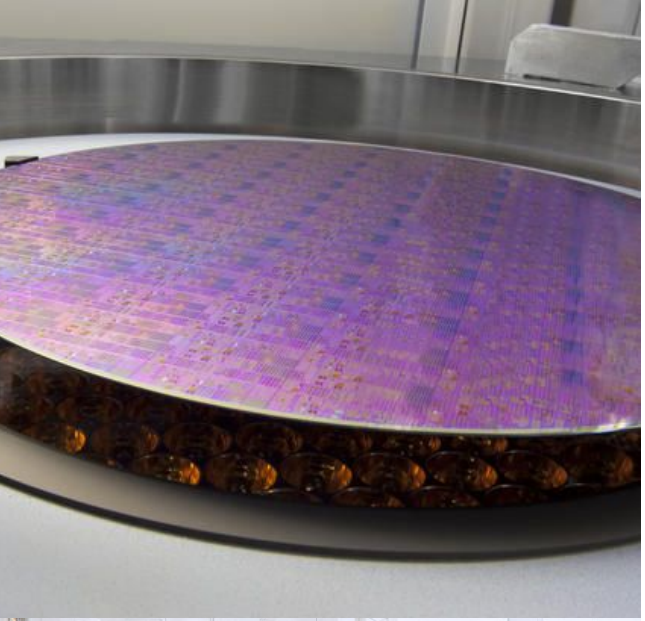
Leveraging Arm Architecture and Rescale Cloud HPC Platform for Enhanced OpenFOAM Performance: A Comparative Analysis

CCFR Webinar
23 January 2024

Sam Zakrzewski PhD.
Senior Solutions Architect
samz@rescale.com

Guillaume Trainar
Director Southern Europe
guillaume@rescale.com



Agenda

- Rescale Introduction
- Arm Partnership
- Chip Architecture
- Single Node Benchmarks
- Multi Node Benchmarks
- External Solver - Michelin's Requirements
- How can you enable your code on `aarch64`?
- Conclusions

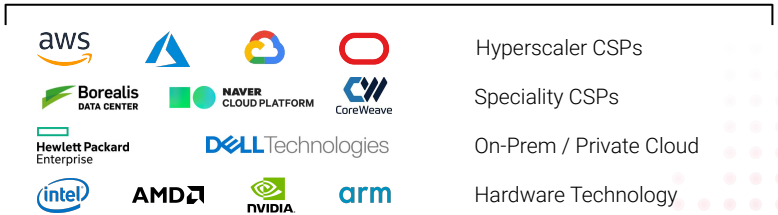
Rescale Completes the Digital Thread in a Diverse Ecosystem

Application / ISV Publishing
(Commercial, Open-source, Custom)

PLM, SPDM,
Workflow
Orchestration,
Schedulers

NFS / DL /
DW
Connectors

Hyperscaler CSPs, SCSP / On-Prem
Technology Connectors



rescale

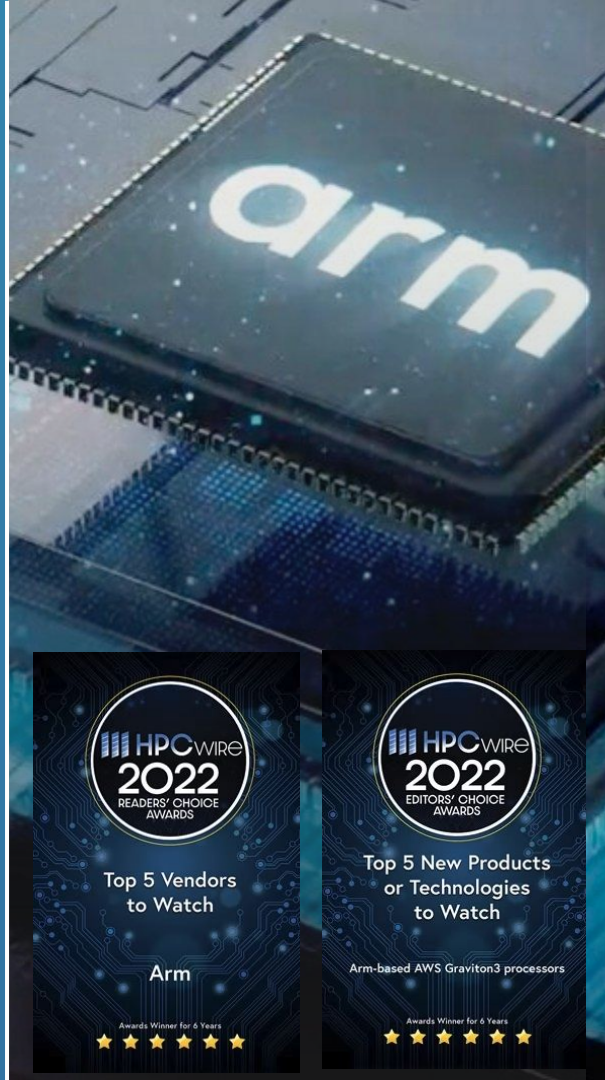
arm

Rescale
Customer Spotlight

Company: Arm
Industry: Engineering Consulting
Use Cases: Chip Design, Design Verification, High Throughput Computing

"Rescale is helping Arm usher in a new era for chip design. Arm-powered cloud computing combined with the intelligent automation of the Rescale platform brings many benefits to our design and verification processes by not only helping Arm engineers create the world's most advanced IP, but also enabling our ecosystem to take full advantage of multi-cloud resources for accelerating R&D. With Rescale, our engineering teams can access the best computing resources they need – including the price/performance and sustainability benefits of running on Arm architecture – whenever they need them."

— Mark Galbraith, VP of Productivity Engineering



AWS Graviton3

Hardware based on Arm technologies

Greener Compute 60% less energy*

Graviton2 Processor

Frequency
2.5 GHz

Many core
architecture
64 cores

Peak Flops
1280 Gflops
2x128-bit NEON

Non-NUMA

Peak Memory B/W
204 GB/s
8 channels of DDR4

7 nm

Arm Neoverse N1

Graviton3 Processor

Frequency
2.6 GHz

Many core
architecture
64 cores

Peak Flops
2662 Gflops
2x256-bit SVE
or 4x128-bit NEON

Non-NUMA

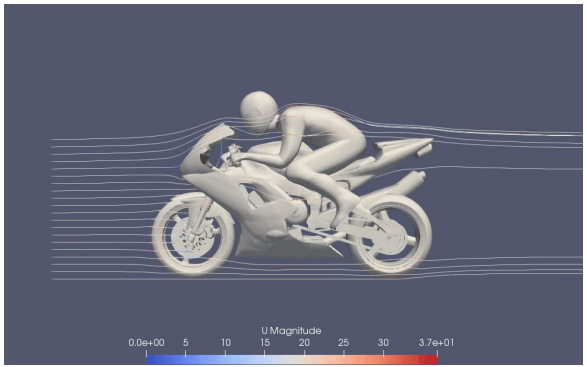
Peak Memory B/W
307 GB/s
8 channels for DDR5

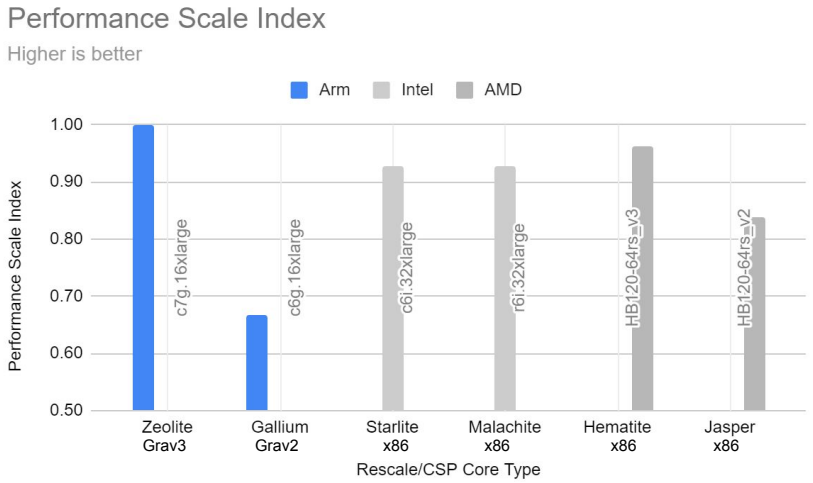
Energy
efficiency
5 nm

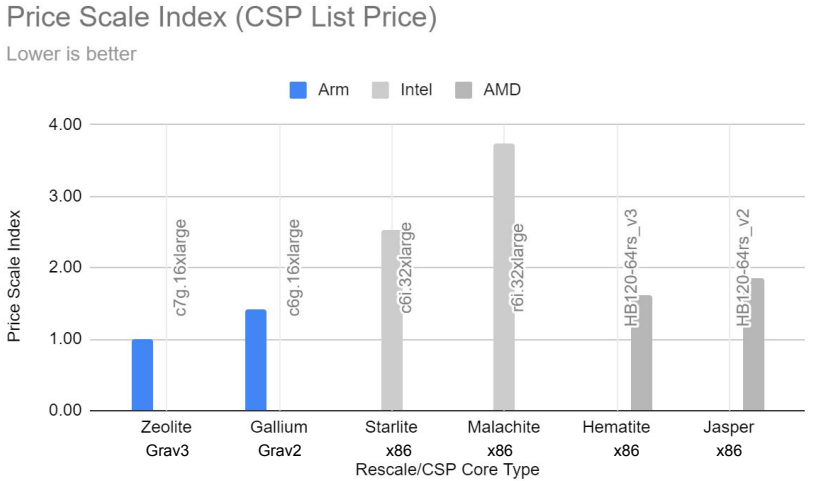
Arm Neoverse V1

Single Node Benchmarks

- MotorBike Tutorial `simpleFoam`
- OpenFOAM+ v2212
- 0.35 million cells
- 64 cores per node
- `aarch64` and `x86_64` compiled with `gcc`

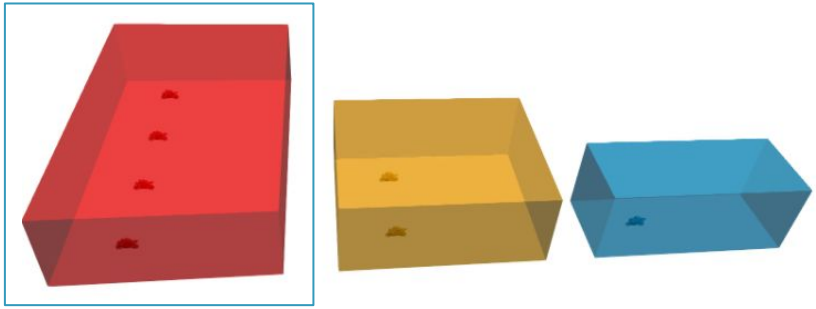


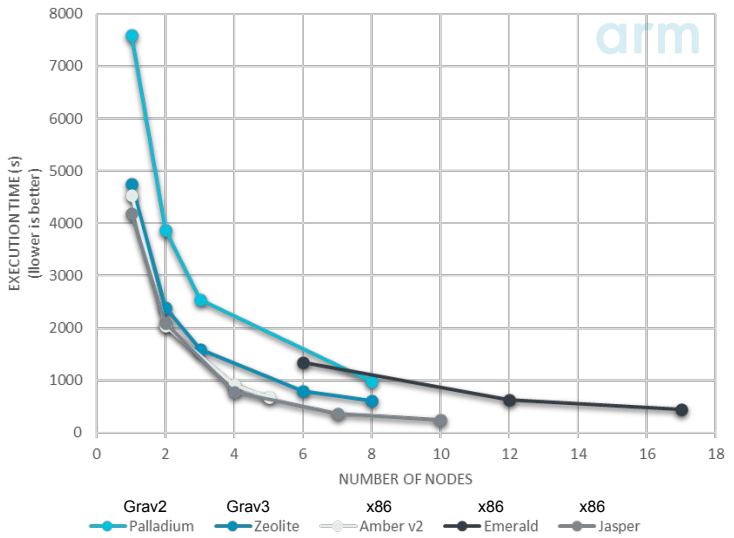


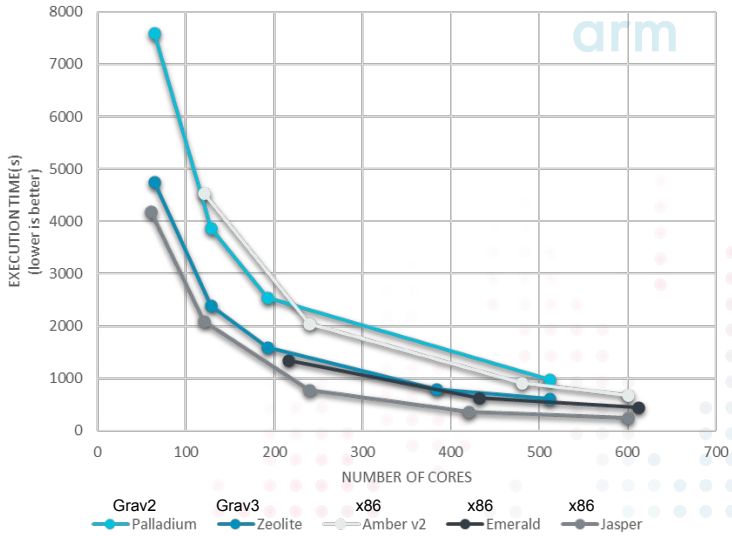


Multi Node Benchmarks

- HPC MotorBike `simpleFoam LARGE`
  - High Performance Computing Technical Committee
- OpenFOAM+ v1912
- 34 million cells
- OpenMPI
- `aarch64` and `x86_64` compiled with `gcc`

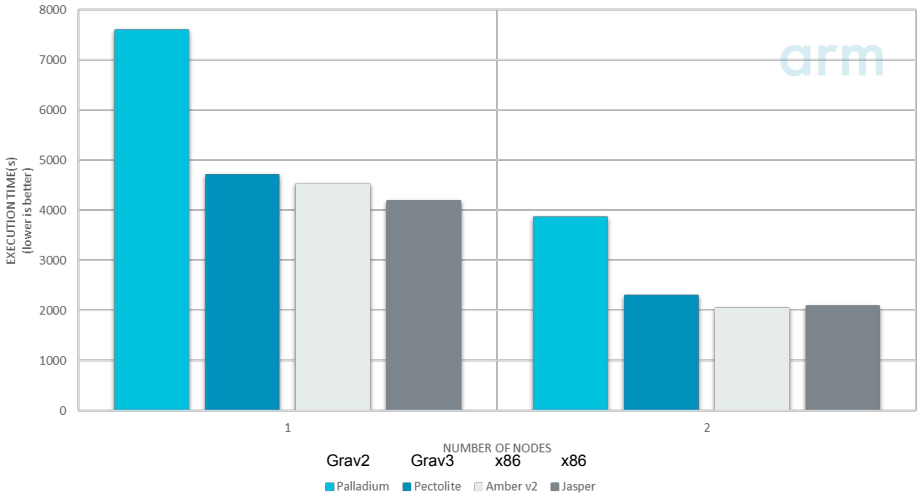


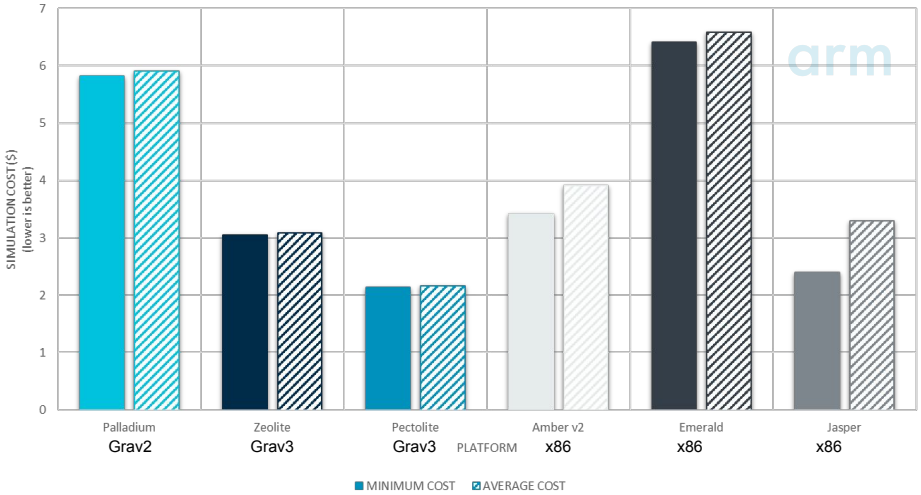




Cost Performance

- For a given number of nodes this OpenFOAM test case runs slightly faster on AMD based instances, up to 13%.
- The main reason is the memory bandwidth at the node level : 350 GB/s for both Amber v2 and Jasper versus 307 GB/S for Pectolite and 204GB/s for Palladium

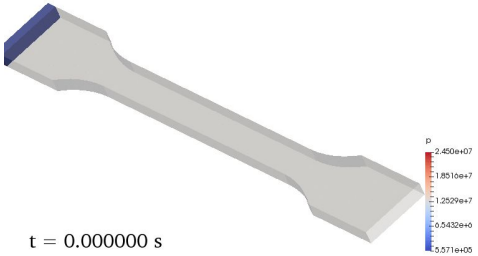


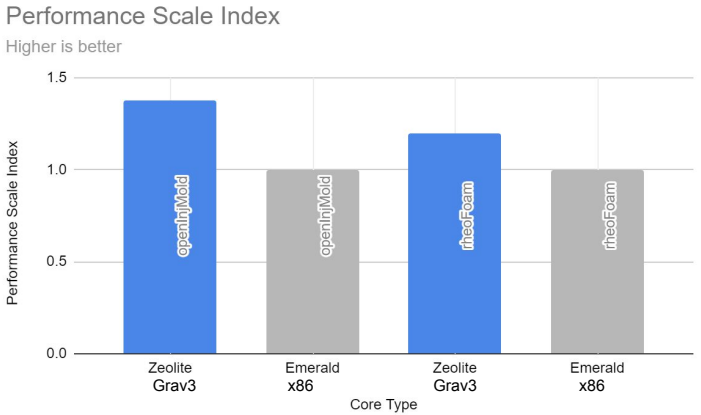


- Pectolite, AWS Graviton 3 based on Arm Neoverse V1 technologies minimizes the cost of simulation.
- Differences between AVERAGE COST and MINIMUM COST on Amber v2 and Jasper could be due to the fact that the test case starts to fit into L3 cache for a higher number of nodes

External Solver - Michelin's Requirements

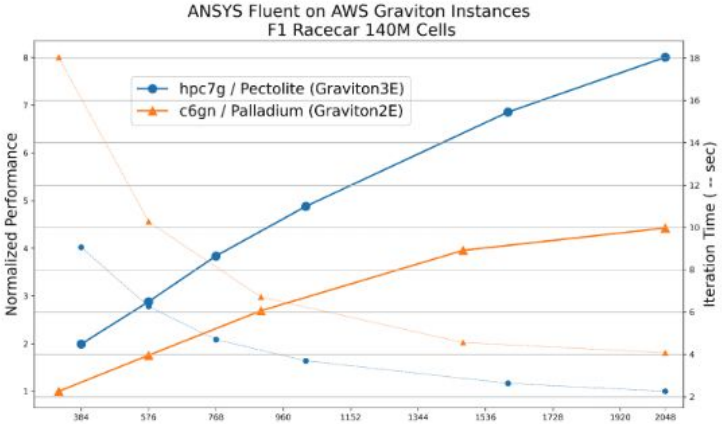
- Michelin is working together with the University of Minho on their material science simulation R&D workflow
- Injection molding and extrusion models in OpenFoam are used to investigate material production characteristics
- External OF solver used OpenInjMod and RheoTool (OpenFOAM 7)
- Compiled for `aarch64` and `x86_64` with `gcc`
- Pre-compiled library implementation





Leveraging `aarch64` on Rescale

- Various ways of deploying `aarch64` software:
- Most major simulations software already available:
  - Siemens CCM+, ANSYS Fluent, LS-Dyna, LAMMPS, GROMACS, SU2, Nvidia NGC Catalog
- Deploy your own containerised software
  - Docker, Apptainer, Singularity
- Compile your full stack on a `aarch64` instance:
  - `gcc` compilers available
  - `armcc` and Arm Performance Libraries
  - `armclang|armclang++` (Arm C/C++ Compiler)
- Publish your `aarch64` software on the platform using Rescale Software Publisher



https://rescale.com/blog/rescale-automates-the-deployment-of-ansys-ls-dyna-and-ansys-fluent-workloads-on-amazon-ec2-hpc7g-instances/

Conclusions

- The Rescale Arm partnership allows engineers to **seamlessly leverage** the latest CPU technologies to drive their digital product development cycle
- AWS Graviton 3 is a major step forward in terms of HPC **applicability and performance** compared to its predecessor.
- Single node benchmarks show that the latest Arm architecture chips are **industry leading** in both Performance and Cost
- Multi node benchmarks show that Arm chips are on a par with AMD and Intel's industry standard cloud HPC core types performance wise, whilst **leading the pack** when it comes to cost
- Engineers are able to develop and run their own OpenFoam solvers on Rescale and deploy them on the architecture of their choice with a consistent methodology in **matter of days**
- Migrating to Arm is a **trivial exercise** for **all compatible HPC workflows** on Rescale

Acknowledgements

- Arm
  - Conrad Hillairet - Staff HPC Engineer
  - David Lecomber - Segment Director for HPC
- Michelin
  - Pierre Barbat - R&D Engineer
  - Pascal Mineau - R&D Engineer
- Rescale
  - Romain Klein - Senior Director, Technical - EMEA
  - Guillaume Trainar - Senior Account Executive
  - David Green - Account Executive
  - Scott Wieland - HPC Engineer
  - Jared Workman - Manager, HPC Engineering

Start your free trial today!

Rescale Test Drive

Instant access to high performance computing for engineering and scientific applications

Digitally transform your R&D process

Join thousands of global leaders developing new innovations across industries including aerospace, automotive, energy, government, higher education, life sciences, industrial manufacturing, semiconductor, and electronics.

Visit: https://eu.rescale.com/signup/

Scan Me

High Performance Computing Built for the Cloud

- Digital Engineering
- Workload Optimization
- Intelligent Automation
- Security & Compliance

Become a Rescale Certified User Expert. Learn more at rescale.com/training

DEMO