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Bull helps AWE scientists
push back the boundaries
of science

Extreme Computing

BULL
Architect of an Open World

EXTREME COMPUTING

Bull helps AWE scientists push back the boundaries of science

To carry out their important work in support of the UK's nuclear deterrent scientists at AWE need a vast amount of computing power.

Until earlier this year, the organisation was reliant on one main supercomputer. However, this year, after a two year competitive tender process, AWE has accepted delivery of three supercomputers from Bull. All three are based on the award winning bullx platform. The first two, named 'Willow', were installed separately, one after the other, in the early part of the year before the most powerful of the three, named 'Blackthorn', was installed later in the year.

Each Willow supercomputer offers in excess of 35 TeraFlops¹ of compute power, which is roughly the same performance as their former supercomputer, while Blackthorn, powered by Intel's latest 6-core Xeon Westmere processors, offers the equivalent capacity of four Willow machines. Together, the Bull trio are vastly increasing the computing power available to scientists at AWE as they unravel, and model, elemental physics, chemistry and biology at the atomic level.

Being such an ultra-dense, ultra high performance, flexible system, the bullx supercomputers are enabling AWE to run a wide range of applications - including simulations of real-time events which scale up to thousands of processors - whilst reducing energy and power consumption and improving operational effectiveness.

Staged succession

Ken Atkinson, AWE's HPC Strategy Manager, explains that the procurement process was staged because the organisation needed to decommission its previous supercomputer.

"It was a bit like a puzzle, we only had so much space so we had to get one Willow up and tested and taking on the work of our previous supercomputer before we could decommission it," reflects Atkinson.

"When we got the second Willow up and running we were then able to keep the first running the work it was scheduled to do and then put the longer, bigger projects onto the second machine. We could then clear the physical space for the Blackthorn to come in and that now takes on the big, longer jobs with the Willows generally taking on the smaller work. They can still take on the larger projects if needs be, say if there is some maintenance scheduled for the Blackthorn, but generally it makes sense to have the larger, more complex jobs running on Blackthorn - with three or four running at the same time - while the day-to-day computing tasks are handled by the Willows," Atkinson explains.

Competitive tender

The original idea at AWE was that the three supercomputers would be supplied under two separate contracts with different vendors. However, Atkinson reveals that although competition for the contracts to supply all three supercomputers was very strong, Bull excelled right from the very start of the process and went on to be selected to deploy all three supercomputers.

"When we first put out a Request for Information in 2008 to outline what we needed, we were most impressed by Bull's response," he recalls.

"All the vendors you would normally think of for a supercomputer project took part in the competitive process, but Bull caught our eye early on because they were very professional and demonstrated value for money. It was

⁽¹⁾ TeraFlops is a measure of a computer's performance. The prefix Tera denotes 10¹² or 1,000,000,000,000. Flops is an acronym meaning Floating point Operations per Second. Hence each Willow system can perform 35 million floating point operations every second.



→KEN ATKINSON

HPC Strategy Manager, AWE

"BLACKTHORN'S RESILIENT DESIGN AND OVERALL SOLUTION, INCLUDING VERY LOW POWER CONSUMPTION, RELIANCE ON OPEN SYSTEMS AND A RESILIENT ARCHITECTURE, WON THE BIDDING PROCESS."

clear to us that they were keen to go into great detail of what they could offer and discuss and understand our requirements. Even though there was no promise of a definite order they took time to talk to us."

"We also took account of Bull's reputation within this market and the fact that other customers had expressed their complete satisfaction with Bull's supercomputers. But the main reason for our choice was the system design, the resilience and the overall package Bull could offer. This combined with their professionalism in how they approached us from the start of the process convinced us to award them the contract," Atkinson explains.

"Blackthorn's resilient design and overall solution, including very low power consumption, reliance on open systems and a resilient architecture, won the bidding process."

Reliability key

During all early discussions between AWE and Bull, the critical factor was proving the 'resilience' of the machines. Atkinson confirms that reliability was so key to the organisation's choice in supercomputers it fundamentally shaped the infrastructure it was looking for, and this became the most influential element in choosing the Blackthorn and pair of Willows.

"In supercomputing there's always a trade-off between whether you have a lot of power in a few processors or aim for slightly less power but through more processors so the system can process more work," he says.

"Resilience is critical for us because we can't have a scientist waiting a few days for results only for the machine

to shut down. So we have gone for an architecture with lots of network routes to processors and multiple disk controllers which are set up so that if one fails, as things are bound to do at some stage, alternative pathways or components are utilised to carry on the work."

This reliability was stringently tested by staging the systems at Bull's factory in France before the machines were accepted and then installed at AWE's facility. Now they are in place, Atkinson reveals that the new supercomputers offer other benefits beyond the huge increase in computing power. Bull implemented the sophisticated Moab scheduling software, provided by Adaptive Computing on the new supercomputers, which has allowed AWE to better manage the many access requests from its several hundred scientists.

"We used to have a scheduling committee and those wanting a significant proportion of the supercomputer resources would have to present their case as to why they needed it and demonstrate the importance of their work," Atkinson says.

"We still have that committee but nowadays it rarely has to physically meet, a lot of what it does can be done through email now. But the big change is having the three supercomputers, one of which, the Blackthorn, is set aside for work that is likely to last for a couple of days or more and requires beyond a set limit of processors. The software is so sophisticated that scientists can get an idea of when their calculations will be completed and therefore plan their project around that. It's making everyone's life so much easier now that we have the resilient supercomputers in place, which are very reliable, and all that extra computing power and uptime is managed fairly by the software."

Greener future

AWE has also been impressed by the low power consumption of the new machines which not only makes for lower energy bills but also makes an important contribution to the organisation's bid to reduce its impact on the environment.

Each Willow beats its energy consumption target of 150kW with a performance of 138kW and the Blackthorn has particularly impressed Atkinson.

"We originally were thinking around the 650kW mark for the Blackthorn but then cut it down to 500kW to see what Bull could come up with," he says.

"In the end they've delivered 380kW which has been really impressive and means the Blackthorn is

something like three or four times more powerful than the supercomputer we used to have, yet it consumes only half the power."

Even lower energy consumption is likely to be at the heart of future supercomputer requirements at AWE, alongside the continued need for a resilient architecture which delivers reliability as well as power. For the next three years or so, though, while the three current Bull supercomputers remain in commission, Atkinson is going to enjoy the continued ability to meet more research requests than ever before, allowing scientists to cooperate rather than compete for time on a vastly improved supercomputer capability.



ABOUT THE ATOMIC WEAPONS ESTABLISHMENT (AWE)

AWE has been central to the defence of the United Kingdom for more than 50 years through its provision and maintenance of the warheads for the country's nuclear deterrent, Trident. The work at AWE covers the entire life cycle of nuclear warheads; from initial concept, assessment and design, through to component manufacture and assembly, in-service support, and decommissioning and disposal.

AWE employs around 4,500 staff and over 2,000 contractors including scientists, engineers, technicians, craftspeople and safety specialists, as well as business and administrative experts – many of whom are leaders in their field.

AWE is managed for the Ministry of Defence (MOD) through a contractor-operated arrangement. While our sites and facilities remain in government ownership, their management, day-to-day operations and the maintenance of Britain's nuclear stockpile is contracted to a private company: AWE Management Limited (AWE ML). AWE ML is formed of three equal shareholders – Serco, Lockheed Martin and Jacobs Engineering Group.

For further information visit: <http://www.awe.co.uk/index.html>



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