TECHNICAL PAPER

Migrating from MVME51005E to Later SMART EC Products

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With the MVME5100 family of products going end-of-life, there are a number of newer products available from SMART Embedded Computing that might be options to replace your MVME5100 family of boards. This document outlines the pros and cons when selecting a replacement board.

All currently available VME boards from SMART Embedded Computing will continue to be available until at least 2025.

SMART™ Embedded Computing

With the MVME5100 family of products going end-of-life, there are a number of newer products available from SMART Embedded Computing that might be options to replace your MVME5100 family of boards.

The newer products will not be drop-in replacements, so some level of work will be required. However, in this paper we will try to outline some of the functional differences when migrating to these newer products.

All currently available VME boards from SMART Embedded Computing will continue to be available until at least 2025.

New processors have new memory map assignments and different I/O chips, such as gigabit Ethernet. The existing software built for the MVME5100 family of products will not work without migrating the source to a different and potentially newer board support package. This document outlines the pros and cons when selecting a replacement board.

Replacement products – Newer Generation

MVME2502 – Based on the NXP QorIQ P2020 (Dual 1.2GHz E500V2 Cores)

MVME8105 – Based on the NXP QorIQ P5020 (Dual 2GHz E5500 Cores)

Both boards were released just a few years ago and have the longest life expectancy. The MVME2502 is an ideal candidate as a replacement for the MVME5100 family of processor board as it offers the best price/performance ratio. For those customers requiring additional performance, you may want to consider if the MVME8105 will be a good fit your budget and needs.

Hardware Considerations for Newer Boards

There are a number of differences with the newer boards compared to the older generation of boards, which will be discussed later. Since the design of these newer boards are based on newer generations of QorIQ processors, fewer critical parts must be managed to maintain the viability of the boards.

The QorIQ processors are considered a system-on-a-chip (SoC) platform, where the processor includes processing elements, all cache, host bridge chip, and Ethernet NICs. Older boards have multiple parts that perform these same functions and must be requalified each time that component goes end-of-life (EOL). SoC processors have one part to manage and NXP has a good history of longevity of supply for these processors.

Though this is typically less important when replacing an older product, the MVME2502 has a number of enhanced features.

1. 2GB DDR3 RAM
2. Five multiprotocol serial ports
3. Three gigabit Ethernet interfaces
4. 8GB EMMC SSD
5. SATA hard drive support
6. 512KB MRAM

One of the first considerations with a replacement is the power available to the replacement. The MVME2502 most closely matches the power required to operate the MVME5100. Power is important, but it is not the only thing to consider.

BOARD	Typical Power Required	Max Power Required
MVME510X Family	15 Watts	23 Watts
MVME2502	17 Watts	23 Watts

One departure for these newer chips is the use of the Altivec Vector Coprocessor found in the MPC7410 of the MVME5100. If the application has special libraries for the Altivec vector coprocessor, then the older MVME5500 or MVME6100 needs to be used. The current QorIQ processors on SMART EC products do not have an Altivec vector coprocessor.

Also the newer E500V2 processing core, that is part of the QorIQ P2020 on the MVME2502, uses a different double precision floating point (DPFP) unit than the traditional PowerPC G4 processing cores found on MVME5100 and older boards that will be addressed below.

The floating point (FP) unit on the older boards uses an IEEE Standard 754 Floating Point unit vs the E500V2 double precision floating point unit in the MVME2502. Both processing cores can perform DPFP in hardware but the floating point instructions have changed and the E500V2 utilizes general purpose registers instead of dedicated floating point registers. The E5500 cores of the MVME8105 do support dual fully pipelined IEEE754 floating point units.

Some analysis was performed comparing the performance of the two floating point units running LMBench under Linux and, in general, performance of the two floating point units were comparable. If there are applications relying on specific features of IEEE754 floating point instructions, then the older boards should be considered but this is typically not the case.

When migrating floating point code to the MVME2502, the compiler is an important consideration. If a binary image compiled for classic PowerPC is run on the MVME2502 and the binary uses floating point instructions, one of two things will happen.

If no floating point emulation is available, the binary will trap on an unsupported instruction; if floating point emulation is available, then the floating point instruction is emulated in the kernel and the floating point performance is greatly reduced.

When using the MVME2502 with floating point-intensive programs it is important to compile programs with a version of GNU Compiler Collection (GCC) that has support for e500V2 and use the appropriate switch when compiling software so that the correct floating point instructions are generated. Current Linux and VxWorks board support packages (BSPs) have appropriate compilers.

Another departure for the newer boards is the user-defined pins on the P2 VMEbus connector. If the existing application uses a PMC that routes I/O from the PMC to the P2 pins of the VMEbus back plane, then the newer boards should not be considered.

The MVME2502 has a different backplane pin assignment of the PMC signals to the user defined pins of the P2. This typically impacts only a small number of applications, but it is something that should be considered.

Finally, if the existing application is dependent on the version of the VMEbus chip on the board, then the MVME2502 and MVME6100 may not be a good choice because they use the newer TSi148 VMEbus chip from IDT versus the Universe II chip which is found on the MVME5100 and the MVME5500. This only has an impact on those rare occasions the application does something unusual and doesn't use the standard VxWorks VMEbus mapping features.

Software Considerations for Dual Core Processors

Newer processor boards support several different operating system choices. VxWorks 6.X and 7.X support a variety of operating modes for multicore processors along with Linux. Though there have been some applications running under Linux on the MVME5100, in most cases, it is some form of VxWorks.

Since the MVME2502 has two processor cores, more modern versions of VxWorks can take advantage of those cores in a variety of ways. The BSP can be configured to run a single Symmetric Multiprocessor (SMP) version of Vxworks managing the two cores. Tasks would be split between the two cores by the operating system. This is only useful when the application can be migrated into threads, which will require migrating the old application to the new threaded environment to fully utilize SMP.

If there are multiple MVME5100 boards in an application, migrating them to a single MVME2502 running VxWorks in SMP mode might be possible, reducing the number of boards that would need to be replaced, but it would require a considerable amount of software modification and many customer programs do not have the time or funding to do these sorts of activities.

Another option is to run Asymmetric Multi Processing (AMP) versions of VxWorks. This is where a VxWorks kernel is run independently on each core. Again, the only advantage to using AMP mode is to collapse systems which have a number of MVME5100 boards in the system to fewer numbers of MVME2502 boards.

The need to migrate the applications to use threading is eliminated but there is added complexity in properly migrating existing applications to this paradigm.

In most cases, applications that currently run on the MVME5100 will run under uniprocessor versions of the operating system, which essentially keeps one of the two cores in reset and never activates the core. In most cases, migrating from the MVME5100 to the MVME2502 will utilize the operating system in this fashion.

The MVME2502 only supports newer versions of VxWorks. Wind River supports 6.8 while SMART EC supports 6.9 and 7.0, but there is no support for older VxWorks kernels like 5.5.1. If the current applications running on the MVME5100 has migrated to a VxWorks release later then 5.5.1, then migrating to the MVME2502 is much simpler.

This does not mean it is simply a recompile and build of the kernel, but there is a migration path to the software running on the MVME2502.

If the application is using the older version 5.5.1 and there is no funding to migrate the application to a newer operating systems, then it might be a better decision to migrate to one of the older boards, that will be discussed next, even though there may be more of a tradeoff in terms of life expectancy when compared to the MVME2502.

Replacement products – Older Generation

MVME5500 – Based on the NXP 1GHZ MPC7547, Single GigE, Universe II VME

MVME6100 – Based on the NXP 1.3GHZ MPC7547, Dual GigE, TSi148 VME

Hardware Considerations for Older Boards

The MPC7457 device used on these older boards has a very similar execution unit as the MPC7410 found on the MVME5100 family of processors. So, the general behavior of the software running on the MPC7457 will be similar to the MPC7410 but faster. Though some binary code compiled for a MPC7410 might run on a MPC7457, there are enough differences with the processors and the other I/O on the board to eliminate this board as a drop-in replacement.

All software will have to be, at a minimum, rebuilt and most likely, BSPs reconfigured. New VxWorks kernels which support the MPC7457 will also have to be purchased from Wind River.

Another common feature of the MVME5500 and MVME6100 is the user defined pin assignments through the VMEbus P2 pins. As mentioned earlier, the PMC pin assignments were updated with the MVME810X and MVME250X boards. The MVME5100 boards match the PMC pin assignments with the MVME5500 and MVME6100. If this is an important aspect of the current applications, then these boards should be considered.

BOARD	Typical Power Required	Max Power Required
MVME510X Family	15 Watts	23 Watts
MVME5500	34 Watts	40 Watts
MVME6100	42 Watts	51 Watts

As mentioned previously, there are two other differences between the MPC7457 and the newer QorIQ processor. The MPC7410 has an IEEE 754 compatible floating point unit and Altivec vector coprocessor. If the applications are dependent on either of these features, then the MVME5500 or MVME6100 should be used.

Power may also impact the decision to pick these older boards. The MVME5500 and MVME6100 require more power to operate.

There are several major differences between the MVME5500 and MVME6100:

HOST BRIDGE

The MVME5500 uses an older host bridge chip from Marvell called the Discovery I while the MVME6100 supports the later generation of the part called the Discovery II. Major differences are:

- Support for GigE natively in the Discovery II while the Discovery I only supports 100Mb Ethernet
- The Discovery II supports 133MHz PCI-X versus 66MHz on the Discovery I, which was important to support faster PMC modules and the faster TSI148 VMEbus controller.

GIGABIT Ethernet

The MVME5500 supports one of the 100Mb Ethernet interfaces from the Discovery I host bridge and a separate GigE NIC for the board's two Ethernet interfaces while the MVME6100 has two GigE NICs integrated into the Discovery II host bridge.

Though GigE is probably not a critical feature for a replacement of the MVME5100, long term support of dual NICs is different for the MVME5500 versus the MVME6100.

Since the NICs are integrated in the Discovery II of the MVME6100, only one part must be managed over the life of the board. In the case of the MVME5500, the additional GigE NIC has already gone through some requalification, which forced a change in the supporting software.

These impacts will be less with the NICs integrated into the host bridge itself.

FLASH

The MVME5500 has a total of 40MB of integrated NOR flash to hold the boot firmware along with VxWorks kernels. The MVME6100 increase that to 128MB total split between two 64MB NOR flash devices.

VMEbus Interface

The MVME5500 uses the same VMEbus controller, the IDT Universe II, as does the MVME5100. The MVME6100 uses the newer IDT TSi148 which supports the much higher performance levels of 2eSST protocols. This is the same interface as found on the MVME810X and MVME250X boards.

Though the MVME5500 and MVME5100 have the same VMEbus controllers, this is not really that much of an advantage because most applications will work using either interface, unless there are specific features of the Universe II that the applications requires.

Software Considerations for Older Boards

One of the strongest arguments for using the MVME5500 or the MVME6100 is with porting software. If the existing application is based on an older operating system like VxWorks 5.5.1, then these older boards should be considered as replacements. The newer products like the MVME810X or the MVME250X do not support anything below VxWorks 6.X. There are many applications that have not transitioned to the newer versions of VxWorks.

There will however be issues with attempting to port the software to VxWorks 5.5.1 on the MVME5500 or the MVME6100. Though the BSP exists, support from Wind River has discontinued for VxWorks 5.5.1. Support agreements would have to be put in place to get support for these old versions of VxWorks from Wind River which will likely be expensive but available for those programs that cannot migrate.

Conclusions

Migration from the MVME5100 family of products to a newer SMART EC VMEbus board cannot be done as a drop in replacement.

Due to the age of the product and the cost, the first board to consider is the MVME2502 board. It has the best longevity and value for any of the products.

If there is sufficient funding for software development, the dual core capabilities and increase memory capability could allow applications which currently use multiple MVME5100 boards to a single MVME2502.

The MVME2502 in uniprocessor mode is a very good replacement if the current application can support newer versions of VxWorks and/or there are power limitations in the system.

If the current application takes advantage of the Altivec vector coprocessor of the MPC7410 or there is insufficient budget to migrate the software to a newer version of the operating system then the MVME5500 or MVME6100 are better choices.

If there are dependencies in the application on specific features of the Universe II VMEbus controller then the MVME5500 is the better choice.

If none of those dependencies exist but the software being used is old and cannot be migrated, then the MVME6100 is the better choice of the older boards due to the reduced number of critical parts to maintain.

All currently available VME boards from SMART Embedded Computing will continue to be available until at least 2025.

To discuss migration of your MVME5100 boards with a SMART Embedded Computing technical expert, please contact us through our website:

https://www.smartembedded.com/ec/contact

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Building on the acquired heritage of industry leaders such as Motorola Computer Group and Force Computers, SMART EC solutions include application- ready platforms, enclosures, blades, edge servers and network accelerator cards for government, communications and transportation markets.

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