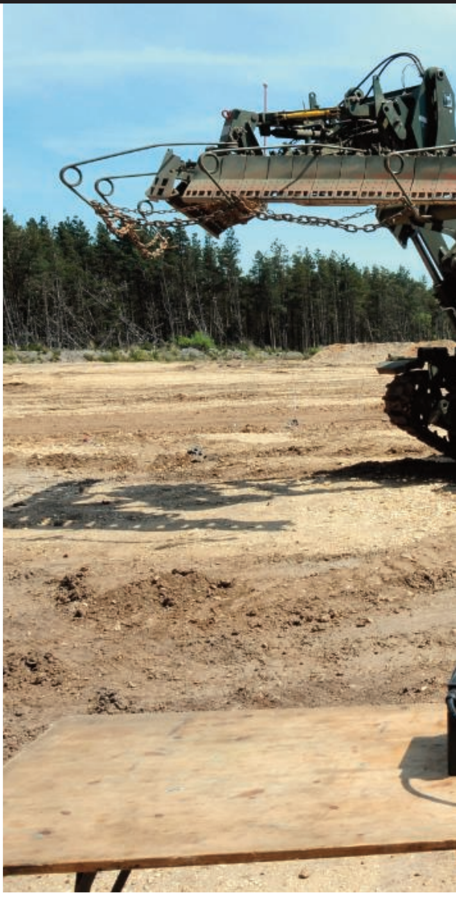
The SBC challenge

The growing deployment of single board computers in military systems brings with it a number of engineering challenges. By **Neil Tyler**.



When it comes to the design and deployment of single board computers (SBCs) for use in high performance military systems, there are a number of engineering issues and challenges that need to be addressed.

There has been significant growth in the number of form factors that are available to design engineers looking to develop SBC based military computing systems. Described by some as a 'renaissance', these latest SBCs are able to offer greater system architecture flexibility and greater compute density as a result of enhanced processor power and capabilities.

These new boards are being designed for demanding military environments with harsh, size, weight and power (SWaP) constraints, such as: manned and unmanned vehicles; and signal processing in intelligence, surveillance, reconnaissance (ISR), sonar, radar and command/control.

"Ruggedisation is something that requires an understanding of the entire sub-system, from the electronic components to the metalwork and how those elements perform at extreme temperatures," explains Aaron Frank, senior product manager, Intel SBC, at Curtiss Wright.

A number of factors have to be taken into account when selecting an SBC, he believes. One of the most important is managing the power requirements of a specific application. As a result, designers have to thin about which form factor will make the most sense for a particular application.

Designers also need to ensure their systems have adequate thermal management capabilities in order to keep the SBC at a suitable temperature. "The thermal characteristics of SBCs can vary immensely," explains Frank, "especially as more multiple die cores and on-die memory cache sizes increase, so more heat is generated.

"A lot of Intel designs used in embedded applications have to contend with SWaP constraints, so we have to use a variety of cooling technologies.

"Typically, there are three approaches to thermal management. The first is an air cooled module, in which we use a heat sink approach; we also have conduction cooled modules, where heat is pulled out of the board by a metal to metal contact on the edge of the board; and we can also use air flow, in which we use an air flow channel on the board to bring air through the frame."

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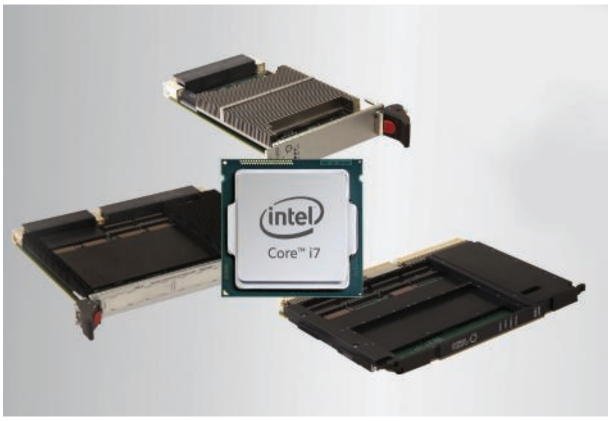
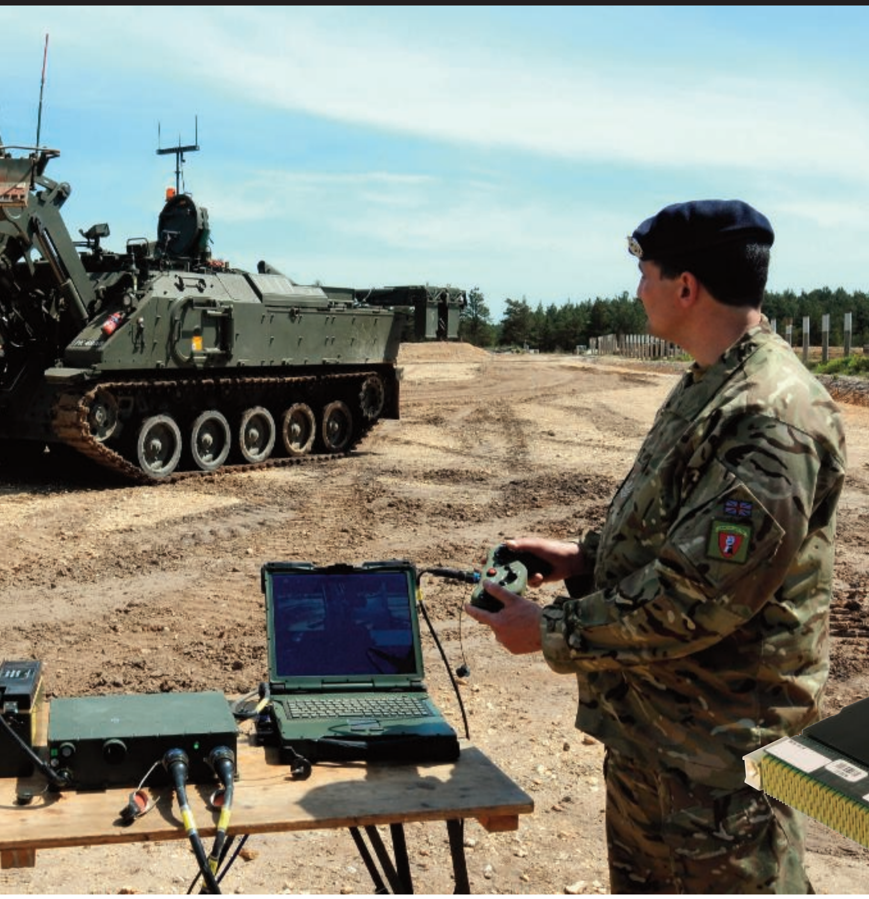


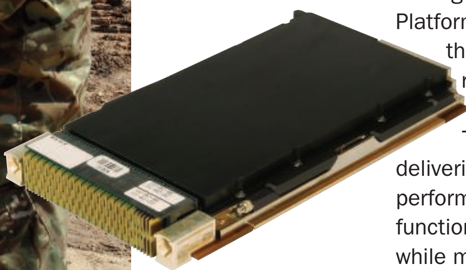
There are a variety of form factors available to engineers. MicroTCA or COM Express tend to be suitable for use in more constrained spaces, such as cockpits. Meanwhile, there are also VME, VPX and CompactPCI.

Smaller form factors tend to be suitable for applications with well defined, but limited, tasks. Should a large amount of computer processing capability be required from the application, then it may need to be housed in a larger, more space efficient platform.

As for the processor, the choices to hand include Intel, ARM and Power Architecture. There is a tendency, according to some product managers, for engineers to stick with a certain type of processor, particular ones they have experience of, rather than selecting the most suitable for their particular application.

Managing obsolescence and upgrading applications also need to be taken into account when selecting SBCs, especially when designing for military applications which may be in service for many years. If the board is going to be used to upgrade an





Main image: New SBCs are being designed for demanding military applications, including in vehicles
Left: Curtiss-Wright's i7 based SBC family
Above: GE's SBC374A has ten times the bandwidth of previous SBCs

existing system, then the design engineer should ensure that it has been designed for the specific pinout of the existing backplane. If that hasn't been taken into account, then you can end up with having to repose or redesign the entire backplane.

Curtiss-Wright Defence Systems creates a number of variants of its existing SBCs so that it can match revised pin requirements, should that be required. However, its focus is primarily on providing consistent pinouts across all its boards as it works to remove the problem of compatibility when it comes to the insertion of upgraded technology.

The memory capability of the SBC is also becoming an increasingly important requirement and will influence the choice of processor. The amounts of memory required in modern designs is growing as more demanding applications require upwards of 16Gbyte of memory, compared with less than 1Mbyte a decade ago.

The SBC must also provide the r the right types and quantities of I/O, whether that is Ethernet, DIO, SATA, USB or serial ports (RS232, 422 and 485), as well as board interconnects (VME, SRIO, PCIe and Ethernet).

Engineers are also being encouraged to consider making available support for an add-on mezzanine card to provide I/O functionality not included on the base SBC.

Curtiss-Wright Defense Solutions recently launched a new Intel based family of SBCs designed specifically to address these various issues and concerns. "We have been producing mission critical Intel computers for many years," explains Frank.

The new modules are based on the recently introduced 5th Gen Intel Core i7 processor (formerly known as Broadwell-H) and the family of boards is available in a variety of module formats, such as 3U OpenVPX VPX3-1259, the 6U OpenVPX6-1959 and 6U VME VME-1909.

The 5th Gen Intel Core i7 processor architecture enables the boards, according to Frank, to deliver very high processing performance in a single CPU-based VME or OpenVPX module. "This latest incarnation of the i7 architecture is intended for use in mission critical applications where the processing of vast amounts of data is crucial. Thanks to the i7 processor, this module's performance levels mean that it is capable of supporting moving and high performance map displays which are being used in advanced radar and electronic warfare applications."

These new modules are intended for use not only in next-generation mission computers, radar processing and imaging systems but also across a wide range of Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR)applications.

Meanwhile, GE Energy Management's Intelligent Platforms business has also housed the Broadwell processor in a rugged 3U OpenVPX single board computer.

The SBC347A is capable of delivering much higher levels of performance and improved functionality than previous versions, while maintaining the same power envelope.

Like the modules from Curtiss-Wright, the SBC374A is the first in a number of Broadwell-based products the company plans to introduce.

This SBC has been designed with two channels of 10Gbase-T connectivity, giving it 10 times the bandwidth of earlier SBCs. The modules can be used to bring enhanced connectivity on the control plance to existing 3U OpenVPX Intel-based platforms, but without needing to undertake disruptive or expensive infrastructure changes.

The SBC374A has been designed to provide a simple form/fit/function pin-compatible upgrade path and, because the Intel Core i7 quad core processor runs at up to 2.7GHz, can deliver as much as 15% greater CPU performance, as well as improved 3D graphics performance. Supplied with 16Gbyte of soldered ECC memory, the modules can provide the on-board and off-board bandwidth needed in more sophisticated applications with its support for PCI Express Gen3 technology and USB3.0.

These are the first of a growing range of modules not only suitable for the military but also for a growing range of industrial applications such as energy exploration and transportation.