Case Study

Intel® Core™2 Duo Processor Single Board Computer

Military Command and Control Systems

GENERAL DYNAMICS
Canada

This Might Be the Last Place You'd Expect to Find an Intel® Processor

Case Summary

Until recently, many developers believed that commercial processors ran too hot for embedded, conduction-cooled (fanless) designs and weren't powerful enough to run the real-time operating systems used in many embedded applications – including military and other applications. But the power-performance efficiency available in recent generations of embedded Intel® processors has put to rest such beliefs.

Many developers rely on the Intel® Pentium® M processor to run their most advanced conduction-cooled platforms. And with new multi-core versions of embedded Intel® architecture, they are beginning to design computers that can host multiple operating systems on a single board. General Dynamics Canada Product Engineer Matt Young says that the newest Intel processors are "the highest-performing, low-power processors commercially available today."

Off-the-shelf availability is the key, because the military has mandated that new systems be based on open industry standards and be compatible with common desktop, server and communications networking systems. GD Canada was one of the first defense industry developers to switch its platforms to COTS (commercial off-the-shelf technology), and says that embedded Intel processors meet the demanding performance and power requirements of the military sector.

The new Intel® Core™2 Duo processor is an excellent case in point. GD Canada enlisted this extremely efficient chip in its newest conduction-cooled 3U Single Board Computer (SBC). GD Canada says its PC3010 SBC is suitable for any number of military applications, ranging from Fire Control to Situational Awareness to Command and Control.

This case study explains why GD Canada chose Intel for its SBC designs, and how recent advances in embedded Intel architecture allowed them to reduce the form factor from 6U to 3U simply by changing chips.

Most Extreme?

The world's toughest operating conditions are undoubtedly on the battlefield, where exposure to extreme temperatures, shock, vibration, dirt, wind, liquids, and chemicals is the norm. Reliable performance in this environment is not optional; it can make the difference between life and death.

Yet this is where some of the highest performance, highest reliability computing systems are needed most. To effectively command and control warfighting resources, and to support all of the sophisticated onboard electronic systems, battlefield commanders need tools that allow them to observe, orient, decide and act at a high operational tempo. All this from within the confines of a tank or similar combat vehicle, often with limited network access and under extreme environmental and combat conditions.

In this environment, the size, weight and power consumption of computing systems becomes critical – a combination of measurements referred to in the defense industry as SWAP. These also need to be balanced against the required performance and the overall system cost. GD Canada Product Engineer Matt Young explains it this way: "When you're inside a tank, people are sitting very near the computing systems, and sometimes even right on top of them. So heat is a real problem. We need to run at the highest levels of performance while staying as cool and efficient as possible, so that we don't create an uncomfortable environment, or burn somebody. Plus, we need to ensure that our customers can afford this technology."

The Move to COTS – a Processing Challenge

Finding a processing platform that runs so efficiently has been challenging for developers like GD Canada. Proprietary technology can offer the performance and power efficiency needed, but such solutions are often vendor-specific, take a very long time to develop and deploy, and can be quite costly to maintain, let alone upgrade.

The Army's Future Combat Systems (FCS) Program

The U.S. Army's Future Combat Systems (FCS) program is perhaps the military's largest deployment of COTS-based solutions to date. FCS calls for the development of a family of advanced combat platforms – manned and unmanned, ground, air, and even sensor systems – with a single computer system (the Integrated Computer System (ICS)). This is the primary initiative by which the U.S. Army will transform and upgrade its current and future computing systems. Over the life of the FCS program, the Army plans to deploy ICS units comprising 100,000 or more SBCs.

Specifications for the Current Force ICS implementation in FCS include a multi-slot, 3U sized CompactPCI* chassis. The ICS requires a standard processor module based on x86 architecture that is capable of hosting the ICS' real-time operating system upon which numerous FCS-specific applications are run.

"The beauty of the FCS ICS SBC is that it is entirely based on common industry standards and therefore supports virtually all common operating systems available on the market today," explains Chris Chance, Business Development Manager at GD Canada. "So even though this implementation of the GD Canada SBC is FCS-specific, it is potentially universal. Consequently, any other customer's implementation of this SBC benefits from FCS' economies of scale and logistics support."

For all of those reasons, the military no longer prefers proprietary solutions, and wherever possible is driving the use of commercial off-the-shelf (COTS) technology. After all, the benefits of standards-based designs are considerable in an environment where hundreds of thousands of computing systems must be able to communicate with each other.

Intel is the industry leader in the development of standards-based, COTS technology, and GD Canada has been using embedded Intel processors in many of its SBCs for more than 10 years. Because it supports virtually all of the most widely-used operating systems and is the preferred design for many popular software development tools and applications, Intel architecture makes it easy for companies like GD Canada to deliver SBCs quickly that can be field tested, all with minimum investment in terms of time and money.

"In the defense sector, the ability to deliver robust, reliable technology is critical. By working with a trusted industry leader like Intel, General Dynamics Canada is able to confidently integrate the most advanced technology available into our solutions, and deliver the solid and responsive solutions our military customers require."

David Ibbetson, Vice President, General Dynamics Canada, Vetronic Systems

What Changed?

"Intel really attacked the thermal output and power consumption problem when they came out with the Intel® Pentium® M processor and associated chipsets," Young says. "That's when we realized a performance per watt advantage using Intel's chips in our conduction-cooled designs."

Shortly after Intel launched the Intel Pentium M processor, the U.S. Army announced the Future Combat System (FCS) program, a move to standardize the Army's entire vehicle computing infrastructure on a common product.

When the Army announced FCS, GD Canada's Intel processor-based 6U SBCs were already in use in a variety of military applications, including Situational Awareness, Fire Control, Surveillance and Command and Control. "We were using embedded Intel® architecture in our 6U design, and the customer had already selected a CompactPCI* backplane. So it was quite logical to look for a compatible Intel® processor for use in our FCS 3U design," Young explains.

GD Canada's PC3000 SBC was the company's first 3U product and it was used to win the FCS ICS bid. "The high-performance/low-power formula of the Intel® Pentium® M processor was very efficient in terms of thermal output and power consumption, which made it possible to effectively cool this board using a conduction-cooled design. That means it could be fully sealed to meet all of the military specifications for rugged deployment."

"It only took eleven months to go from contract to implementation, which is very fast for a military system," explains Chris Chance, Business Development Manager for GD Canada's bid. "Because we already had a CompactPCI* board using Intel® processors, all we really had to change was our chips."

Even Better with Virtualization and Multi-Core

GD Canada says the only real limitation with the Intel Pentium M processor is that a second board is still needed to segregate secure applications. "While the Intel® Pentium® M processor is a very efficient chip and addresses a lot of the military's SWAP requirements, we're even more excited about Intel's new multi-core chips and hardware-based virtualization," Young says. "With those technologies, we'll finally be able to use just one SBC to run both secure and non-secure programs."

The next version of GD Canada's 3U SBC – the PC3010 – uses the multi-core Intel Core 2 Duo processor and the Intel® 3100 chipset. It is the first conduction-cooled 3U SBC based on this combination of chips and GD Canada's first functional upgrade to the current FCS processor. From a performance standpoint, "the multi-core versions of Intel's processors really put us ahead in the game," claims Chance.

And because the Intel Core 2 Duo processor includes hardware-based virtualization technology, these powerful chips can run both real-time and general-purpose operating systems simultaneously, while supporting the separation of routine (red) and ciphered (black) network traffic. "Virtualization is becoming essential in military applications. It means you only need one computer now where you used to need two," Young says. "Intel's ability to deliver hardware-based virtualization was a big factor in both our preference for the embedded Intel® processors and also a reason why our customer prefers our design."

About the GD Canada PC3010 Single Board Computer

The PC3010 is a CompactPCI 3U conduction-cooled Single Board Computer (SBC) designed for rugged, embedded applications, such as military command and control systems. The PC3010 platform uses the low power Intel® Core™2 Duo processor at 1.5 GHz, along with the Intel® 3100 chipset. The SBC also includes an Intel® 82571 dual Gigabit Ethernet controller and up to 12 gigabytes of on-board flash memory. The PC3010 is optionally equipped with a PCI Express mezzanine graphics card or can be run as a low power headless "blade."

Because it is half the size of the previous-generation SBC, the 3U PC3010 helps customers increase their computing power while saving space, weight and power. The PC3010 integrates an IPMI 2.0-compliant baseboard management controller to provide remote management functionality. Because the PC3010 is pin compatible with the PC3000, customers using the existing PC3000 SBC (based on the Intel® Pentium® M processor and Intel® 855GME chipset) have an easy upgrade path. Simply remove the PC3000 and drop in the new board.

The PC3010 card is qualified to MIL-STD-810E for use in tracked/wheeled vehicle applications and is rated for operating temperatures from -40° C to +85° C. The maximum power consumption of the PC3010 is rated at 30 W.

"Leveraging Intel's expertise and experience has given General Dynamics Canada a clear competitive advantage."

David Ibbetson,
Vice President,
General Dynamics Canada,
Vetronic Systems

Satisfied Customers

GD Canada says its customers are now asking for Intel by name. "They understand how Intel® technology brings value to their solutions: faster time to fielding, dynamic technology insertion, standards-based compatibility, support for any operating system, a long and trusted roadmap, high performance, and an incredible track record for reliability," Chance claims. "It seems that every other Army program wants to demonstrate some kind of FCS commonality, and the easiest way for them to do that is to go with Intel, which means using this card."

But it's more than that. "Our decision to use Intel started in 1995. We needed an architecture that was going to be supported for more than three years, and that's when we turned to the Embedded and Communications Group within Intel. We've found that having access to a long technology roadmap, along with Intel's desire to work closely with our development team and the subsequent excellent support, has really been key in helping us to establish a good relationship with our customers, and in enhancing our competitive position." Chance says.

For More Information

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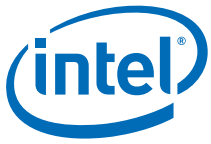

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