CFD setup and computational time cut 50 percent

"By using UberCloud 's ready-to-execute STAR-CCM+ application container, we simplified our software setup, and the Microsoft Azure HPC cluster based on Intel Xeon processors delivered a much faster analysis than our desktop workstations could. Our approach—using UberCloud containers and Azure HPC—cut our overall time by 50 percent."

Velmurugan Patchamuthu, Founder & CEO, CAE Technology Services Inc.

Manufacturers in many industries worldwide are using computational fluid dynamics (CFD) in designing their products by running simulations of how gases and fluids flow around and through their product materials. CFD offers engineers and researchers the math tools they need to investigate how gases or fluids flow around physical objects to help streamline those flows and optimize the materials and geometry of those objects. While CFD can be done with powerful workstations, users are finding that harnessing the superior horsepower of high-performance computing (HPC), plus the use of software containers, can deliver results far faster and easier—and with higher quality. That's what brought UberCloud and CAE Technology together.

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Tapping the power of HPC supercomputing

Founded in 2009 by CEO Velmurugan Patchamuthu, CAE Technology today has 75 engineers working from offices in India, Germany, Silicon Valley, and the Middle East. They provide a broad portfolio of sophisticated engineering services, including computer-aided design, computer-aided engineering, CFD, structural analysis, and much more. The company's global client base represents some of the biggest names in aerospace, automotive, heavy engineering, rail, marine, and medical devices.

CFD calculations are best run on supercomputers with parallel processing. Found most often in large corporations and universities, the technology was typically beyond the means of smaller companies like CAE Engineering until recent years. Advances in workstations' computing power can make it possible for CFD users to run simulations on their desktops, but the computations can take hours, sometimes days.

In 2012, Burak Yenier and Wolfgang Gentzsch set out to change that. They launched UberCloud, a Microsoft and Intel partner, in California's Silicon Valley as a way to provide the world's scientific and engineering communities with much greater access to existing HPC resources via the cloud computing concept. Intel was one of UberCloud's early funders and worked with Yenier and Gentzsch on several projects, lending technical support and advice.

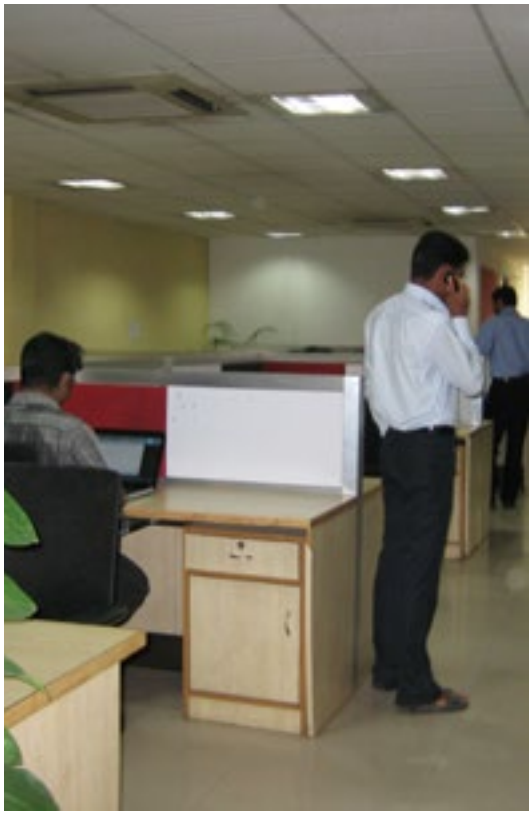
As Yenier, now UberCloud's CEO, explains, "To start, we want to democratize high-performance computing, making it much more accessible and, at the same time, much easier to use, like what Microsoft Azure HPC clusters based on Intel Xeon processors can provide our users. But our ultimate goal in doing so is to help unleash what we think is an enormous but pent-up wave of creativity and innovation in science and engineering."

Gaining momentum and enabling the future

Today, UberCloud counts more than 3,000 companies and individuals from 72 nations as part of its community of providers and users. It offers access to more than 50 different cloud resources, including Microsoft Azure HPC clusters, plus a diverse selection of more than 100 software providers.

In 2014, Yenier met Patchamuthu and found that CAE Technology's CFD client services made it a perfect candidate for what UberCloud calls an "experiment"—a CFD test simulation using one of UberCloud's HPC resources and its containerized software applications. At the time, CAE Technology's engineers were running their CFD applications on workstations, taking whatever time they needed for their calculations.

They chose as their CFD analysis use case an assignment that CAE Technology had received from a top client, one of the world's largest auto manufacturers. The project involved the intake manifold of a new V6 engine design. The car maker



Customer Name: CAE Technology Services
Industry: Information Technology
Country or Region: US
Customer Website: www.caetechnology.net
Employee Size: 75
Partner Name: UberCloud

Customer Profile
CAE Technology Services, based in Bangalore, India, provides a wide range of engineering services—from product design, to 2D and 3D modeling, to sophisticated analyses (FEA, crash analysis, and CFD)—for clients in the automotive, aerospace, medical equipment, and oil and gas industries, among many others.

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"We plan to use UberCloud Star-CCM+ containers and Microsoft Azure HPC clusters featuring Intel Xeon processors as a powerful combination that's especially suitable for our most urgent, time-sensitive client projects. The tools both are accessible anytime and, via the cloud, anywhere in the world, so we gain much greater flexibility in how we can serve our clients' needs going forward."

Velmurugan Patchamuthu, Founder & CEO, CAE Technology Services Inc.

wanted CAE Technology to conduct what's called a steady-state, incompressible flow analysis. "The goal of this investigation was to help our client's V6 engine designers and engineers understand the airflow and pressure drops through the manifold's six branches, so they can optimize them to achieve maximum engine efficiency," Patchamuthu explains. "It's important to achieve a uniform flow rate across each branch of the intake duct, and our CFD analysis will help them do this."

Using UberCloud containers and Microsoft Azure HPC resources

To conduct the necessary CFD calculations for this simulation, Patchamuthu and Yernier chose STAR-CCM+ CFD computation software from CD-adapco, a leading provider of application software for computer-aided engineering. STAR-CCM+ introduced the first commercially available polyhedral meshing algorithm. Meshing refers to how CFD divides the surface geometry of an object into discrete elements called cells that are suitable for computational analysis. Polyhedral meshing provides more accurate analysis for fluid-flow studies than a hexahedral or tetrahedral mesh of a comparable number of cells.

The experiment team accessed the STAR-CCM+ software by way of an UberCloud Application Container, a ready-to-execute package in the cloud. The container greatly simplifies the steps involved in configuring the software for the CFD simulation and running it on the selected HPC cloud resource.

According to Yenier, turn-key software containers save time because of their preset configurations, which are optimized for HPC operations. "We compare them to multimodal shipping containers that have revolutionized how cargo was shipped around the world, saving huge amounts of time and cost," he says. "These containers promise to do the same for software, especially when used in complex applications like CFD on HPC resources."

For compute-intensive processing power, they selected the Microsoft Azure platform's parallel-processing HPC cluster using Linux RDMA Technology and based on Intel Xeon processors. The computations were performed in the Microsoft Azure cloud, on Azure A9 instances. These featured a 10-node class, medium-sized cluster, with 8 compute nodes featuring dual-socket Intel Xeon E5-2670 CPUs operating at 2.60 gigahertz and 112 gigabytes of RAM. The setup totaled 128 cores and 1 terabyte of RAM. "We were really happy to have been working with both Microsoft and Intel technologies on this project, because that helped to assure us that the HPC performance would run our CFD experiment as specified," Patchamuthu says.

The Azure A9 instance nodes were connected with a 40 Gbps InfiniBand network with remote direct memory access (RDMA) technology. The Linux-based RDMA technology can help boost the performance of the Message Passing Interface, a standard communications

protocol in parallel processing, to a latency of less than 3 microseconds and nonblocking 32 Gbps of throughput.

Cutting setup and computational times by 50 percent

The simulation required two steps using the STAR-CCM+ UberCloud container running on the Azure A9 instance. The first was to create a polyhedral mesh of the V6 intake manifold's design, which numbered 3.47 million cells. This operation took 17.7 minutes on 128 cores.

The second step was to run 10,000 iterations of the simulation, monitoring air velocity, pressure, and other parameters. This step took 5 hours and 20 minutes on 128 cores, compared with the simulation run on the workstation, which took more than 14 hours. Post-processing of the results included the development of visualizations for the contours of air-flow velocity, pressure, flowlines, and other outputs.

"By using UberCloud's ready-to-execute STAR-CCM+ application container, we simplified our software setup, and the Microsoft Azure HPC cluster based on Intel Xeon processors delivered a much faster analysis than our desktop workstations could," Patchamuthu says. "Our approach—using UberCloud containers and Azure HPC, and including meshing, simulation, and postprocessing—cut the overall time by 50 percent."

Patchamuthu considers UberCloud and Microsoft Azure HPC clusters to be important additions to the toolset of CAE Technology. His team members who took part in the UberCloud experiment found both the UberCloud containers and the Azure platform easily accessible through the cloud and easy to use, with minimal latency.

"We plan to use UberCloud STAR-CCM+ containers and Microsoft Azure HPC clusters featuring Intel Xeon processors as a powerful combination that's especially suitable for our most urgent, time-sensitive client projects," he says. "The tools both are accessible anytime and, via the cloud, anywhere in the world, so we gain much greater flexibility in how we can serve our clients' needs going forward."

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>
> ***Burak Yenier, Cofounder & CEO, The UberCloud, Inc.***

Software

- Microsoft Azure HPC resources

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