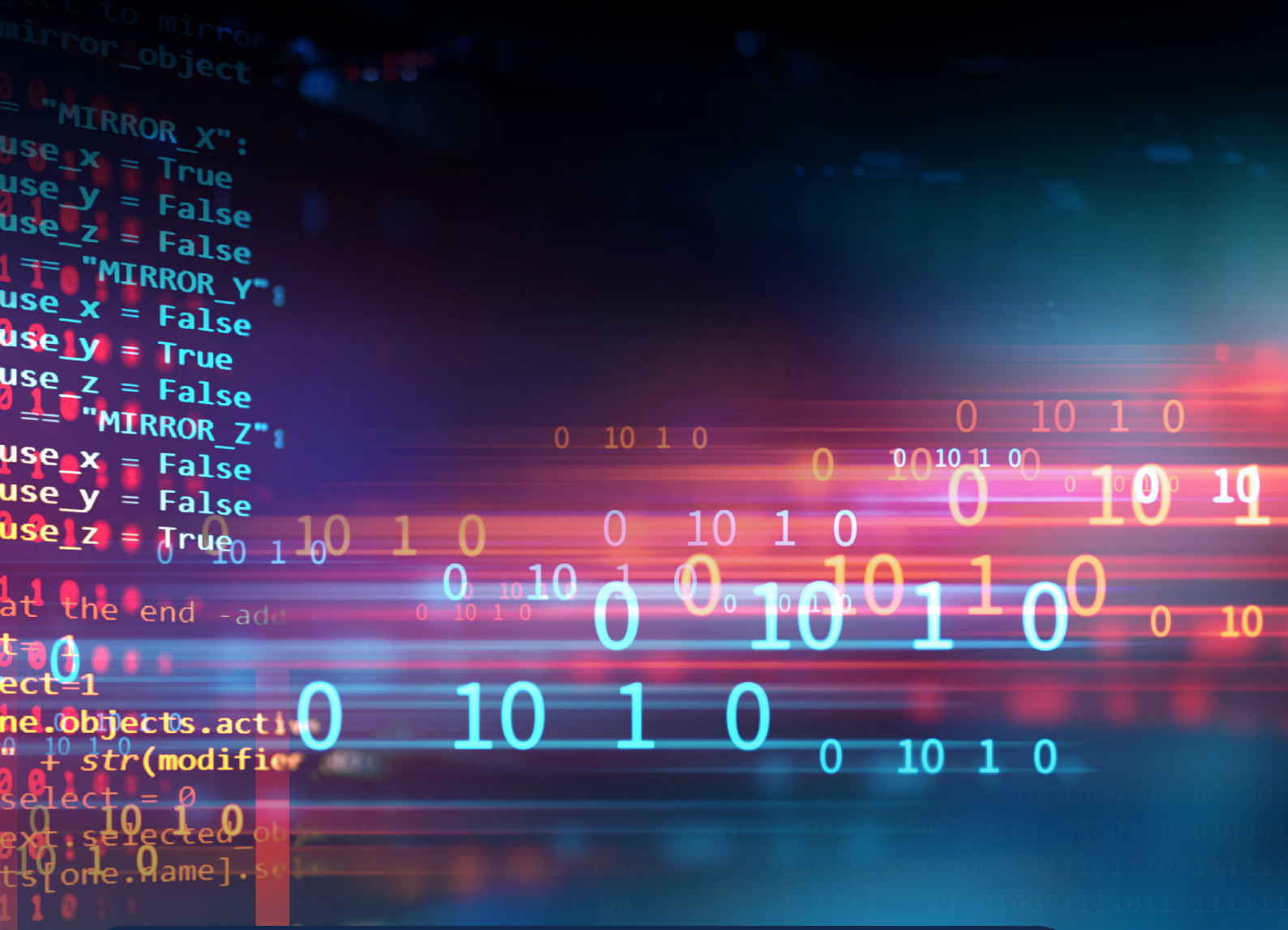


AdaCore | Build Software that Matters

Case Study

The Critical Role of Pricer Software in Banking and Finance

BNP Paribas

Summary

BNP Paribas, one of the world's leading banking and financial services institutions, operates in a highly dynamic and risk-sensitive environment. An important aspect of its operations within its Global Markets division is the need for a robust and reliable risk calculation engine that can handle millions of daily requests with high accuracy, performance, and reliability. BNP Paribas adopted the Ada programming language to enhance its ability to meet these demands for its risk calculation models within the equity pricer. This case study explores how Ada has been highly beneficial in BNP Paribas's ability to deliver reliable, high-performance solutions across its markets business.

The Critical Role of Pricer Software in Banking and Finance

In the banking and finance industry, a "pricer" typically refers to a computational tool or software application used to calculate the prices of financial instruments, such as derivatives, bonds, options, and swaps, and serves as a core component of trading operations. Precision and reliability are indispensable for maintaining operational integrity.

Beyond pricing, a pricer plays a critical role in risk management and regulatory compliance. Accurate valuations are essential for assessing market risks, setting appropriate capital reserves, and ensuring adherence to financial regulations.

Therefore, a pricer is more than just a computational tool; it's a foundational component that affects decision-making processes, risk assessment, and the institution's ability to navigate financial markets effectively. Investing in performant, precise, and reliable pricer software is not merely a technological choice but a strategic necessity that underpins competitiveness and stability in the financial sector.

BNP PARIBAS

Customer:

BNP Paribas, a global leader in banking and financial services, relies on high-performance, reliable software for risk calculations in its equity pricer. Their dedicated team of developers continually enhances this critical system.

Challenge:

BNP Paribas Global Markets' main challenge in this instance was to develop a risk calculation engine capable of accurately processing millions of daily requests quickly and reliably. The software has to support rapid development cycles with frequent releases and remain maintainable and adaptable, even while exploiting low-level efficiencies of the underlying hardware.

Solution:

They adopted the Ada programming language for its robust features, clear syntax, and ability to prevent common programming errors. With Ada, BNP Paribas was able to enforce a clear separation of concerns between quantitative analysts and software engineers, and the language supported their high-performance computing requirements. They also utilized AdaCore's open-source GNAT Pro compiler, aligning with their commitment to open-source software.

Results and Benefits:

Ada allowed BNP Paribas to develop and deploy a robust, efficient system capable of precise, high-volume processing. The language's safety features improved reliability, and the team experienced smooth onboarding of new developers. Using AdaCore's tools, they effectively manage multi-language development, and their ongoing commitment to Ada ensures continued software quality during system enhancements.

Produced by AdaCore

Global Markets Quantitative Research

At BNP Paribas, the Global Markets Quantitative Research unit is responsible for the development and production of pricing software. The team's developers are dedicated to the pricer's continuous improvement. Demonstrating high agility and responsiveness to the dynamic financial environment, they deliver two releases per week, ensuring the software remains up-to-date with the latest market developments and technological advancements. The pricer handles millions of requests per day, showcasing its robustness and critical role in the bank's daily functions.

To meet these demands, the team leverages High-Performance Computing (HPC) techniques, working close to the hardware to maximize performance. This involves utilizing Single Instruction, Multiple Data (SIMD) operations for parallel processing and exercising precise control over memory representation. Despite operating at such a low level, there is still a need for high-level constructs to ensure that the software remains maintainable and adaptable to new requirements.

Members of Global Markets Quantitative Research come from diverse professional backgrounds. On the one hand, there are software engineers who are experts in software architecture, optimization, and system robustness. On the other hand, there are quantitative analysts ("quants"): mathematicians with programming skills who focus on the business aspects, applying complex mathematical models to financial data. This multidisciplinary collaboration is essential. The software engineers and quants work in tandem to create a pricer that is both technically robust and financially accurate.

Ada, where maintainability meets performance and reliability

The project, initiated in Ada, has grown to encompass a codebase of approximately 3.5 million lines of Ada, alongside an equivalent amount of C++ code, integrated over the years. Actively maintained, with 40 to 80 Ada commits per day in the software's version control system repository and two weekly releases, this codebase supports continual evolution and development.

A core advantage of Ada is the clear separation of concerns, which allows quants to concentrate on complex modeling while software engineers manage the system architecture. Ada's clear and unambiguous syntax ensures contributors face no surprises in code behavior, allowing non-expert programmers and juniors to quickly grasp and contribute to work produced by more senior colleagues.

"Ada has features that prevent us from making mistakes. We don't have buffer overflows, integer overflows, initialization order issues, or dangling pointers." said David Sibai, Global Head of Global Markets IT Engineering, "At the same time, we have features that facilitate the development of readable code."

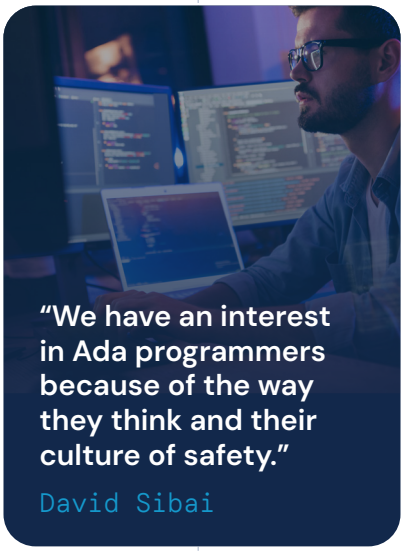
This accessibility, combined with Ada's inherent performance and reliability, is critical for managing the millions of transactions and complex calculations that the system processes daily. Despite the large scale of development, the system remains robust and efficient, empowering teams to work effectively, even when some of the developers are domain specialists rather than expert programmers.

Nicolas Ballabriga, Quantitative Engineer, confirms "Day after day, we realize the necessity of the guarantees that the language provides to us."

Seamless Onboarding to Ada:

BNP Paribas's Approach and the Value of a Quality-Driven Culture

Onboarding new developers to any software project presents challenges, With Ada, a manager might be concerned that the language is not as widely used as others in a particular domain. This can lead to the perception of a steep learning curve or difficulties in recruiting Ada developers.



"We have an interest in Ada programmers because of the way they think and their culture of safety."

David Sibai

The BNP Paribas team has a different perspective. "We don't have any problem onboarding new members in the team." said Mr. Ballabriga " People with prior C++ programming experience quickly identify by themselves how Ada avoids many of the C++ pitfalls. Others with Python experience are more surprised by the constraints of Ada, but they can adapt very quickly."

While BNP Paribas can onboard developers without prior Ada experience, it still actively seeks Ada programmers because they often bring a culture of safety and reliability that aligns with the company's standards. As Mr. Sibai expressed, "We have an interest in Ada programmers because of the way they think and their culture of safety."

Embracing Open Source:

How Global Markets Quantitative Research's Commitment Influenced Their Choice of GNAT Pro

Open-source software has long been a cornerstone for the Global Markets Quantitative Research team. It has been ingrained in their operational philosophy since the late 1990s when they began deploying Linux systems in production environments. This enduring commitment to open-source solutions reflects a broader value system that prioritizes transparency, flexibility, and collaborative innovation.

This foundational belief significantly influenced their decision to adopt GNAT Pro and partner with AdaCore. The choice was not merely about selecting a tool but aligning with a philosophy that empowers them with control and insight into the technologies they rely on. "Today, I would not trust a closed-source compiler." said Mr Sibai.

By utilizing an open-source compiler like GNAT Pro, Global Markets Quantitative Research gains several critical advantages:

- **Transparency:** Full access to the source code allows the team to understand the inner workings of the compiler and run-time libraries.
- **Security:** With the ability to inspect and modify the code.
- **Flexibility:** Open-source tools can be customized to meet specific project requirements, facilitating innovation and adaptation to changing needs.

The partnership with AdaCore further solidifies this commitment, as AdaCore is renowned for its support of open-source principles and provides robust, reliable tools that meet Global Markets Quantitative Research's rigorous standards. The unit's dedication to open-source software is not just a technical preference but a strategic choice that enhances its operational capabilities and aligns with its core values.

Streamlined Multi-Language Development

Over the years, BNP Paribas Global Markets Quantitative Research's main software project, which was originally based on the Ada programming language, expanded significantly through mergers and acquisitions. This growth led to the integration of a substantial amount of C++ code into the codebase.

Managing multiple programming languages within a single project introduces several challenges. Leveraging AdaCore's comprehensive support for both Ada and C++, the team was able to use a unified set of development tools. This provided them with a consistent interface and workflow, regardless of the programming language they were working with.

Having a single point of contact for all development tools proved to be a significant advantage. The entire development team benefited from the same level of support and guidance, streamlining communication and collaboration.

Embracing the Future: Ada's Continued Role and Promising Developments at BNP Paribas

As the BNP Paribas Global Markets Quantitative Research team continues to innovate in high-assurance software, Ada remains a cornerstone of its technological strategy. The bank is not only leveraging Ada's robust features but also actively investing in advancements that will enhance software quality and developer productivity.

Advancements in Static Analysis

Understanding the critical importance of code reliability and security, BNP Paribas is developing custom lightweight static analysis tools using AdaCore's Libadalang technology. Ada's expressive nature allows the creation of tailored tools that seamlessly integrate into existing workflows, enabling early detection of potential issues. Moreover, the bank is implementing automatic refactoring processes. These automated systems enhance code quality and maintainability, allowing developers to focus on delivering value.

Commitment to the Latest Technologies

BNP Paribas demonstrates a steadfast commitment to technological excellence by consistently adopting the latest versions of the Ada language and GNAT Pro compilers. This proactive approach ensures that the bank benefits from new features, performance optimizations, and security enhancements as soon as they are released. By staying current, BNP Paribas not only improves its existing systems but also positions itself to quickly leverage emerging technologies.

Looking forward, the team is keenly interested in forthcoming language improvements introduced in GNAT Pro, such as fast and lightweight controlled objects and an overhaul of object-oriented programming.

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