TOWARD THE DEMOCRATIZATION OF CAE WITH SOFTWARE CONTAINERS

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CAE, HPC, case studies, cloud, containers, benchmark

ABSTRACT

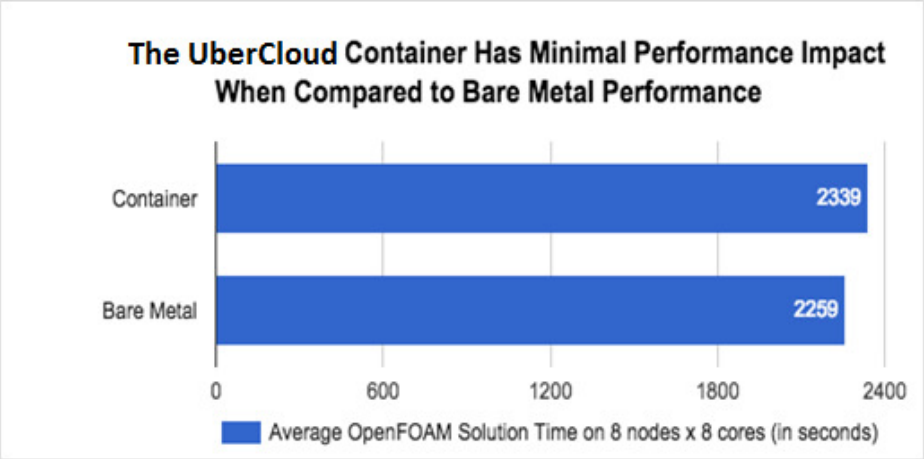
Countless case studies demonstrate impressively the importance of Computer Aided Engineering (CAE) for engineering insight, product innovation, and market competitiveness. But so far CAE was mostly in the hands of a relatively small elite crowd, not easily accessible by the large majority of engineers. In this presentation we argue that – despite the ever increasing complexity of CAE tools, hardware, and system components – engineers have never been this close to ubiquitous CAE, as a common tool, for every. The main reason for this next big progress can be seen in the continuous advance of CAE software tools which assist enormously in the design, development, and optimization of manufacturing products. Now, we believe that the next big step towards ubiquitous CAE will be made very soon with new software container technology which will dramatically facilitate software packageability and portability, ease the access and use, and simplify software maintenance and support, and which finally will pass CAE into the hands of every engineer.

These novel high performance interactive application software containers, whether they run on-premise, on public or on private clouds, bring a number of core benefits to the otherwise traditional HPC environments with the goal to make HPC widely available, ubiquitous:

- **Packageability:** Bundle applications together with libraries and configuration files.
- **Portability:** Build container images once, deploy them rapidly in various infrastructures.
- **Accessibility:** Bundle tools such as SSH into the container for easy access.
- **Usability:** Provide familiar user interfaces and user tools with the application.

- **Rapid Deployment:** Simplify and compress deployment time of HPC applications.

In addition, the lightweight nature of the CAE container suggests low performance overhead. Our own performance tests with multi-host multi-container CAE applications on the Lawrence Livermore National Lab (LLNL) Hyperion supercomputer and on Microsoft Azure A8/A9 compute instances demonstrate that there is no significant overhead for running high performance workloads as a CAE container.



In our extended abstract and in the presentation we will highlight several performance benchmark results with CAE applications. We also aim at presenting two case studies with ANSYS, CD-adapco, and OpenFOAM containers running on LLNL Hyperion and on the Microsoft Azure Cloud:

- **Case Study:** UberCloud Team 182 – OpenFOAM Modelling and Product Optimization of an ABB Dry-type Transformers in the Cloud.
- **Case Study:** UberCloud Team 185 – Simulation of Air Flow Through an Engine Intake Manifold in the Cloud.

During the past two years UberCloud has successfully built CAE containers for software from ANSYS (Fluent, CFX, Electromagnetics, Icepak, Mechanical, LS-Dyna, DesignModeler, and Workbench), CD-adapco STAR-CCM+, COMSOL Multiphysics, NICE DCV, Numeca FINE/Marine and FINE/Turbo, OpenFOAM, PSPP, Red Cedar HEEDS, Scilab, Gromacs, and more. These application containers are now

running on cloud resources from Advania, Amazon AWS, CPU 24/7, Microsoft Azure, Nephoscale, OzenCloud, and others.

Together with recent advances and trends in application software and in high performance hardware technologies, the advent of lightweight pervasive, packageable, portable, scalable, interactive, easy to access and use CAE software containers running seamlessly on workstations, servers, and any cloud, is bringing us ever closer to what Intel calls the Democratization of High Performance Computing, and to the age of Ubiquitous CAE where *"technology recedes into the background of our lives,"* according to Xerox PARC's Mark Weiser.