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# Development of ALM (Asset Liability Management) system for the banking and insurance businesses operations

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The goal of this project is to help Japan's biggest mega-bank-scale financial institutions meet their portfolio targets by running daily simulations of the banks' entire asset-liability portfolio for several years, while taking into account market risks and credit risks. In order to conduct a realistic financial simulation, this system was based on an actual accounting computer model used at financial institutions, and simulated data based on the Monte Carlo ALM (Asset Liability Management) simulation. By conducting a parallel simulation using a maximum of about 3,000 CPUs under the TSUBAME GRID CLUSTER environment, we succeeded in conducting large-scale calculations of an unprecedented scale. These massive-scale calculations also led to the discovery of new hot spots.

*Keywords: ALM (Asset Liability Management), VaR (Value at Risk), EaR (Earnings at Risk), EDF (Expected Default Frequency), TP (Transfer Pricing), Basel II*

## Background and Goals

For banking and insurance businesses, Asset Liability Management – which is used to track maturity and interest on assets and liabilities, and manage their cash flow, liquidity risk, exchange risk, and interest rate risk – is a top management priority from the perspective of improving or maintaining a financial institution's international competitiveness.

Last year (2007) was especially a year shaken by the sub-prime mortgage crisis and the first year of implementing the new BIS (Bank for International Settlements) regulation (Basel II). This project's financial simulation is an internal model that supports Pillar II of the new BIS Regulation. The top agendas are providing appropriate control over risk asset volume, and improving ROE by making the best possible portfolio. Until now, financial institutions had no choice but to calculate these figures with much less accuracy due to the large calculation volume.

This project used the TSUBAME GRID CLUSTER, a large-scale high-performance computing environment to conduct financial simulations of the entire asset-liability portfolio at mega-banks. This project came up with risk indicators such as VaR (Value at Risk), EaR (Earnings at Risk) as well as TP (Transfer Pricing) allocation and an earnings forecast for each scenario. Based on these experiments, the system was able to reduce the number of hours conventionally spent on calculating as the number of CPUs was increased for parallel calculations. This showed the possibilities of large-scale ALM simulations under a large-scale, high-performance computing environment.

## Overview

To paint a clear picture about the scale of simulations, Japan's largest mega-banks would input data on a total about 3 million transactions in a simulation. They would also simulate about 1,000 days worth of transactions in three years and conduct the Monte Carlo Method 10,000 times.

The total computing volume would be massive because they would be a multiplication of these calculations. All of these figures would need to be processed in roughly a day in order to contribute to a financial institution's decision-making process.

This project simulated false data (in Table 1) based on the scale of a mega-bank and experimented in a large-scale, high-performance computing environment of

our application called Numerical Technologies Altitude®.

| | |
|---|---|
| Number of Transactions | Roughly 3.4 million |
| Number of Total Cash Flow | Roughly 500 million cases |
| Number of Calculation Processing | Roughly 4.4 billion cases / per scenario |
| Number of Clients | Roughly 200,000 cases |
| Simulation Period | Three years |
| Number of times Monte Carlos Method was used | 1,000~10,000 times |
| Number of Nodes used in calculation | Maximum 189 units |
| Accounting Process Rule | Market Value Method + Amortization/ Accumulation Method |

Table 1 Simulation condition

Because the TSUBAME Grid Cluster is a computing system built on a hardware consisting of a standard x86-64 architecture and the standard Linux OS, it took little time to begin operations. The financial simulations were conducted multiple times based on the market scenario obtained by the Monte Carlo Method and the credit scenarios of each individual company. These differing scenarios had no correlation in the calculation. This makes Monte Carlo Method the most appropriate method for simultaneously processing on multiple nodes.

Results and Reviews

Figure 1 shows the cluster performance in cases where the number of nodes used in the TSUBAME Grid Cluster are changed. (The number of times simulated by the Monte Carlo Method: 1,000 times)

Tests confirm that the parallelization efficiency was gained in the Scenario Simulation part, which is conducted in parallel simulation using multiple nodes. As is evident in the results of the Total Simulation, the parallelization efficiency in overall calculations falls as the number of nodes increases. This is because the total calculation time is reduced, exposing new hot spots, and increasing the percentage of other formatting processes, among other things. A total of ten and a half hours were spent on calculations when 10,000 Monte Carlo simulations were conducted using a maximum of 189 nodes.

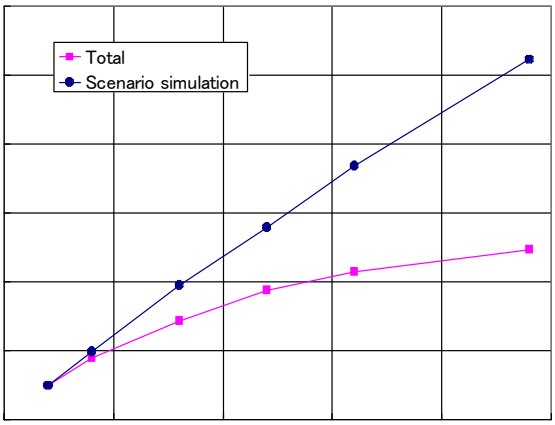


Figure 1 Cluster performance for ALM simulation on TSUBAME (Number of simulations: 1000)

The newly discovered hot spots were parts that create credit scenario (calculating the daily EDF under a multivariate correlation and judging the default of path dependence.) This is a very significant part in evaluating the credit risk relating to the sub-prime mortgage crisis and other issues. For this reason, responding to hot spots is an urgent issue.

Summary and Future Agenda

This project has shown the possibilities of ALM simulation on a mega-bank scale on the TSUBAME Grid Cluster, a high-performance computing environment. For a private company to install its own high-performance computing environment like the TSUBAME Grid Cluster, it would require countless hours and several billion yen in investment. But operating TSUBAME took minimum time because the system employs a standard architecture

like a Linux server, which many private enterprises use.

This project aimed to improve performance under a large-scale high-performance computing environment by changing existing codes as little as possible. In the future, the goal is to further improve performance by responding to hot spots and recoding to suit the large-scale high-performance computing environment. This project also aims to show that it is possible to conduct 100,000 calculations, which is considered necessary in a realistic computing environment when installing the system in a banking or insurance business.