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The Actuary's High-Performance Computing Challenge

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The insurance industry is under increasing short-term pressure. It faces growing competition from non-traditional competitors and must satisfy an investing public, increasingly aware of the ever-expanding number of investment options. In step with these pressures, the industry has evolved to develop products that are more complex and offer more aggressive returns.

This shift is putting new computational demands on existing tools. In fact, computational requirements are expected to increase more than 100-fold, far exceeding the capabilities of desktop computers and many existing enterprise computing resources. To meet this challenge, leading insurers have turned to high-performance computing (HPC). Working with its vast partner channel, Microsoft has responded swiftly to offer a choice of HPC solutions specifically targeted toward the challenges of the industry to help insurers meet these new demands with an eye to cost, profitability and productivity.

Factors Driving the Move to HPC

Traditional life insurance and annuities face competition from new products, such as variable annuities and equity indexed Annuities designed to offer more aggressive financial returns to the policyholder based on the performance of a particular equity index or linked investments. Another recent development is the emergence of the Life Settlement-backed Securities industry, through which the insured public can sell traditional life policies to investors for eventual use as the collateral for

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asset-backed bonds. The fact that third-party investors will outbid life insurance companies for the cash surrender value of mature policies implies the existence of new applications for actuarial computational models. Although the reduction of policy surrender rates could have little or no effect on the bottom line of the industry, does this new type of financial instrument represent the emergence of a new set of applications that attempt to divert profit and cash from the industry through the innovative use of computational modeling?

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The industry consolidation has reduced cost, thus improving profitability. At the same time, it has forced a reduced number of larger companies towards a greater dependence on fewer risk-and-return scenarios, requiring greater diligence in the evaluation of each scenario.

An additional challenge is the increased competition for the limited number of attractive investment opportunities required to generate the required returns to fund the expected portion of earnings and growth from invested capital. Competition requires insurers to invest more aggressively, in some cases using improved computational models to guide investment decisions.

As insurance products increase in complexity, so does the rigor of regulatory compliance. Federal and state insurance boards require complete transparency and the ability to interrogate the drivers of profit and loss across actuarial processes. Increased complexity and embedded risk in new insurance products has resulted in regulatory changes to mitigate this risk.

All of the above factors drive the increased investment in computational infrastructure required by the actuarial profession to keep up with these increased demands. Investing in the computational power required to run larger models more frequently results in improved productivity and more reliable results.

HPC's Emergence

It is expected that this combination of competitive, financial and regulatory pressure will increase computational modeling requirements by two or three orders of magnitude. A commensurate increase in computational power will be required, demanding capabilities beyond what is provided by a single desktop or high-end workstation.

Over the next three years the calculation of life insurance reserve requirements must conform to the mandate for a computationally-intensive principle-based approach (PBA). The PBA seeks to factor in a wider range of economic risk, as opposed to a traditional formulaic approach. With this shift, all life insurance providers will require dedicated compute clusters for computational modeling. This transition has already resulted in significant investments by leading providers of variable annuities in computational modeling software and hardware. The graphic (See page 27) explains why the use of nested stochastic modeling in the PBA leads to dramatic expansion in computational requirements.

In anticipation of these upcoming requirements, many companies have already begun incorporating nested stochastic analysis into their product pricing and development process. This usage pattern rewards the decision of leading providers to develop dedicated HPC clusters. HPC is also required to support the annual regulatory requirement for in-depth analysis of solvency scenarios for each company.

As a result of these changes, HPC is poised to move from the category of an advanced tool to a mission-critical capability in the IT strategy of every life insurance provider. HPC will be required in order to meet monthly regulatory obligations, possibly as early as Jan. 1, 2009. Increasing actuarial model size will also require the adoption of 64-bit technology for larger memory address space support required over the full range of modeling techniques.

Microsoft's HPC Solutions

Microsoft has quickly responded to support the industry with tools and solutions tailored to meet these requirements. A new version of Windows Server is available for the computers required to run actuarial models. Microsoft Windows Compute Cluster Edition (CCE) is fully-compatible with existing 64-bit versions of Windows Server and runs all the industry leading actuarial modeling packages, such as Milliman's MG-ALFA, SunGard's iWORKS Prophet and Towers Perrin/Tillinghast's MoSes. CCE is the most cost-effective version of Windows Server for HPC; dramatically reducing the software cost for the implementation of HPC clusters, with processor counts numbering in the hundreds or thousands.

The Windows Compute Cluster Pack (CCP) includes a resource manager, job scheduler and management pack, allowing the low cost creation, management and scheduling of HPC clusters for the execution of actuarial models. CCE and CCP are combined as the components of Windows Compute Cluster Server 2003 (CCS).

For customers interested in building their own actuarial models, Microsoft Visual Studio 2005 offers a wide range of parallel and high-performance development tools that can be integrated with the entire set of Microsoft products allowing the development of fully-integrated modeling systems using high-performance compilers, parallel development tools, high-performance SQL server engines for storage and retrieval of transactional and historical data, reporting tools for post processing analysis, workflow tools for development of regulatory compliant information sharing applications, collaboration tools for sharing of data and analysis worksheets using Office SharePoint Server 2007.

Microsoft has invested in recruiting, developing, training and integrating a wide range of solutions integrators and software partners to support risk modeling for the insurance industry. For example, many existing resource schedulers such as Digipede Networks, DataSynapse GridServer and Platform LSF/Symphony support the distribution of compute tasks to CCE-based compute nodes. Newly developed applications can leverage the integrated support for computational grids using the .NET Framework supported within tools such as the Digipede Grid Networks. Microsoft's HPC initiative also includes integrated support of mathematical modeling tools such as Matlab, Mathamatica, and Microsoft Office Excel 2007 on a CCS cluster. Most importantly, Microsoft has encouraged support for CCS as a production platform for the industry leading actuarial modeling packages such as MG-ALFA, MoSes and Prophet.

The competitive and regulatory pressures of the insurance industry are driving increased complexity, requiring more sophisticated actuarial tools. Computational clusters represent a key technology to meet this increasing pressure. Microsoft has invested in the products required to implement computational clusters in a cost-effective manner using existing staff and operational monitoring software. Microsoft HPC technologies ensure the implementation of these capabilities will occur in the shortest possible time.

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Nested Stochastic Modeling

"Nested" stochastic models, as the name implies, are stochastic models inside of other stochastic models. They are not explicitly part of the principle-based reserve method, but since the setting of reserves and capital will be based on stochastic valuation, earnings projections will require stochastic projections at each future projection data, across all scenarios. This means that nested stochastic models are needed to appropriately manage the business, price new products, project earnings, or measure risk. These models are not for the technologically challenged—a 1,000 scenario model with reserves and capital based on 1,000 paths at each valuation point for a 30-year monthly projection requires the cash flows for each policy to be projected 360 million times. Layer on top of this the desire to look at the implications of stochastic mortality or credit and we have introduced additional nested loops into the projections.

The ability to run these types of projections and analyze the resulting information will require significant changes in the hardware and software infrastructure at most companies. Ultimately, a solution for many of these challenges will involve grid computing (linking many PCs together under common control). Some companies are already running stochastic and nested stochastic projections on grids with as many as 1,500 PCs.

Nested Stochastic Modeling