AdaCore

The GNAT Pro Company

Executive Summary

Eurofighter Typhoon is the world's most advanced swing-role combat aircraft. A highly agile aircraft, it is capable of ground-attack as well as air defence. With 620 aircraft on order, it is also the largest and most complex European military aviation project currently running. A collaboration between Germany, Italy, Spain and the UK, it is designed to meet air force requirements well into the 21st Century.

Advanced electronics and state of the art onboard computers are critical to the Typhoon's high performance and agility. These systems need to be safe, reliable and easily maintained over the estimated 25 year lifecycle of the aircraft.

The Ada programming language was therefore the natural choice for Typhoon's onboard computers. It provides a high-integrity, high-quality development environment with a well defined structure that is designed to produce highly reliable and maintainable real-time software. Typhoon is currently the largest European Ada project with over 500 developers working in the language. Tranche 1 of the project saw 1.5 million lines of code being created.

BAE Systems is a key member of the Eurofighter consortium, responsible for a number of areas including the aircraft's cockpit. As part of latest phase of the project (named "Tranche 2") it needed a solution for host Ada compilation in the development of software for the Typhoon's mission computers, as well as for desktop testing.

BAE Systems selected GNAT Pro from AdaCore in 2002 for this mission-critical and safety-critical area of the project. AdaCore has been closely involved with the Ada language since its inception and was able to provide a combination of multi-language technology and world-leading support to BAE Systems.

As part of the development approach the majority of mission computer testing is now being carried out at PC level, using an exact replica of the aircraft cockpit on the desktop. BAE Systems is using GNAT Pro with VxWorks for desktop integration testing, therefore saving considerable time and resources.

While GNAT Pro has been in use for less than a year, BAE Systems is already predicting considerable savings during the coding and unit testing phases. Fewer

engineers per line of code are needed and engineers report being able to edit, compile / link and debug their code much more efficiently and painlessly than before.

"For a project of this size and complexity we needed a strong partner. AdaCore's technical support capabilities, including training, particularly impressed us, as well as the company's close involvement in the Ada language from its very beginnings," said Terry Westhead, Compiler Specialist, Eurofighter Typhoon Enhanced Process & Toolset Team, BAE Systems. "GNAT Pro's ease of use and ability to run in multiple languages and platforms in a robust and scalable manner made AdaCore the natural choice for such an important project."

Background

Developed by a consortium of companies in the UK, Germany, Spain and Italy, Typhoon will fulfil air force requirements well into the 21st Century. The aircraft is in full production and, having achieved Type Acceptance, the first of the 620 aircraft planned for the four partner nations were delivered in 2003.

Typhoon has a highly agile Air Superiority and Air-to-Surface, swing-role weapon system, making it the most capable front line combat aircraft available. The four partners expect Typhoon to have an operational life of 25 years. As operational needs change over such a long period flexibility and growth potential for operational enhancements are an inherent part of Typhoon's design. All major systems of Typhoon therefore incorporate a large capacity for future enhancement.

The project is split into two tranches, with development work beginning on Tranche 2 in 2004. The capability enhancement provided by the Tranche 2 contract includes the precondition for full air-to-ground capability, as well as significant enhancements to the flight control software and the Defensive Aids systems.

Unprecedented attention has been given to Human-Machine Interfaces (HMI) and onboard systems meaning that Typhoon uses advanced digital technology to enhance operation and survivability, as well as simplifying aircraft maintenance.

BAE Systems is responsible for a number of areas, including the nose, cockpit, canards, inboard flaps and rear tail with rudder.

A pioneer in technology with a heritage stretching back hundreds of years, BAE Systems is an international company engaged in the development, delivery and support of advanced defence and aerospace systems in the air, on land, at sea and in space. The company designs, manufactures and supports military aircraft, surface ships, submarines, fighting vehicles, radar, avionics, communications, electronics and guided weapon systems.

Business need

Advanced onboard computers are at the heart of Typhoon, controlling flight and weapon systems. Obviously with such mission critical components safety and performance are crucial, meaning that BAE Systems needed a programming language that combined reliability and ease of maintenance with performance.

Ada was the natural answer to BAE Systems' and Typhoon's needs in many areas. Already used in a number of defence and aviation projects around the world, including the BAE Systems Harrier, Panavia Tornado, BAE Systems Hawk and Lockheed-Martin F-16 and F-22, it is the natural choice for long life, safety-critical applications.

"Ada has been used for the majority of the onboard Typhoon computers as it combines real-time performance with advanced safety-critical features. **Aside from its performance and reliability, Ada is also the best language to help implement highly complex mathematical algorithms and moding, as well as the handling of databus communications**," commented Terry Westhead.

In 2004, as part of Tranche 2 of the Eurofighter programme, a solution for host Ada compilation was required for the development of software for certain mission computers. Following an extensive procurement phase on behalf of Eurofighter, BAE Systems selected AdaCore's GNAT Pro running on x86 Windows and Unix for host development, as well as for VxWorks on PowerPC for desktop integration testing. This replaces DEC Ada which was used in Tranche 1. A three year development phase will be followed by at least fifteen years maintenance.

About AdaCore and GNAT Pro

Founded in 1994 by the original authors of the GNAT technology, AdaCore is the leading provider of solutions for all aspects of Ada software development. AdaCore was founded by the original developers of the GNAT Project. This means that customers access expertise provided by the actual developers of GNAT Pro themselves, ensuring the best technical support, provided by those with the strongest level of Ada expertise. AdaCore is a new kind of software company providing innovation through its market-leading GNAT Pro technology and an expert support system second to none. The net result is reduced risk, higher productivity and shorter time to delivery.

GNAT Pro is the most widely used Ada development environment, and a natural solution where efficient and reliable code is critical. At the heart of GNAT Pro is a full featured multi-language (Ada, C, C++) development environment complete with libraries, bindings and a range of supplementary tools. All its technology combines the flexibility and freedom associated with Open Source development and the assurance that comes from knowing that all tools go through a rigorous quality assurance process. It is based on the GNU GCC compiler technology and is backed by rapid and expert support service.

GNAT Pro has been used by industry and government customers worldwide in professional, mission-critical software products ranging from small-footprint real-time embedded applications to large-scale information management systems. It has been ported to more platforms, both native and embedded, than any other Ada technology.

Benefits

The GNAT Programming Studio provides the most advanced debugging facilities available, allowing faster development without compromising performance. Through its multi-language, multinational support, GNAT Pro allows seamless collaboration across the project, backed up by the ability to run natively on a wide variety of platforms, including both Windows and DEC Alpha.

As a well-structured language, Ada is perfectly suited to such a large mission-critical project. As a very readable and maintainable language it allows newcomers to the

project to go through the learning curve very quickly when they pick up code written by another software engineer.

With Typhoon scheduled to continue in service until beyond 2030, the project needed a language that was scalable and easy to maintain, as well as reliable. GNAT Pro is intended for systems comprising many thousands of modules, and millions of lines of code. Its robust system architecture therefore scales based on program size and does not degrade abruptly when a fixed capacity is reached. Additionally its Project Manager facility offers users a flexible framework for organising large multi-person development efforts, such as the Typhoon project.

Typhoon is the most advanced combat aircraft in the world. To ensure that it delivers this performance a high-quality, mission-critical software development environment was essential. AdaCore and the Ada language were therefore the natural choice to power the Typhoon, throughout its 25 year lifecycle.