

## Coventry University Customer Case Study

The University uses ScaleMP's vSMP Foundation to enhance its research and innovation capabilities in the Automotive Engineering Applied Research Group



ScaleMP's vSMP Foundation virtualization-aggregation solution significantly improves the research capabilities and lowers costs for Coventry University



*"We are scientists, not IT experts. We need a system that works well with our software and frees up time to allow us to focus on what we consider to be the most demanding theoretical and modeling problems. We want the system to work flawlessly at a high level of performance so that we are unaware of it", said Dr Carol Roberts, Research Fellow in the Automotive Engineering Applied Research Group at Coventry University. "Thanks to the vSMP Foundation virtualization-aggregation software, we have a very versatile system that performs well with a wide range of applications. By providing a single virtual system, the IT complexity is significantly reduced, and while having access to large shared memory for our most demanding larger simulations when needed"*

### Objective:

Coventry University was required to upgrade its High Performance Computing (HPC) infrastructure in order to keep up with the increased demand from its faculty and students. Their cutting edge research in the Automotive Engineering Applied Research Group required more computing power. The goal was to minimize capital expenditure outlays, while maximizing research capabilities with a system that was easy to manage for the researchers and would not require an experienced IT operations group.

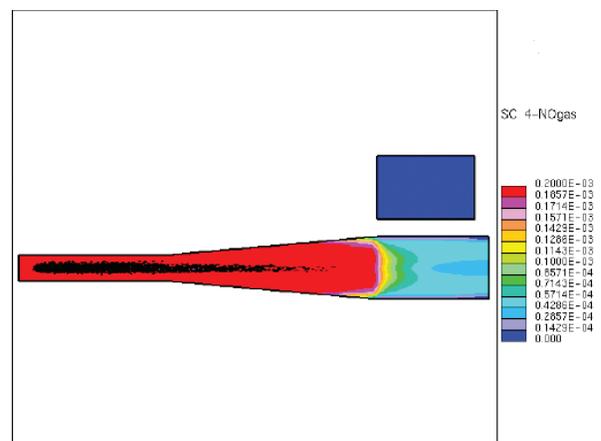
### Approach:

Coventry University compared benchmark performance of different architectures and technology alternatives (using their own workloads and STAR-CD \*\* User Subroutines). This evaluation led them to select ScaleMP's vSMP Foundation software, combined with x86 based blade-servers. This solution best addressed the core requirements of Coventry University.

### IT Improvements:

- A reliable, high-performance, scalable compute infrastructure.
- A versatile computing platform that could address a variety of HPC workloads, ranging from large memory to distributed applications on the same infrastructure.
- A simplified supercomputer that was able to handle a range of programming models ranging from legacy code, to MPI with reduced IT skills requirements.

### SCR simulation showing droplets and NO concentration



### Business Benefits:

- Reduced capital expenditure outlays due to the avoidance of purchasing proprietary SMP systems.
- Ability to use x86 standards based systems and software versus using proprietary vendor systems, with resulting additional costs.
- Improved performance driving faster time to innovation and results in the research projects.

# CUSTOMER SOLUTION QUICK VIEW

## Hardware Stack

- 8 x Intel Servers
- Processor: 8 x Xeon E5420 @ 2.5GHz (total 32 cores, 320 GFlops peak)
- Memory: 192 GB shared RAM

## Virtualization Layer

- vSMP Foundation

## Software Stack

- CentOS 5.0
- STAR-CD V4

## Customer Background

Coventry University in the UK is an evolving and innovative educational institution, building a reputation of excellence in education. The Automotive Engineering Applied Research Group (AEARG) was established in 1993 to act as a focus for automotive related research in the Faculty of Engineering and Computing. Research activities include engine/emissions research, motorsport engineering, vehicle studies, passenger safety, vehicle handling assessment, aerodynamics, cooling systems, intelligent transportation systems and vibro-acoustics. Strong external support is provided by major automotive companies, such as Daewoo, Ford Motor Company, Jaguar, Land Rover, Siemens etc. One of the areas of cutting edge research is in automotive exhaust after-treatment systems. Computer models have been created to predict flow distribution, temperatures and emissions. Star-CD software is used as part of this modeling. The porous medium approach is used to model the whole catalyst monolith, as well as the flow in exhaust systems.

## Customer Challenge

The university's computation center wanted to upgrade its High Performance Computing (HPC) infrastructure in order to keep up with the increased demand from faculty and students doing cutting edge research in the Automotive Engineering Applied Research Group. As part of this, the computation center decided to add additional Shared Memory (SMP) capability for running large simulations requiring large memory in addition to running distributed (MPI-parallel) applications. Key computing challenges are processing speed and the need for a versatile system that can handle a lot of very small single processor jobs, where mesh sizes are less than 200 cells, and also very large transient parallel processing jobs across 16 processors. Ease of use by non-experts is also a very important requirement. While Coventry University wanted to move to an x86 architecture based infrastructure for cost reasons, it seemed impossible to avoid having to invest in separate cluster infrastructure as well as a Shared Memory system (SMP) to address its computing requirements. Dr. Jim Tabor, head of the university's HPC computation center evaluated ScaleMP and its vSMP Foundation virtualization software for its ability to aggregate multiple server nodes into a single virtual system, and provide a very flexible platform that could not only support large shared memory applications but also parallel applications on the same underlying IT infrastructure.

## Solution Selection Process

Coventry's server infrastructure included an Itanium based cluster. They evaluated several technology vendors before settling on a blade infrastructure from a leading server vendor, complemented by vSMP Foundation to replace the existing system. vSMP Foundation enabled Coventry to use the new compute infrastructure as a Shared Memory Processing (SMP) system to eliminate management and maintenance complexity, and to be able to address both large memory requirements as well as compute intensive shared memory applications. The primary application for the vSMP Foundation -based SMP is Star-CD, a Computational Fluid Dynamics (CFD) application, as well as customized, in house code, created by the University. As part of the selection process, Coventry University established a comprehensive set of performance benchmarks to ensure that the specialized user subroutines written for Star-CD worked well on the target platform, that performance on the chosen solution would improve on the existing infrastructure, and that it would deliver the manageability expected.

## Benefits

With vSMP Foundation, Coventry University gains the following key benefits:

- Better performance than the Itanium system being replaced
- Use of standard Linux OS compared to previous proprietary HP-UX
- Significantly lower capital expenditures (CAPEX), versus acquiring a traditional SMP system, while delivering better performance
- Significantly easier to manage; flexibility to run different types of applications in the virtualized environment (MPI, OpenMP, legacy code, etc)
- Easy to install and manage versus a regular cluster (single OS, no need for a cluster file system, mask InfiniBand complexity, etc)

*“From an IT perspective, the two key criteria in evaluating new systems for me are cost and complexity.” said Dr Jim Tabor, head of the HPC computation center, at Coventry University. “ScaleMP delivered on both of these. The overall cost for the solution was lower than alternatives and the day to day management was simplified, making it possible for our researchers and scientists to administer the system with minimal IT staff involvement. We have successfully deployed vSMP Foundation in August 2008, and it is delivering the results we expected”*

## Technology

vSMP Foundation aggregates multiple industry-standard off-the-shelf x86 servers into one single virtual high-end system for the High-Performance Computing (HPC) market. vSMP Foundation provides customers with an alternative to traditional expensive symmetrical multiprocessor (SMP) systems and also offers simplified clustering infrastructure with a single operating system. It supports aggregation of up to 16 servers into a single virtual SMP system, providing customers with:

- Up to 4 terabytes (TB) of shared memory for large memory requirements
- Up to 128 cores virtual SMP, proven scalability and record-breaking memory bandwidth
- Ease of use and lowest Total Cost of Ownership (TCO) for applications, with simplified systems management compared to cluster alternatives
- Simplified storage architecture through very fast internal storage
- Improved utilization through a centralized and consolidated architecture

\*\* Note : STAR- CD is an application that provides solutions to complex fluid mechanics problems and is a very versatile platform for industrial CFD simulation. It also has capabilities to perform structural analysis calculations, offering a comprehensive solution for flow, thermal and stress simulation.

