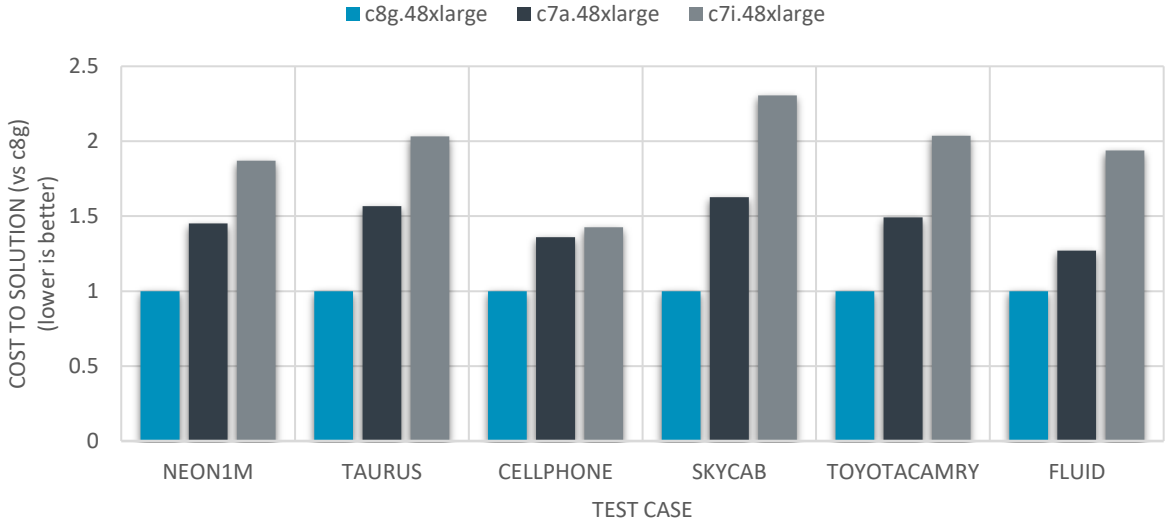
Altair OpenRadioss

AWS EC2 Instances benchmark









Competitive performance

Arm Neoverse V2-based AWS Graviton 4 processors gives competitive performance against AMD Genoa-based and Intel Sapphire Rapids-based instances.

Leading cost to solution

Graviton 4 shows great benefits in terms of price-performance compared to x86 instances.

I have no experience with Arm

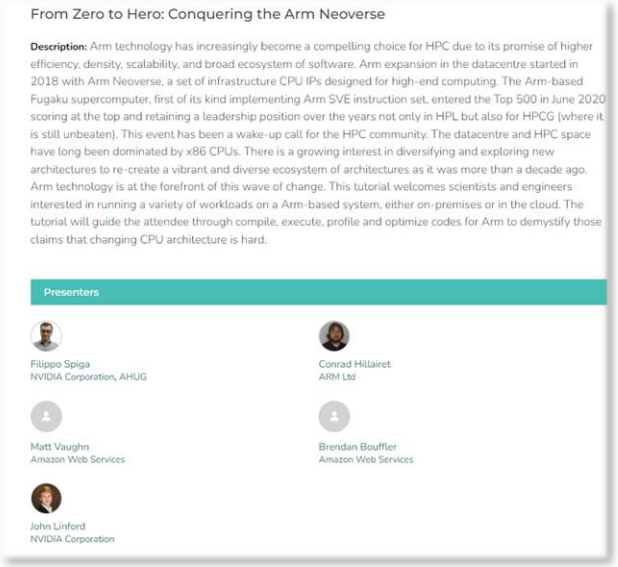
Should I be worried ?

Overthinking:
The art of creating problems that weren't even there.

Most applications compile on Arm architecture with little to no modification

- All major Linux distributions support Arm, with extensive library of common packages (AArch64).
- Upgrading to newer library / software versions might be needed.
- GNU Compiler Collection (GCC) and LLVM are fully supported.
- Commercial compilers for Arm are available.

SC23 Denver, CO | i am hpc.


From Zero to Hero: Conquering the Arm Neoverse

Description: Arm technology has increasingly become a compelling choice for HPC due to its promise of higher efficiency, density, scalability, and broad ecosystem of software. Arm expansion in the datacentre started in 2018 with Arm Neoverse, a set of infrastructure CPU IPs designed for high-end computing. The Arm-based Fugaku supercomputer, first of its kind implementing Arm SVE instruction set, entered the Top 500 in June 2020 scoring at the top and retaining a leadership position over the years not only in HPL but also for HPCG (where it is still unbeaten). This event has been a wake-up call for the HPC community. The datacentre and HPC space have long been dominated by x86 CPUs. There is a growing interest in diversifying and exploring new architectures to re-create a vibrant and diverse ecosystem of architectures as it was more than a decade ago. Arm technology is at the forefront of this wave of change. This tutorial welcomes scientists and engineers interested in running a variety of workloads on a Arm-based system, either on-premises or in the cloud. The tutorial will guide the attendee through compile, execute, profile and optimize codes for Arm to demystify those claims that changing CPU architecture is hard.

Presenters

Filippo Spiga
NVIDIA Corporation, AHUG

Conrad Hillairet
ARM Ltd

Matt Vaughn
Amazon Web Services

Brendan Bouffler
Amazon Web Services

John Linford
NVIDIA Corporation

https://github.com/arm-hpc-user-group/sc23-tutorial-neoverse

arm

arm COMPILER

Arm provided C/C++/Fortran compiler with best-in-class performance

Compilers tuned for Scientific Computing and HPC

Latest features and performance optimizations

Freely available

Tuned for Scientific Computing and HPC workloads

- Processor-specific optimizations for Neoverse-based platforms
- Optimal shared-memory parallelism using latest Arm-optimized OpenMP runtime

Linux user-space compiler with latest features

- C++ 17 and Fortran 2003 language support with OpenMP 4.5
- Support for Armv8-A and SVE architecture extension
- Based on LLVM and Flang, leading open-source compiler projects

Freely available on leading Linux distributions

Documentation

- Fortran : https://developer.arm.com/documentation/101380/latest
- C/C++ : https://developer.arm.com/documentation/101458/latest

arm PERFORMANCE LIBRARIES

Optimized BLAS, LAPACK and FFT for HPC applications

Freely available

Best-in-class performance

Validated with
NAG test suite

Arm provided 64-bit Armv8-A math libraries

- Optimized BLAS, LAPACK, FFT and math.h routines
- FFTW compatible interface for FFT routines
- Sparse linear algebra and batched BLAS support

Best-in-class serial and parallel performance

- Generic Armv8-A optimizations by Arm
- Tuned for Arm Neoverse family of processors

Validated by Arm Engineers

- Validated with NAG's test suite, a de-facto standard
- Community supported

Documentation

- https://developer.arm.com/documentation/102620/latest

GNU compilers are a solid option

- With Arm being significant contributor to upstream GNU projects

- GNU compilers are first class Arm compilers
  - Arm is one of the largest contributors to GCC
  - Focus on enablement and performance
  - Key for Arm to succeed in Cloud/Data center segment

- GNU toolchain ships with Arm Allinea Studio
  - Best effort support
  - Bug fixes and performance improvements in upcoming GNU releases

- GCC 14.2.0

MPI

- Parallel Programming

- Supported since 3.1.2 (currently 4.1.7 & 5.0.6)
- Provided by default on AWS EC2 Graviton instances
- Upstream contributions
- Used inhouse
- Active development from Arm and Arm partners

Support

- How can I get some help during the event ?

- Via Slack
  1. Join the AHUG Slack Workspace
     - You may receive an invitation prior to the event
     - Link available here https://a-hug.org/contact/
  2. Join the **teratec-hackathon-hpc** slack channel
     - Send a private message to Conrad Hillairet
  3. Ask your questions:
     - **In the slack channel**
     - Using private message to Conrad Hillairet
- Email
  - conrad.hillairet@arm.com

Thank You
Danke
Gracias
Grazie
谢谢
ありがとう
Asante
Merci
감사합니다
धन्यवाद
Kiitos
شكرًا
ধন্যবাদ
תודה
ధన్యవాదములు

Graviton4 introduction

Arthur Petitpierre
Graviton Principal SA
Amazon Web Services

Graviton4

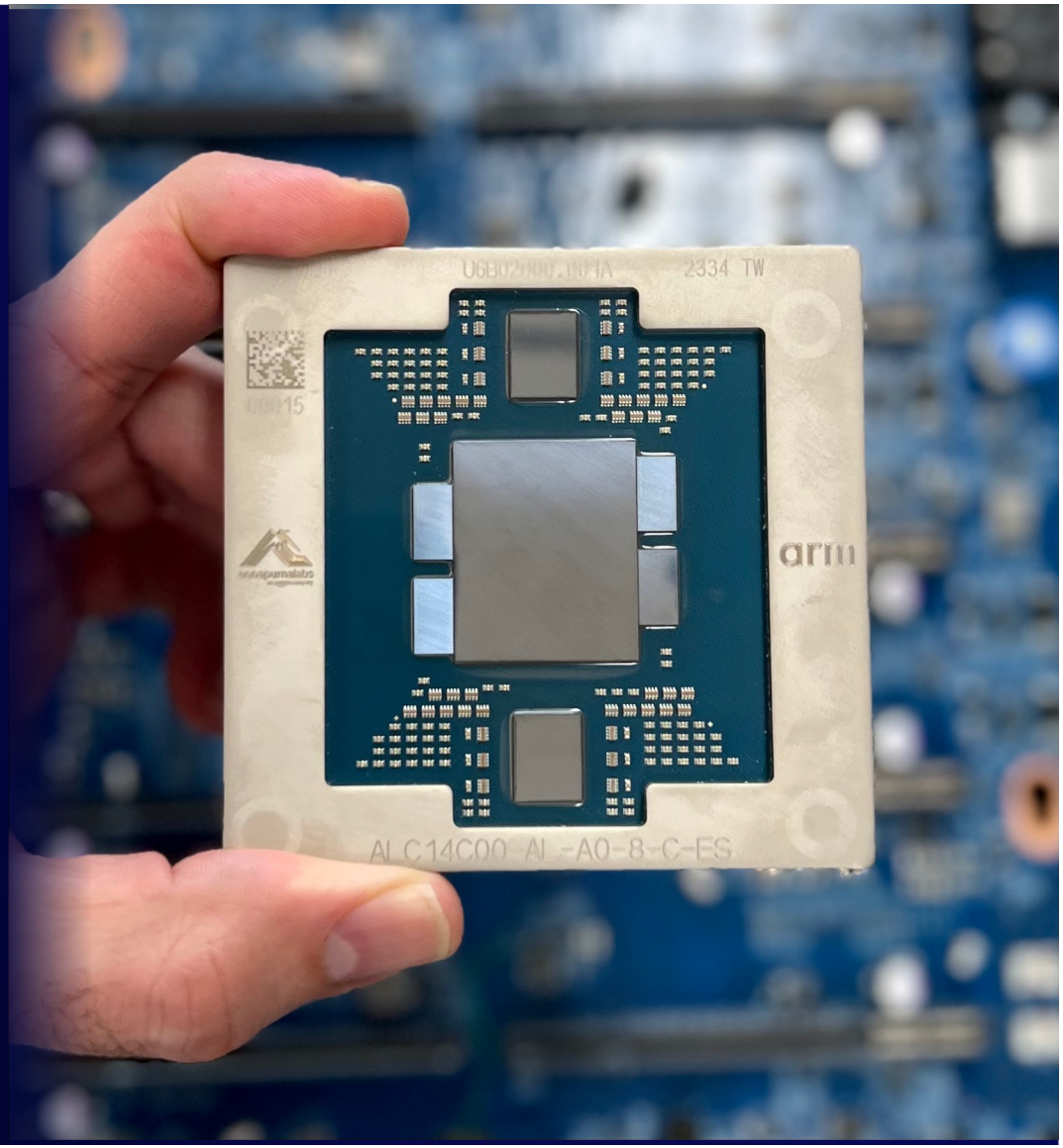
96 Neoverse V2 Cores

2M L2 cache per-core

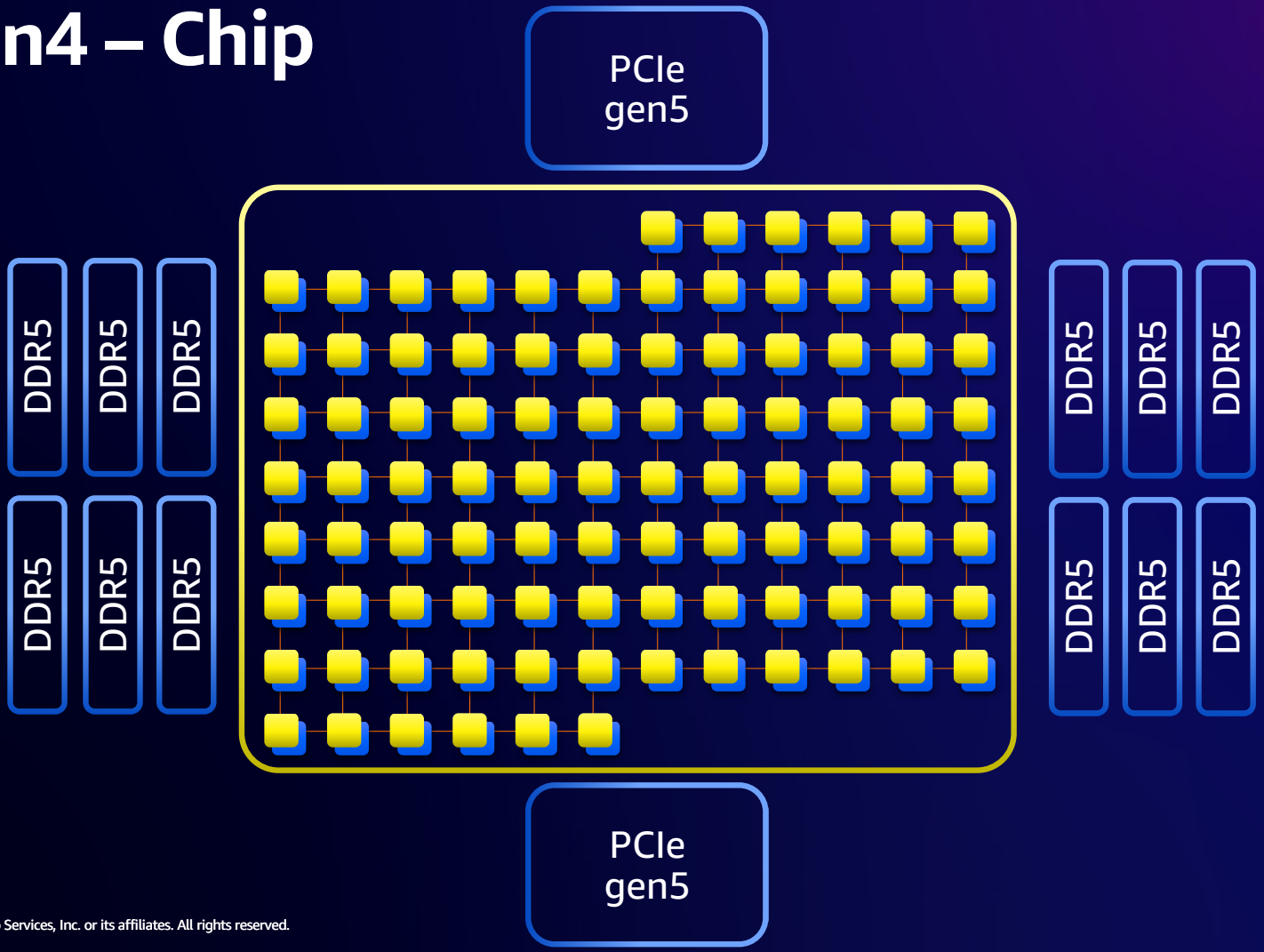
Seven chiplet design

12 DDR5-5600 channels

Up to 96 lanes of PCIe gen5



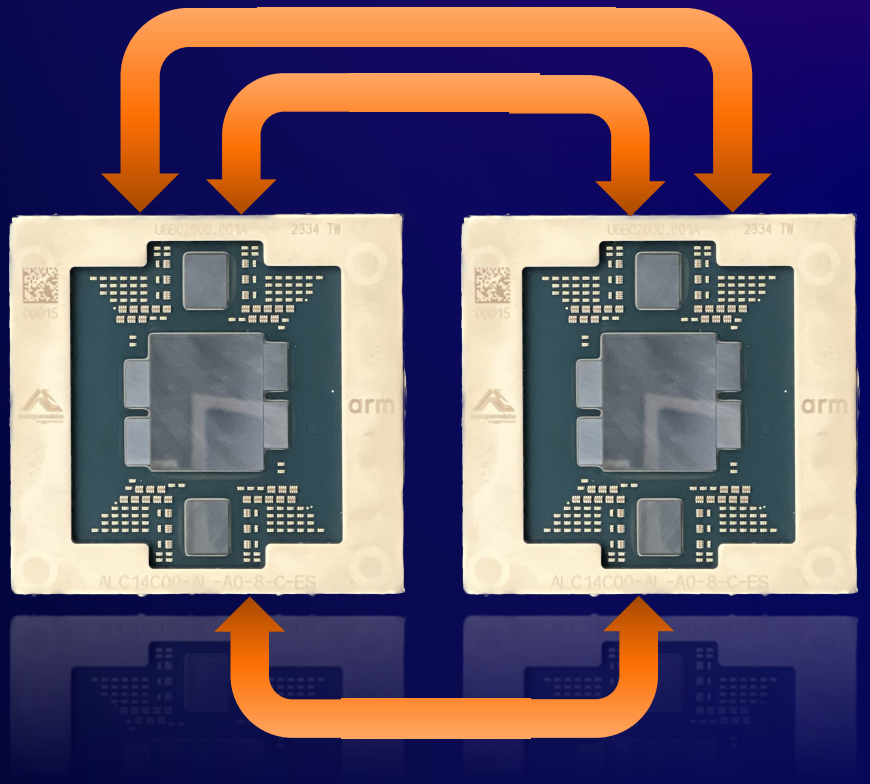
Graviton4 – Chip



Graviton4 Scale Up

EXPANDING WORKLOADS GRAVITON APPLIES TO

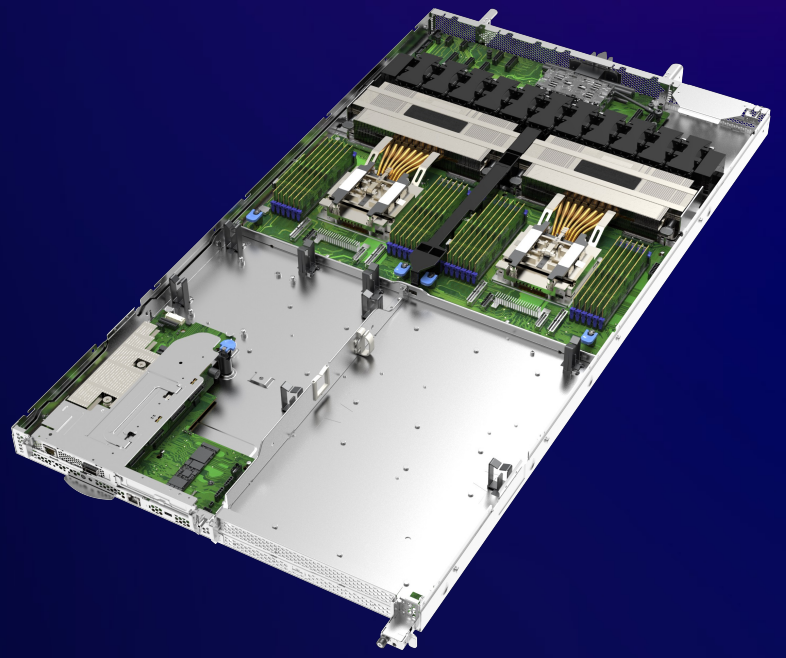
- Single socket 24xl (96 vCPUs)
  - 50% more cores-per-socket than Graviton3
- Support for coherent multi-socket
- Single systems with up to:
  - 3x more cores than Graviton3
  - 3x more DRAM than Graviton3



Flexible Dual-Socket Configurations

Four operating modes enabled by Nitro

- Two non-coherent virtual
- One coherent virtual instance
- Two metal instances
- One coherent metal instance



Save power when not operating in coherent mode

Focusing on Real Workload Optimization

	Graviton3 (V1)	Graviton4 (V2)
Caches		
L2 Cache per core	1MB	2MB
Branch Prediction		
NanoBTB	96	1k
BTB	8k	4k+12k
Fetch Queue	16 entries	32 entries
Fetch Buffer	12 entries	16 entries
Architecture Features		
SIMD	SVE	SVE2
Control flow integrity	PAC	PAC+BTI

Thank you!

Arthur Petitpierre
arthurpt@amazon.com

Teratec Hackathon HPC

Benjamin Depardon – benjamin.depardon@ucit.fr
Jorik Remy – jorik.remy@ucit.fr

one thing is sure…

Hybrid is the future of HPC

The question is

HOW TO GET THERE?

Your key partner for Hybrid HPC

OPTIMIZE

OKA Suite

WORKCLOUD

SELECT

RATIONALIZE

NICE
an aws company

aws partner network

FLEXIBILIZE

HPC Cloud Journey

Consulting

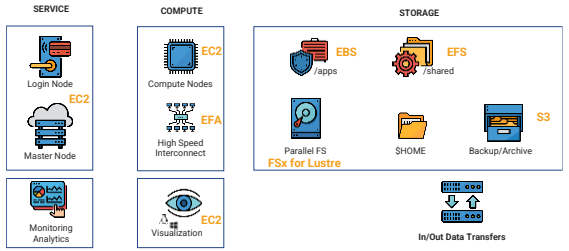
OKA Suite

Identify HPC Workloads and their On-Premises Behaviour

WORKCLOUD

Understand the appropriate Move to Cloud Strategy

Build



HPC Reference Architecture

CCME

Prototype / Test / Benchmark

Integration & Move-to-Cloud

Run

CCME

CCME Support & Professional Services

Storengy Moves HPC to AWS, Runs Geoscientific Simulations 2.5 Times Faster

2021

Storengy, a subsidiary of the ENGIE Group, is a leading supplier of natural gas. The company offers gas storage, geothermal solutions, carbon-free energy production, and storage technologies to enterprises worldwide. To ensure its products are properly stored, Storengy uses high-tech simulators to evaluate underground gas storage, a process that requires extensive use of high-performance computing (HPC) workloads. The company also uses HPC technology to run natural gas discovery and exploration jobs.

For many years, Storengy ran its HPC workloads in an on-premises IT environment, but it struggled to manage an increase in jobs. “Our HPC environment was not designed to scale easily. We had to do larger simulations in a very short time as our business grew, and we lacked the ability to support the gas exploration workloads,” says Jean-Frederic Thebault, engineer at Storengy.

Storengy also sought to accelerate the deployment of HPC clusters for its engineers. “It typically took weeks or sometimes months to provision server clusters for a new project,” says Thebault. “We wanted our engineers spending their time on research, not provisioning.”

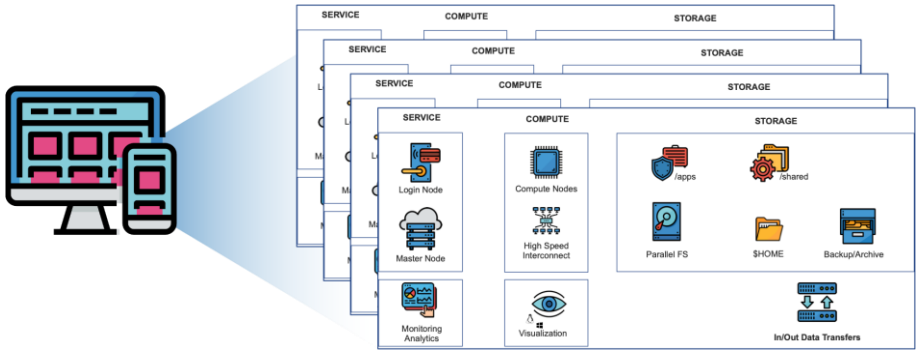
> **Using the CCME tool on AWS, we can deploy HPC resources in 30 minutes, compared to the weeks or months it would take to procure servers and provision compute in our on-premises environment.”**
>
> **Jean-Frederic Thebault**
> *Engineer, Storengy*

What is CCME?

Solution to transparently **build customizable HPC clusters in AWS**

CCME

Match workloads' needs: adapt the type and number of **compute resources**, provision a **high-performance network** and **file system**, automatically **scale in and out…**



adaptability simplicity
data management
heterogeneity publish services
remote visualization
standard jobs scheduler accessibility
web interface user management security
cost management

Cluster-in-a-Box: For An easy AWS Cloud Journey

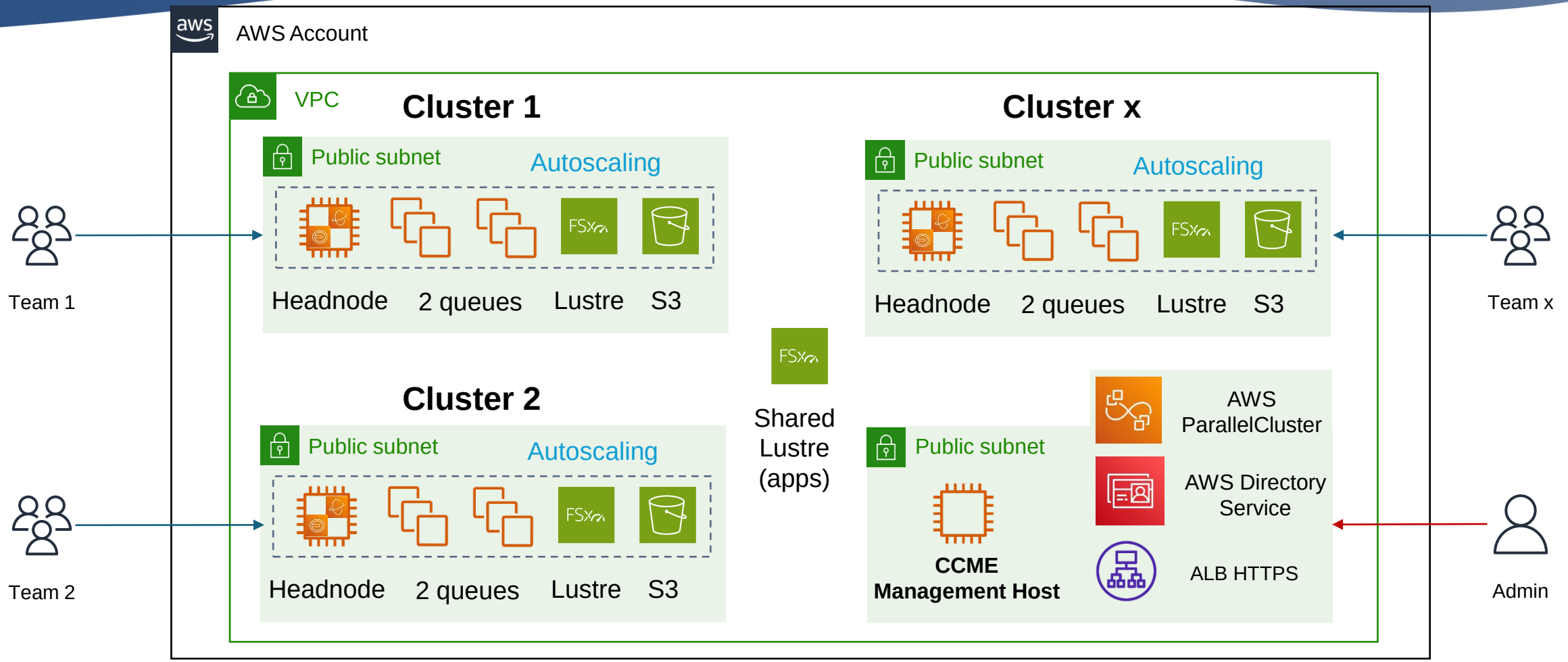
UCit manages it for You

Your HPC Cluster of CHOICE on AWS…

Cost & Budget under Control

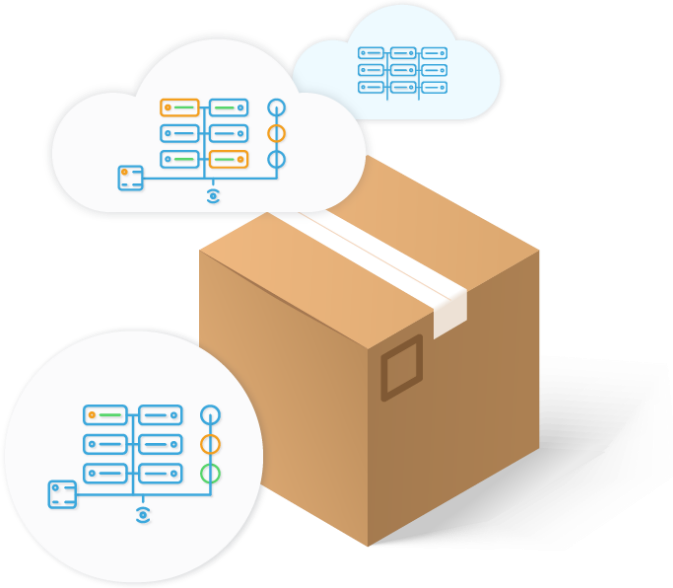
Simple Access through SSH or a Web Portal

Hackathon Architecture



Cluster available for each team

- Each cluster is fully isolated from the others (network, accounts…)
- Job scheduler: SLURM
- Headnode: c8g.4xlarge (16 vCPUs, 32 GiB)
- Compute, 2 queues
  - c8g.24xlarge (96 vCPUs, 192 GiB) – 1 instance
  - c7g.16xlarge (64 vCPUs, 128 GiB) – 1 instance
- Storage
  - Shared NFS – 500GiB (/home)
  - **FSx for Lustre – 1.2TB (/fsx)**
  - S3 for results
- Remote access
  - SSH connection to frontend node through login/password
  - Web portal EnginFrame



The Hackathon Box

Available from Monday 9AM to Friday 7PM

Learn more at

www.ucit.fr

THANK YOU
&
GOOD LUCK!