



## Case Study

Intel® Itanium® 2 Processor

Dual-Core Intel® Xeon® Processor

Financial Services

Risk Management and Compliance



# Increasing Computing Power Reduces Risk

## High-Performance computing power of 64-bit Intel® Itanium® 2 processors helps reduce financial trading risks

Financial institutions need to accurately measure and manage financial risks in order to efficiently, and effectively trade with counterparties. However, risks modeling and calculations in today's busy financial markets require high-performance computing platforms in order to deliver the accuracy and timeliness that is needed to effectively carry out profitable trading. Researchers from Australian developer, Credit Risk Systems (CRS) found that Itanium® 2-based servers running the company's optimized version of BoundaryRider\* application, could effectively deliver the results banks need to reduce financial trading risks.

“Rapid availability of risk measures has the capacity to radically alter trading room dynamics, behavior and opportunities. Because 64-bit Intel® architecture servers deliver results in minutes rather than days, the world's largest global trading banks can run their entire portfolios of 500,000 or more trades in a few hours with no compromise in accuracy.”

Dr. Robert Bursill  
Senior Technical Lead  
Credit Risk Systems

### Challenge

- **Accurate and timely data is crucial.** Rapid growth and complexity in the global derivatives industry has outpaced the ability of existing risk measurement systems to deliver timely, accurate data.
- **Risk aversion is not optimal.** Facing a choice between increased accuracy and timeliness, most financial institutions have chosen the latter and adopted an overly conservative risk position to compensate for lack of data.

### Solution

- **Use high-performance technology.** Intel, along with boutique software developer Credit Risk Systems, has resolved this conundrum by using inexpensive, scalable server architecture based on the Intel® Itanium® 2 processor.
- **Improve accuracy, reduce calculation time.** Utilize the high-performance servers with CRS BoundaryRider application to deliver supercomputing-class performance that increases risk calculation accuracy while shortening calculation time.

### Assessing the Situation

In recent years, expanding markets operations and a more scientific approach to regulatory and governance requirements have forced financial institutions to consider more accurate credit risk assessments. However, the time needed to perform these complex and data intensive calculations has forced most banks to make do with conservative approximations. These approximations reduce the computational burden in risk calculation, at the expense of overstating credit exposure and regulatory capital.

Overstating credit exposure consumes significant parts of trading counterparties' credit limits and reduces the volume of trading a bank can carry out with a counterparty. Less trading, in turn,

# BoundaryRider\* running on Itanium® 2-based servers reduce the computational burden in risk calculations, providing timely and accurate credit risk assessments.

means less profit. This is particularly true for mining companies, where hedging produces active and profitable trading but credit limit is in short supply due to the uncertain nature of the industry.

"Long dated trading and volatile business conditions create very large credit exposures," says Justin Taylor, managing director, Credit Risk Systems (CRS), an Australian software developer that specializes in the optimization of Monte Carlo based credit risk modeling.

"Modeling helps banks to project those risks, and these projections are used as the basis for credit limits as well as the capital calculations they're required to perform for regulatory purposes."

Monte Carlo simulations evaluate a large number of potential future paths, or projected outcomes, then rank them to provide a guide to likely future performance at any given confidence interval.

## Spotlight: Credit Risk Systems

- Credit Risk Systems (CRS) provides software and consulting solutions to banks on the management of risks associated with financial markets trading. The company's solutions help clients improve business performance in areas related to modeling, products, policy and capital. Many of its employees have degrees in mathematics, physics, IT or engineering, seven with doctorates.
- CRS also consults to the 'big four' major Australian banks on areas as diverse as independently validating risk models; reviewing internal risk systems; setting up a bank quantitative group; calculating the impact of Basel II on regulatory capital; independently reviewing operational risk models.

Ideally, a bank would be able to integrate the effect of a potential trade before it is dealt, so that its impact could be immediately integrated into simulation modeling and factored into credit risk calculations.

With tens of thousands of trades and thousands of counterparties commonly managed every day, however, the number of calculations involved quickly rises into the billions.

"All banks would prefer to use Monte Carlo simulation to measure credit exposure and capital, but until now this has been unachievable within available decision making timeframes," says Taylor.

## Delivering the Solution

CRS, whose researchers have decades of experience in applying mathematical expertise to the financial services industry, recently explored the effectiveness of Intel® architecture-based servers in handling Monte Carlo-based credit counterparty risk calculations.

In an attempt to solve this problem, CRS had previously ported their risk engine code to the NEC SX5\*, which powered the once world-leading Earth Simulator supercomputer and is favored for immensely complex tasks such as weather modeling. However, such systems are prohibitively expensive, costing millions of dollars, and require additional specialized power, cooling, operational and administrative expertise.

CRS found a far more cost-effective solution in new 64-bit Intel® Itanium® 2 processor based servers running an optimized version of its BoundaryRider\* application.

BoundaryRider is a comprehensive risk management application that includes a broad range of statistical models and the ability to customize scenarios to a bank's particular requirements. Previous adaptations of BoundaryRider for use on scalable vector supercomputers such as the NEC SX5 provided a point of comparison during the calculations. During



**"Banks have relied on a process that rarely if ever lets them get a complete answer to their risk questions. By utilizing the increased computing power of the 64-bit Intel® Itanium® 2 platform, they can now get that answer on demand."**

Dr. Robert Bursill  
Senior Technical Lead  
Credit Risk Systems



**“These results show that Intel® technology can support a long held risk objective of the bank that until now had been thought unachievable on an affordable and internally maintainable platform.”**

Steve McCarthy,  
Head of Market Risk  
Quantitative Support,  
National Australia Bank

comparative testing, BoundaryRider\* was tested on a variety of servers running Microsoft Windows Server 2003\* and 32-bit Intel® Xeon® processors, 64-bit Intel Xeon processors with Intel® Extended Memory 64 Technology 1 (Intel® EM64T), and 64-bit Intel® Itanium® 2 processors.

Using a real-world, anonymized data set provided by a leading Australian banking institution, CRS ran the credit counterparty risk calculations on each platform. The data set included 40,359 trades and 2,040 counterparties, with a representative range of transactions including FRAs, interest rate swaps, cross currency swaps, caps and floors, FX forwards, vanilla FX options, FX barrier options and FX partial barrier options.

The Monte Carlo simulation involved projecting 5,000 market rate scenarios for FX rates, interest rate curves and volatilities. Trades were revalued at 26 fixed time nodes plus all trade maturities. In total, the Monte Carlo simulation used by CRS involved approximately 14 billion trade revaluations (482 billion cashflow valuations).

Baseline analysis of the data set took 30 hours to complete on a conventional 32-bit Intel® architecture-based server. Such a long calculation cycle is incompatible with the bank's requirement to quickly get actionable, accurate information upon which to base its investment decision making.

CRS then tested a 64-bit port of BoundaryRider on a 4-way server running dual-core 64-bit Intel

Xeon EM64T processors at 3.0GHz and 16GB of RAM, providing a system peak of 48 GFLOPS (billion floating point operations per second).

The calculation took just 2 hours and 38 minutes on the Intel EM64T platform. Each 64-bit processor ran 42 percent faster than its 32-bit equivalent.

In further testing, BoundaryRider was recompiled using Intel® 64-bit vectorizing compilers in order to take advantage of the increased performance of the 64-bit Itanium 2-based servers. A Silicon Graphics International Altix\* server, running 1.6GHz Intel Itanium 2 processors in a 24-processor (symmetric multiprocessing architecture) SMP with 64GB of memory, was able to complete the same calculations in just 29 minutes, providing a further 82 percent performance increase per processor core compared with the Intel EM64T-enabled Intel Xeon processor-based server.

“Intel Itanium 2 systems are more scalable than other architectures in terms of the number of processors you can put into a single node,” says Dr Rob Bursill, technical lead, CRS.

“With software pipelining and vectorization, the Intel Itanium 2 processor actually performs at just over half the speed of the NEC SX5\* supercomputer processor, which was used in the Earth Simulator, but costs less than one-tenth as much. That puts the Intel Itanium 2 processor right up there with the fastest computers in the world—and at the same time,

### Key Technologies

- 64-bit Intel® Itanium® 2 processors provide the best-fit on commodity hardware for data intensive Monte Carlo based credit risk modeling.
- CRS BoundaryRider\*, a comprehensive risk management application was recompiled using Intel 64-bit vectorizing compilers to take advantage of the increased performance of 64-bit Itanium 2-based servers.

### Integral Answers

- End of day and intra-day Monte Carlo based credit exposure is achievable on commodity hardware.
- The cost of ownership of a supercomputer class simulation is now within the reach of bank IT departments.
- Symmetric Processing Architecture (SMP) significantly improves the performance of large counterparty run-times.

it's something that is within the comfort zone of a banking IT shop."

The SMP design of the SGI Altix\* server was a major contributor to its increased performance. In another single counterparty simulation, for example, a large portfolio calculation that took 54 minutes on a single Intel® Itanium® 2 processor server was cut to just 3.6 minutes using a 16-way SMP architecture.

Indeed, testing has shown that SMP servers running Intel Itanium 2 processors offer near-linear scalability even with large numbers of processors.

Cores	Processor	Counterparties	Time
1	32-bit	2,040	30 hrs
8	64-bit Intel® Xeon® processor with Intel® EM64T	2,040	2 hr 38 min
24	64-bit Intel® Itanium 2 processor	2,040	29 min

Table 1. 64-bit Intel architecture sped complex Monte Carlo based risk simulation significantly.

Cores	Processor	Counterparties	Time
1	64-bit Intel® Itanium 2 processor	Largest	54 min
8	64-bit Intel® Itanium 2 processor	Largest	3.6 min

Table 2. 64-bit Intel® Itanium® 2 microarchitecture shows near-linear scalability.

"These results show that Intel® technology can support a long held risk objective of the bank that until now had been thought unachievable on an affordable and internally maintainable platform," says Steve McCarthy, Head of Market Risk Quantitative Support, National Australia Bank.

Such robust scalability is a lifesaver because increasingly restrictive finance-related legislation like BASEL II prevents banks from using different calculation standards for trading risk management and regulatory capital.

Banks will be expected to use as high a degree of accuracy as possible for their daily calculations, and CRS's experiments have shown that 64-bit Itanium 2-based servers are an extremely cost-effective platform on which to make this happen.

"Most banks use a process that never provides an accurate answer to their risk questions," says Bursill, "and the way they do things is predicated on the fact that they can only do it this way. By utilizing the increased computing power of the 64-bit Intel Itanium 2 platform, they can now get that answer on demand—and that has the potential to change the whole way they operate."

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### Return on Investment

- Credit risk analysis that takes 30 hours on a single processor 32-bit system can now be completed on a multiprocessor-based 64-bit server within 29 minutes\*\*.
- Time to process a very large single-counterparty exposure has been cut from 54 minutes down to 3.6 minutes\*\*.
- Faster analysis allows banks to base their credit risk profiles, and therefore their capital investment strategies, on more accurate numbers produced more quickly than ever using increasingly complex Monte Carlo simulations.



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\*64-bit Intel® Xeon® processors with Intel® EM64T requires a computer system with a processor, chipset, BIOS, OS, device drivers and applications enabled for Intel EM64T. Processor will not operate (including 32-bit operation) without an Intel EM64T-enabled BIOS. Performance will vary depending on your hardware and software configurations. Intel EM64T-enabled OS, BIOS, device drivers and applications may not be available. Check with your vendor for more information. Performance will vary depending on the specific hardware and software you use. See most up to date benchmarks at <http://www.intel.com/products/benchmarks/server/index.htm> for detailed information.

\*\*Source: Dr. Robert Bursill, Credit Risk Systems

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