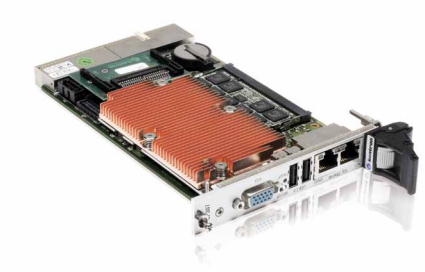
kontron

» Application Story «

VME & CPCI in Defense/Aerospace

Single Fastjet Pilot Flies Multiple Aircraft

Rugged VME and CompactPCI hardware platform controls multiple unmanned aircraft



During March 2007 a series of QinetiQ research activities culminated with a Royal Air Force (RAF) pilot successfully controlling multiple unmanned aircraft from the cockpit of a Tornado military jet. For this series of flight trials, QinetiQ's sophisticated control software was hosted on a dedicated Kontron platform comprising a mix of standard, off-the-shelf boards based on 3U CompactPCI® and VME embedded computing form factors as well as Kontron industrial servers.

At the end of March 2007, autonomous control of unmanned aircraft took a major step forward. Thanks to cutting edge technology, one pilot was able to simultaneously fly a combination of five real and computer generated aircraft at the same time. Sitting at the controls of a Tornado, the pilot was also able to command a BAC 1-11 which was acting as an Unmanned Air Vehicle (UAV) plus three additional unmanned aircraft which were being computer generated (but which appeared as totally real assets to the pilot). This was not a cost cutting measure for commercial airlines, but a solution that could deliver benefits in a number of situations in addition to the military potential, including life saving and humanitarian scenarios. Examples include coastguard search and rescue, disaster relief operations and environmental monitoring.

Figure 1: QinetiQ's Tornado and BAC 1-11 aircraft QinetiQ's Tornado and BAC 1-11 aircraft used during the surrogate UAV flight trials which used a dedicated Kontron multi form factor system based on 3U CompactPCI® and VME.

Built-in intelligence

The technology has important military applications and was developed by QinetiQ as a defence project funded by the UK Ministry of Defence (MOD). The system gives unmanned aircraft an advanced level of independence and intelligence. A series of successful flight trials were flown in March 2007 using a Tornado as the command and control aircraft and QinetiQ's BAC 1-11 trials aircraft acting as a „surrogate" unmanned air vehicle (UAV). The Tornado pilot also had the responsibility of commanding three other simulated UAVs. Throughout the flights a mixed RAF and QinetiQ flight crew were on-board the BAC 1-11 for safety monitoring and control during takeoff and landing. QinetiQ's Tornado Integrated Avionics Research Aircraft (TIARA), flown by an RAF test pilot, assumed control of the BAC 1-11 acting as a surrogate UAV and three simulated UAVs for the middle section of each flight.
Working in combination, the Tornado and the four UAVs carried out a simulated ground attack on a moving target. The sophisticated system allowed the UAVs to act autonomously, communicate and sense their environment, including possible enemies, and target their weapons. However, the final decision to fire simulated weapons was retained by the Tornado pilot. The system has been designed to provide the UAVs with a significant degree of independent intelligence in order to minimise pilot workload, while at the same time ensuring that the most important decisions are retained by a human operator.

The challenge – reliable performance under tough conditions

During the flight trials real conditions were simulated and the Tornado pilot had to command the BAC 1-11 and the three simulated UAVs as if they were real aircraft. For this, QinetiQ developed complex and sophisticated software for remote command of the BAC 1-11 and generating the simulated aircraft and their simulated environments. For hosting the software during the flight trials QinetiQ required an embedded hardware platform powerful enough to provide the necessary real-time processing and tough enough to withstand buffeting during the flights on-board the BAC 1-11.
Another important requirement was the use of standard, off-the-shelf embedded computer technology for cost effective project implementation. Moreover, since the platform also needed to combine CompactPCI® and VME technology in one multi-processor system, QinetiQ needed a partner that could provide all of the required form factors from a single source, including BSP for different OS such as VxWorks and Linux. The partner of choice was Kontron.

The solution – rugged multi-processing with multi form factors

Kontron supplied two identical hardware systems: one in the BAC 1-11 trials aircraft and the other in a ground based installation used for laboratory testing. Each platform consisted of multiple racks containing several VME and CompactPCI® boards as well as the Kontron Industrial Silent Server 4U (KISS-4U).
Since VME is a well-established, proven technology that is designed for high-availability and reliability, it is ideal for use in the avionics/defense sector. CompactPCI® also meets the rigorous demands for reliable operation in rugged environments: the robust connectors, metal guides and metal front plate hold the highly integrated CompactPCI® boards firmly in place inside the mounting cabinet. The electronic connectors are also robust, providing a board design that is inherently resistant against vibrations and shocks. With its rugged design, including shock and vibration protection for the system's HDDs, the 4U Kontron Industrial Silent Servers (KISS-4U) with 3.2 GHz Intel® processors were also the optimal choice for reliable onboard operation.

Real time control by combining CPCI and VME

For the flight trials, the control of the BAC 1-11 and the three simulated UAVs was handled by QinetiQ software running on Kontron components in 4 server racks – one rack for controlling each of the UAVs. Each rack contained multiple VMP2 3U Power PC processor boards and CP306 3U processor boards with processors based on Intel® Centrino® technology. The boards were connected by two CP930 3U

fast Ethernet switches. With its versatile design the CP930 3U fast Ethernet switch with five fast Ethernet ports was the ideal choice for handling real-time communication between the different form factors.
Kontron also supplied a blade array for communication purposes consisting of numerous 6U Compact-PCI® boards (CP6000) with processors from Intel's® Centrino® Platform and 2 x CPCI UC232-2 dual head serial cards. With 2 x RS-232/422/485 interfaces and baud rates up to 1.5Mbps, the UC232-2 cards are especially designed for this kind of rugged and performance-oriented communication application. The KISS4U servers, mounted in separate racks, hosted a range of essential status monitoring applications. The servers were equipped with high performance 3.2 GHz processors and Matrox Dual Head graphic cards for connecting multiple displays. They enabled the operators on board the BAC 1-11 to monitor and check system performance during the trial flight.

Figure 2: QinetiQ's Tornado Integrated Avionics Research Aircraft (TIARA) pictured from its BAC 1-11 which was acting as a surrogate UAV as part of the overall trial

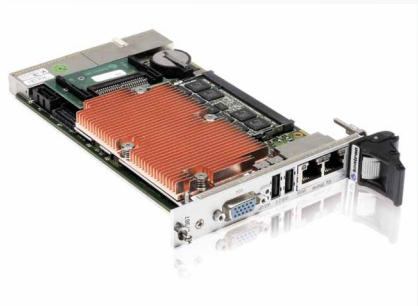
Looking ahead

The UAV autonomy technology developed by QinetiQ is already being used in a number of further government and defence industry-backed programmes. QinetiQ is playing key roles in the Taranis project, a £124 million joint industry and MOD initiative led by BAE Systems to develop an autonomous unmanned combat aircraft. Furthermore, QinetiQ's technology is supporting the £32 million ASTRAEA project, a joint industry and Department of Trade and Industry initiative to explore the technical and regulatory challenges of using UAVs for civil and commercial applications.
"After their impressive performance under tough conditions in the flight trials, combined with the advantages of one stop shopping for hardware and integration services, we will certainly keep Kontron's boards and systems in mind for future projects", explained Tony Wall, MD of QinetiQ's Air business. "Kontron was able to provide exactly the right kind of off-the-shelf rugged technology and multiple form factors we needed for these applications – including BSP for different OS such as VxWorks and Linux."
The design of the boards chosen for this project started in 2005. Future developments will most certainly be based on multi-core platforms to boost performance and reduce power consumption/heat dissipation. Only Kontron offers multi-core embedded computer technology on 10 different form factors and in 12 different systems. In recognition of its extensive portfolio of multi-core based embedded products, Kontron was awarded the "2007 Multi-Core Alignment Award of Excellence" from Intel®. Even more solutions will follow in the near future. Therefore, Kontron is the ideal partner for multi form factor applications and form factor independent consulting, including support for all relevant OS used in similar applications.

Kontron CP6001 6U CompactPCI Board - Reliable, Resistant, Rugged

The Kontron CP6001 is a 6U CompactPCI® PICMG 2.16 compliant board designed to withstand the toughest environmental conditions.
Based on the Intel® Core™ Duo / Core™2 Duo processor and mobile chipset, it comes in three rugged levels defined as R1, R2 and R3. All three versions are available with E2 capabilities (extended temperature range from -40° C to + 85° C). The R1-version is designed for standard application requirements in air-cooled environments. The R2-version is ruggedized for high shock and vibration environments in accordance with the VITA 47 EAC6 specification. The R3-version is fully conduction cooled and meets VITA 47's ECC4 requirements. Together, these 6U CompactPCI® boards provide a cost-effective alternative for rugged, high demand systems in a variety of markets, including military and aerospace.

3U CompactPCI® board with Intel® Core™ Duo/Solo processors



The Kontron CP307 is a 3U high-performance CompactPCI® CPU board equipped with the Intel® Core™ Duo T2500 (2 GHz) / Intel® Core™ Duo L2400 (1,6 GHz) or Intel® Core™ Solo processor T1300 (1.6 GHz).
It offers optimal performance per watt for CompactPCI® in 3U thanks to the low power dual-core technology. PCI Express for high I/O bandwidths rounds off the CPU board, which is streamlined for performance. Designed with soldered processor and memory to handle the toughest environmental conditions, the Kontron CP307 can be used in industrial robots, vision systems, mobile data capture systems, or in aircraft, train or vessel applications to name just a few.

VMP3 CPU board from Kontron – Outstanding performance and security

The latest addition to Kontron's family of 3U and 6U VME processor boards is the VMP3 3U VME CPU board with the Freescale PowerQUICC III RISC processor MPC8541.
The PowerPC board with a maximum clock-rate of 660 MHz is distinguished by outstanding performance (1520 MIPS at 660 MHz according to Dhrystone 2.1) with reduced energy consumption (10W at 660 MHz), and also offers two integrated Gigabit Ethernet ports. The integrated Hardware Security Engine supports encryption in accordance with IPSec, DES, 3Des and AES. This feature, along with the very fast DDR-SDRAM, makes the VMP3 a universal processor board for computing-intensive real-time applications such as those found in automation, transportation and military technology.

KISS-Server Family for Robust Applications

The Kontron Industrial Silent Server (KISS) family offers a wide range of rugged, 19" 1U, 2U and 4U server configurations for every application.
The ultra-quiet (<35 dBA) Kontron KISS family of servers combines multi-core performance with low power and high availability. The flexible layout provides choice of either PICMG 1.3 SHB or ATX compliant motherboards. Shock protected 5.25" and 3.5" HDDs ensure data safety which is enhanced even further by the RAID 1 subsystem. Expansion possibilities are provided by PCI, PEG and PCIe x4 slots. Multiple Gbit Ethernet, USB 2.0 and serial interfaces add to the versatility of the Kontron KISS family, making it the perfect fit for customized industrial server solutions in industrial automation, process control, high-speed image processing, medical technology, defense engineering, transportation and many others.

About Kontron

Kontron designs and manufactures standards-based and custom embedded and communications solutions for OEMs, systems integrators, and application providers in a variety of markets. Kontron engineering and manufacturing facilities, located throughout Europe, Americas, and Asia-Pacific, work together with streamlined global sales and support services to help customers reduce their time-to-market and gain a competitive advantage. Kontron's diverse product portfolio includes: boards and mezzanines, Computer-on-Modules, HMIs and displays, systems, and custom capabilities.

Kontron is a Premier member of the Intel® Embedded and Communications Alliance.

For half-a-decade now, Kontron has been named a VDC *Platinum Embedded Board Vendor*. Based entirely on user feedback, industry professionals evaluate vendors on over 45 non-product related criteria. Kontron is only one of two companies to receive the Platinum award 5-years running.

Kontron is listed on the German TecDAX stock exchange under the symbol „KBC".

For more information, please visit: **www.kontron.com**

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