DEVELOPMENT OF COM EXPRESS VME CARRIER BOARD WITH REMOTE MANAGEMENT CAPABILITY

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Abstract

VME market is shrinking gradually. We have recently faced with difficulty that our choice of VME CPU boards from the market has been restricted. Since over two hundreds of VME computers have been deployed, we have to solve the difficulty. We, therefore, design and develop a COM Express VME carrier board. It is equipped with the VME64x interface and the PICMG standardized COM Express interface. We can build up our VME CPU board by combining the carrier board with a suitable COM in the growing COM Express market. We design the carrier board to realize another solution for the difficulty. That is, the VMEbus can be controlled from its PMC/XMC slot without using a COM Express module. High-reliable server computer would be a VME controller via a PCI or PCI Express extension like Serial Rapid I/O, for example. In addition, we design the carrier board to support remote management functions. The daughter board attached onto the carrier will provide VME/COM monitoring function, VMEbus reset function and KVM (keyboard, video, mouse) over IP function via an independent network interface on the carrier. The design details and the available functions will be presented.

INTRODUCTION

In recent years VME market has been shrinking gradually. We have sometimes faced with difficulties of a narrow choice of VME boards in the market. The situation is the same for VME CPU boards although many brand-new CPUs are brought to CPU market one after the other. And in many cases it takes long time to release a new VME CPU board equipped with the new CPU.

The control system of SPring-8 employs over two hundreds of VME computers. In addition about a hundred of VME computers will be deployed in XFEL (X-ray free electron laser) now constructed in the SPring-8 site. So long as such a large number of VME computers are used, it is not practical for us to abandon VMEbus even though the market has been shrinking. We should make efforts to solve the difficulties of narrow choice of VME boards.

We have paid attention to COM (Computer on Module) appeared on the market. In a wide variety of COM standards, COM Express attracts our attention. COM Express is most promising COM because it is a unique standard established by PICMG. The COM Express market is practically growing. We have, therefore, designed and developed a COM Express VME carrier board that would work as a VME CPU board by attaching a COM Express module. We could choose our suitable COM Express module in its large market. In addition, we could test and utilize the newest CPU in the VME computers soon.

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COM EXPRESS

As described above, COM Express is a unique standard COM defined by PICMG. There are two types of form-factors : basic form-factor (125 mm ! 95mm) and extended form-factor (155 mm ! 110mm), and five types of pin-out of interface connector(s) with a carrier board. Pin-out type 1 module has a single 220-pin connector with two rows (row A and B) that forms basic pin-out. The others have another 220-pin connectors (row C and D) in addition to a basic pin-out. Table 1 summarizes pin-out types of COM Express.

COM Express modules are driven with a single +12V power rail through the interface connectors.

Table 1: Pin-out Types of COM Express

Type	Connector rows	PCI Express lanes	PCI bus	IDE	LAN port
1	A/B	6	No	No	1
2	A/B+C/D	22	Yes	Yes	1
3	A/B+C/D	22	Yes	No	3
4	A/B+C/D	32	No	Yes	1
5	A/B+C/D	32	No	No	3

DESIGN OF COM EXPRESS VME CARRIER BOARD

We designed our COM Express VME carrier board having the following three functions:

- Function of COM Express VME carrier board.
- Function of remote management capability with a daughter board.
- Function of VMEbus remote control capability without a COM Express module.

A block diagram of our designed carrier board is shown in Fig. 1.

Function of COM Express VME Carrier Board

Needless to say, this is the most important function of the carrier board. We designed it as a 6U, dual slot VME64x board with Gigabit Ethernet, USB, Serial ATA and PMC/XMC interfaces. Difficulties on the design were layout, pin-out and power supply with the attached COM.

We have limited our choice of COM Express modules with the basic form-factor because we require a PMC/XMC slot. The extended form-factor is incompatible with a PMC/XMC slot on the 6U VME

board. We considered that the market of the basic form-factor was large enough for our choices.

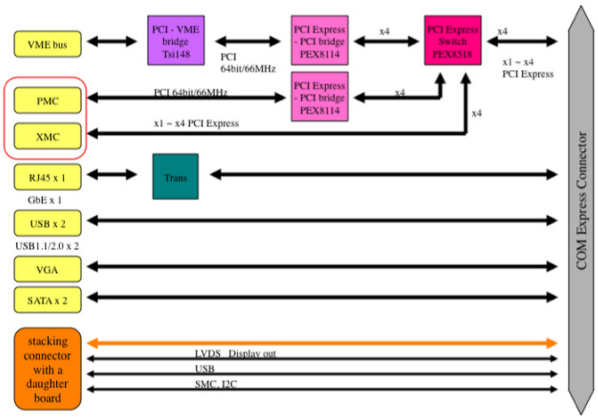

Figure 1: Block Diagram of the COM Express VME Carrier Board.

We designed the carrier board having type-1 pin-out but two interface connectors due to COM Express module compatibility. Only the type-1 pin-out can keep compatibility with the other pin-out types. We, therefore, don't use the specific functions assigned in C and D rows of the connector such as IDE, PCI and additional LAN port. As storage devices, SATA DOM (Disk-On-Module) and/or USB DOM will be used instead of IDE. PCI devices such as a Tsi148 [1] PCI/VME bus-bridge chip are controlled on PCI express lane(s) of a COM Express through a PEX8518 [2] PCI Express switch and a PEX8114 [2] PCI Express/PCI bus-bridge chip. The carrier board supports only one Gigabit Ethernet controller on the COM Express module. No LAN PHY chips are prepared on the board. In this way, we successfully designed the carrier board having pin-out type compatibility. At present, we have test the carrier board using a type-2 module because most of the COM Express modules are type-2. We expect the carrier board equipped with a type-3/4/5 pin-out module will work well.

With the consideration of the balance of power consumption and cooling of the COM Express module, we assumed that the maximum power consumption of the attachable COM was about 60W. The carrier board was designed to make +12V to the module by using only +5V of the VME bus because it would be installed in legacy 32bit VME chassis.

Function of Remote Management Capability

We designed the carrier board providing the following remote management functions by stacking a daughter card. The management daughter card works independently from the COM Express module on the carrier board. The daughter card is driven by its own CPU (533MHz PowerQUICC II PRO (MPC8347) [3]) and OS (Linux), and has an independent Ethernet interface from the COM Express module.

- VME bus management functions such as measurements of power supply voltages (+5V and ±12V), observation of interrupt lines and generation of a SYSRESET signal.
- VME chassis management functions such as temperature measurement and observation of cooling fan fault.
- COM Express module management functions such as observation of temperature and drive-voltage of CPU(s) and generation of a reset signal to the CPU(s). Because these functions are achieved by using standard interface such as I^2C, compatibility between COM Express modules can be kept.
- KVM (Keyboard, Video, Mouse) over IP functions enabling us to monitor and operate a console of the COM Express module by capturing video, keyboard and mouse signals.

Because these functions including KVM over IP are providing as web services on the Linux on the daughter board, we can manage the VME CPU boards using any web clients on the same network. Of course, any application programs can be used for the management because API functions are prepared.

We have often intended to achieve remote management capability for VME computers like server computers. The daughter card can realize the powerful management functions with lower-cost and minimum space.

Function of VMEbus Remote Control Capability without a COM Express Module

While the board was the COM Express carrier board, we designed it providing remote control capability of the VMEbus through the PMC/XMC slot without a COM Express module.

We have achieved this function by switching upstream and non-transparent ports on the PEX8518 PCI Express switch. When we use a COM Express module, the module site is set to upstream ports and all ports are set to transparent mode. On the other hand, the XMC (PMC) site is set to upstream and the module site is set to non-transparent ports when a COM Express module is not attached. The non-transparent mode of the PCI Express switch enables us to avoid the single root-complex configuration problem on the PCI Express specification. We can control the VMEbus from remote CPUs by installing PCI Express (PCI) extension capable interfaces such as Serial Rapid I/O [4] and StarFabric [5] on the XMC (PMC) slot.

DEVELOPMENT STATUS

We have already finished the hardware development and will complete software development for remote management function on the daughter card in a few days. Figure 2 shows a picture of the developed boards that will be released from ARKUS Inc. [6] as Axvme2000 (carrier board) and Axvme2001 (remote management daughter card).

We have evaluated the COM Express VME carrier functions by using AM120 model 110 (Plug-N-Run G5) by PFU Ltd [7]. The module is a basic form-factor and type-2 pin-out COM Express module equipped with 1.6GHz Core 2 Duo L7500. As the first step, we succeeded in Linux installation into the module and succeeded in VMEbus access VMEbus through Tsi148 on the carrier board. For the next step, we will install Solaris widely used in equipment controller in SPring-8. Furthermore, we will intend evaluating the other companies' products and pin-out types.

Figure 2: Picture of the COM Express VME carrier board with the remote management daughter card.

As mentioned above, software for the remote management functions are now in progress, but almost finished. In the preliminary evaluation, we have almost succeeded in remote management including KVM over IP function using a Web browser.

For the evaluation of remote control functions without a COM Express module, we interconnected the carrier board with a Linux PC by using StarFabric interface cards. We succeeded in VMEbus control through the StarFabric cards. The StarFabric card was installed onto the PMC slot of the carrier board. The evaluation is enough because the XMC slot is equivalent to the PMC from the viewpoint of connection to the PCI Express switch.

FUTURE APPLICATIONS

We are going to replace old VME CPU boars used in SPring-8 with the carrier boards equipped with COM Express modules. We will utilize the remote management functions of the daughter card to record the VME computers status into database. That will facilitate our maintenance works while the SPring-8 accelerators stops because we will always check the status and detect something abnormal.

We will study the remote control of the VME chassis from high-reliable and high-performance server computers in remote places. That will enable us to enhance reliability and manageability. We will be able to gather and consolidate all CPUs into a place. In addition, we will be able to restructure the localized VME computers into any combination of logical hosts by using virtualization technology. For example, we use five localized VME computers for all the magnet power supplies of the SPring-8 storage ring now. By using the remote control function, we will concentrate all the CPUs into a server computer and control all the power supplies from the server computer without performance penalties.

For the PCI Express extensions, we consider Serial RapidIO is most promising at present. It has wide bandwidth and good real-time features enough to extend PXI Express. Of course Serial RapidIO is a switched fabric standard enables multi-processor interconnect configuration, so there may be more interesting applications.

SUMMARY

We have developed the COM Express VME carrier board that works as a VME CPU board by attaching an appropriate COM Express module in the larger market. We expect that it would be the good solution against the shrinking VME CPU market. In addition to the carrier functions, the remote management functions such as status monitor, reset CPU and KVM over IP are available by staking the daughter card. They are achieved independently from the main CPU(s) on the COM Express module.

Moreover, the carrier board was designed having remote control capability through the PMC/XMC slot from external CPU(s). It enables us to control VME chassis from high-reliable and high-performance server computers in remote place. The remote control functions would contribute reducing local noise and local heat in the VME chassis generated by local CPU(s).

At present, almost all the functions of the carrier board are evaluated and are confirmed well. We are also going to test the carrier board by using Solaris and other COM Express products.

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