SGI BioCluster combines high-performance SGI® Altix® XE Clusters with eXludus' MultiCore Optimizer software
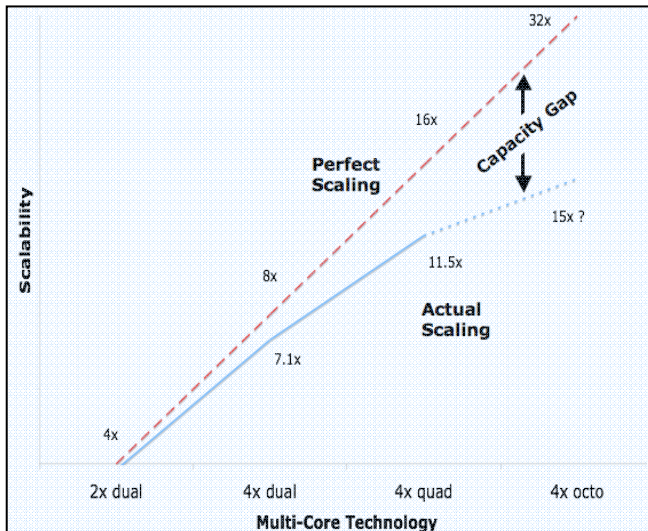
White Paper
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Introduction

Multi-core processors represent potentially the most significant processing advancement in decades, and this technology can greatly benefit BioScience research and development by significantly reducing the time needed to process given work loads.

BioScience application throughput increases promised by multi-core processing capacity are essential to reducing "time to innovation". However, researchers, scientists and others have not been able to realize the full benefits of this processing capacity as most applications are serial designs inherently incapable of exploiting parallel multi-core architectures. Harnessing and scaling multi-core processing is also limited by the inability of existing technologies to efficiently allocate system resources. When a single system resource - in this case processing power - scales disproportionately in relation to other resources, imbalance results and creates conditions where applications can exhaust resources or interfere with one another, an exponentially increasing likelihood as the number of processor cores per system increases, unless appropriate measures are taken to avoid these conditions. Failure to implement such measures leads to sub-optimal resource utilization and slower user application performance.

The graph below illustrates this resource imbalance effect. As the number of cores within a system increases, you quickly reach a point of diminishing processing benefit for each incremental core

added. eXludus' Multi-Core Optimizer, a performance-enhancing component of the SGI BioCluster, is the first node-level capacity management technology developed specifically for multi-core processors, and has been designed to properly allocate system resources and prevent performance limiting job interference. Implementing such measures enables multicore systems to deliver their full processing capacity and thereby significantly improve BioScience application performance.

SGI BioCluster combines SGI® Altix® XE Servers with MultiCore Optimizer to maximize core utilization. The power of this combination has been clearly demonstrated. In a 64 core cluster configuration, the BioCluster has demonstrated up to 90% performance gains when running various BioScience applications and workloads.

SGI BioCluster allows researchers, scientists, analysts, and others to fully exploit the benefits of multi-core processing architectures and speed "time to innovation"!

Achievements

In the following BLAST example (6GB NT (human genome) data set submitted as a job array) MultiCore Optimizer determined the optimal resource allocation schedule and accelerated the application by hiding all I/O latencies (200GB total) that were previously limiting multi-core processing efficiency (N.B. the graphs are generated by MultiCore Optimizer). The result was that job run time was almost halved!
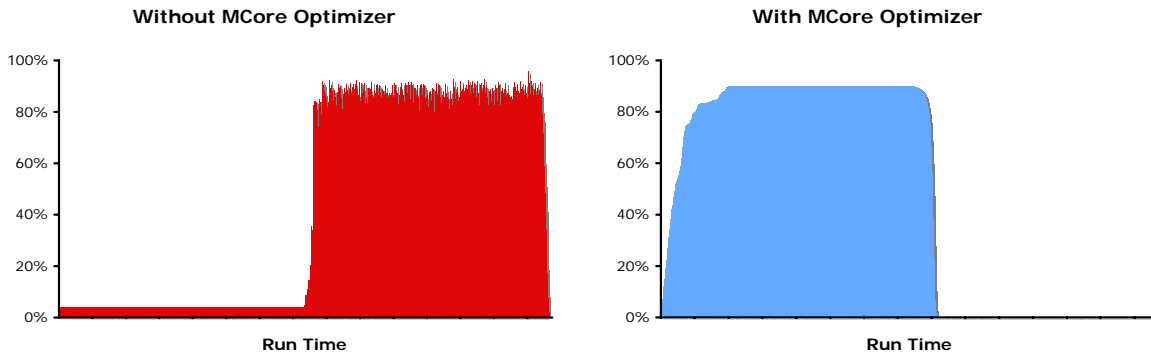
In this next diagram we illustrate how eleven independent jobs of varying size are typically dispatched by workload managers to nodes, and how MultiCore Optimizer increases job throughput through intelligent resource allocation optimization.
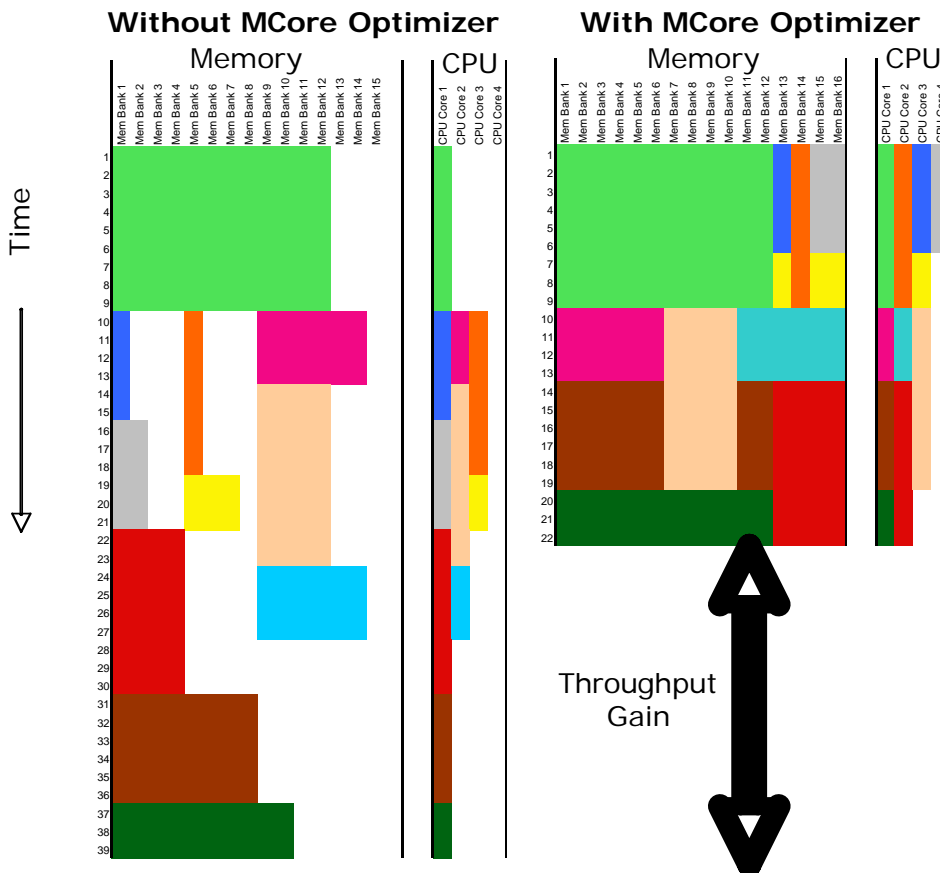
The white spaces indicates unused memory or processor resources. As can be seen, with MultiCore Optimizer resources are more heavily used and all jobs terminate in less time, even though each individual job's run time remains the same. By jobs spending less time queued, the time-to-response as measure by users is significantly reduced.

Conclusions

Although multi-core processors create a resource imbalance condition that can be harmful to applications and reduce system efficiency yield, eXludus' MultiCore Optimizer compensates for the imbalance through capacity management and optimized resource allocation. With the ability to make full use of all system capacity, MultiCore Optimizer efficiently uses all BioCluster core resources.

The SGI BioCluster, with eXludus' MultiCore Optimizer, benefits are many, and profound:

- BioSciences application performance is significantly improved as a direct result of making full use of the available system processing capacity. Better application performance leads to faster results and shorter "time to innovation".
- Consolidation efforts can be enhanced as more work can be completed within the same number of – or fewer – systems.
- Administrative overhead is reduced as system administrators no longer need to analyze specific application resource requirements in order to segment and isolate workloads.
- Energy efficiency is improved, as powered cores are not left un- or under- utilized.

No application or operating system changes are required to take advantage of the MultiCore Optimizer functionality and, thereby the SGI BioCluster's power. Applications run as is. Users need not change anything in their everyday work.

To learn more about SGI BioCluster or eXludus' MultiCore Optimizer please visit www.sgi.com/industries/biosci/ and www.exludus.com.

4111