Research on Design of Health Management Computing Module Based on FT2500

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Abstract. In order to solve the problem of insufficient computing power of domestic computers for industrial scenes, a solution based on the computing module of FT2500 processor is proposed in this paper. The module uses ZX200 bridge chip to expand common interfaces such as serial port RS232, Ethernet, USB, SATA and PCIe bus. PCIe bus with multiple bandwidths enhances the scalability of the module; The 10 Gigabit network improves the high bandwidth data transmission capacity and meets the needs of data processing. This module supports the health management function, which can monitor the internal voltage, current and temperature of the module, and collect the monitoring information of other modules through IPMB bus. This module uses the modular design of Kunlun firmware as the boot program in the startup stage.

Keywords: FT2500 · VPX · Health Management · Kunlun firmware

1 Introduction

At present, the industrial computer is widely used in the field of land, sea, air and sky as the Brain and Central nervous system of command and control, information processing, data calculation, man-machine operation, target detection and navigation. With the increasingly fierce competition of big countries, the Western countries block our information technology industry, which seriously damages our information technology security. It is imperative to establish the information technology industry with domestic CPU as the core. With the wide application of new technologies such as Internet of things and 5G in industry field, a mass of industrial data is produced, so it is urgent to develop high performance and high bandwidth computer. FT2500 main module has strong computing performance, multi-task processing capacity, floating-point computing capacity has a strong advantage. The design of an expandable computer module based on FT2500 can effectively solve the problem of insufficient computing capacity of home-made computers. The module adopts dual-CPU VPX bus architecture, with ZX-200 bridge chip, the interface includes display, serial port, Ethernet, USB, Sata, PCIE bus, 1000mb network and so on.

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2 System Solution

The overall design scheme of FT2500 computing module is shown in Fig. 1. The module adopts two FT2500 processors. The X4 four link high-speed direct connection interface is used between the dual CPU processors for interconnection. The data transmission rate of single link can reach 25gbps. The two CPUs are combined into a single OS image system through the direct connection bus, which is equivalent to 128 core CPU; 8-way DDR4 controller is integrated inside each CPU, and two CPUs can expand no less than 256gb DDR4 memory through 16 way DIMM socket; FT2500 processor provides 1-way x16 and 1-way X1 PCIe bus interface. The x16 PCIe bus of the two CPUs is respectively connected with pex8764 switching chip to expand the subsequent PCIe devices. Among them, the x16 PCIe bus of CPU1 is extended with 1-way PCIe x16, 1-way PCIe X8 and 1-way PCIe X4 bus through pex8764 switching chip, and the extended 1-way X8 PCIe bus is connected with Intel x710, and then 4-way 10 Gigabit Ethernet is realized through optical module; The x16 PCIe bus of cpu0 is led out through pex8764 exchange chip, one way of PCIe x16 and one way of PCIe X8 bus. The extended one way of X8 PCIe bus is connected to Intel x710, and then four ways of 10 Gigabit Ethernet are realized through optical module. The extended one way of X4 PCIe bus is connected to ZHAOXIN ZX-200 bridge, and then peripheral functional components such as USB, SATA, Gigabit Ethernet, VGA and BMC are extended [1, 2].

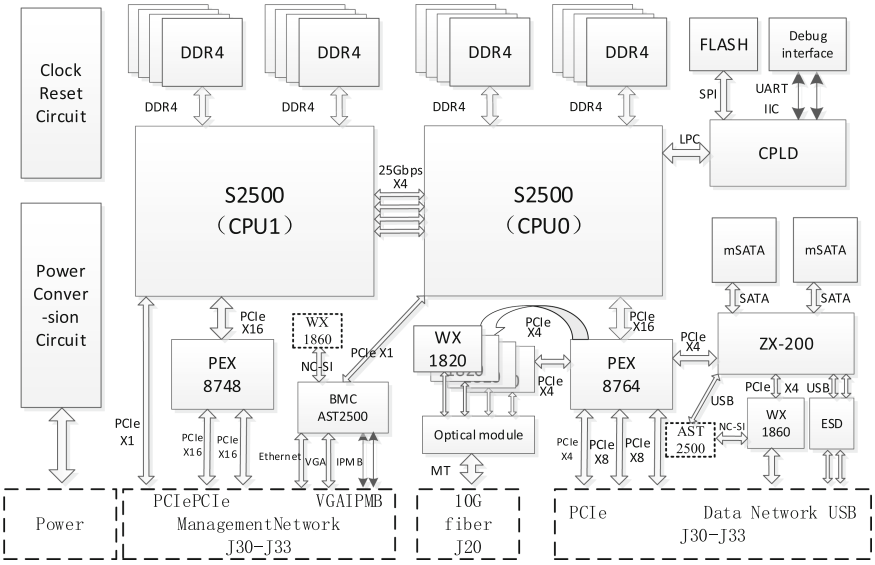

Fig. 1. Composition of computer module system

3 Hardware Design of Health Management

The Board Card Monitoring Chip AST2500 is the main choice of the monitoring chips for all kinds of server motherboards at present. It can be used to monitor the voltage, current, temperature, etc. at the same time, it has rich peripheral communication interface, can report to FT2500A through LPC bus or serial port, and realize the monitoring of this board system. At the same time, it can monitor the voltage, current and temperature of other board cards in the chassis through IPMB, and report to this board, moreover, the monitoring data can be monitored remotely through MDI interface Ethernet, or reported to the internal management unit of the chassis through IPMB bus. AST2500 chip internal integration 1-way display controller, support external VGA display and KVM over IP function. The BMC management module provides board-level management function for the computing module, and adopts the standardized management sub-card unit to realize the temperature, the voltage and current monitoring of the board, as well as VGA display and remote KVM functions. It can also be configured as SMC management module to use, in addition to the realization of the board's management health functions, but also to achieve the entire chassis and the chassis of other Functional Board Card Monitoring and management functions [3].

The Design Block Diagram of the management function unit of the computing module is shown in Fig. 2. The core part of the module is a BMC management sub-card, which is installed on the computing module using an XMC connector, and is directly connected to the FT-2500 processor via a 1-way PCIE X1 bus, extending the FT2500 1 channel VGA display, while FT2500 connects to the BMC via a ZX-200 bridge extension's 2 channels USB interface, enabling remote KVM with management network and

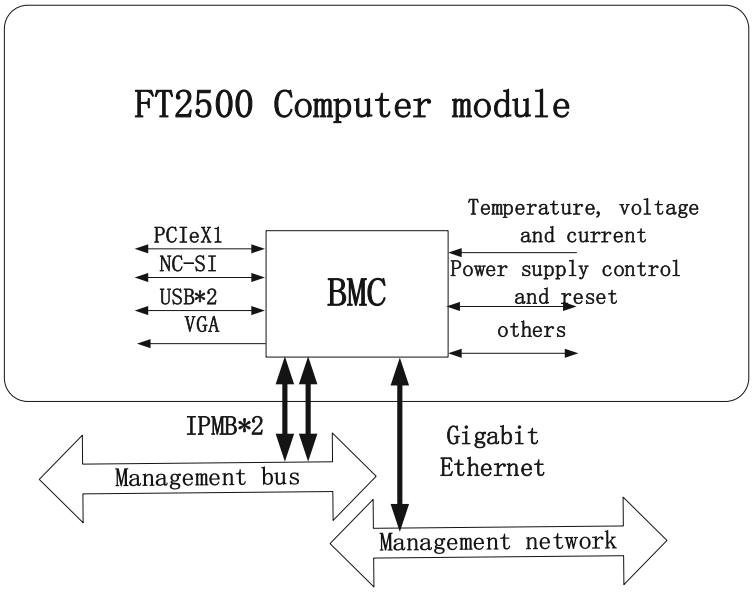

Fig. 2. Design block diagram of calculation module management function unit

VGA display, the BMC management sub-card provides redundant IPMB bus connection to the external management bus, also can connect to the management network through Ethernet, all BMC information summary to SMC, SMC and BMC information interactive IPMI specification. BMC monitors the temperature, voltage and current status of the CPU, memory and power supply, and performs the operation of switching, reset and status detection When the BMC detects the abnormal occurrence of the board, the fault information is sent to the management module SMC via IPMB, which is reported to the main board or the remote administrator, the SMC supports serial port and WEB access, while the BMC sub-card provides NC-SI interface and connects to the WX1860 gigabit network card extended by FT-2500, which forms a multiplex relationship with the data network port [8].

4 Design of Health Management Software

BMC software mainly runs on the BMC management sub card. As shown in Fig. 3, the software architecture of BMC management system includes three layers: firmware boot layer, operating system layer and BMC application layer. Among them, the bootloader mainly completes the initialization of the hardware interface and transfers the control right to the operating system; The operating system layer mainly completes the drive and allocation of specific hardware resources (Linux is selected as the operating system in this scheme); The application layer mainly realizes management related applications, such as web, IPMI protocol, voltage, the temperature and current detection.

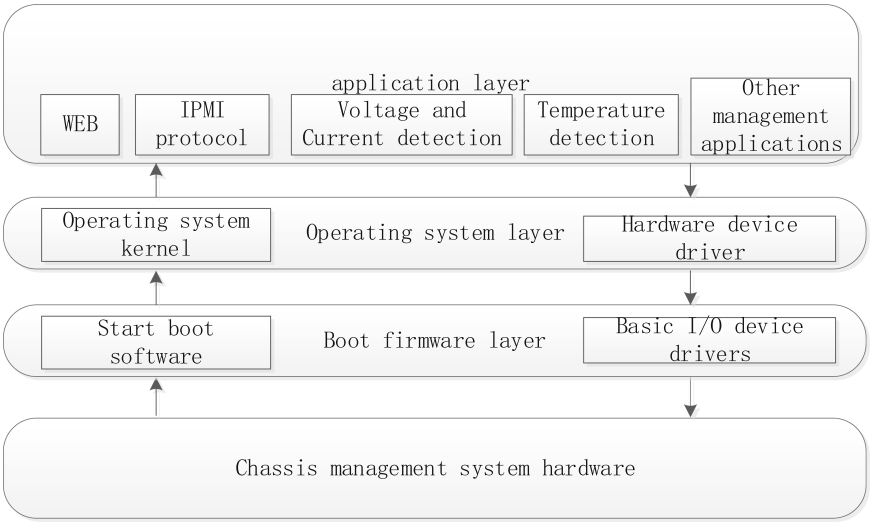

Fig. 3. Management system software architecture

4.1 BMC Operating System Layer Design

In this scheme, the management software runs Linux operating system, and the operating system layer mainly completes the development of kernel and driver based on ast2500 processor. As shown in Fig. 4, the design flow chart of Linux operating system transplantation and driver based on ast2500 processor is mainly to complete the initialization of processor and the modification of driver code, and make it support network functions, JFFS2, YAFFS file system, etc. at the same time, modify the MTD partition so that the kernel can mount the file system on the storage device [9].

4.2 Design of Voltage and Temperature Acquisition Software

Figure 5 shows the flow chart of BMC voltage and temperature acquisition software. When BMC is powered on, first read the temperature and voltage value of this module. If there is no interruption, report the temperature and voltage status of this module to SMC module through IPMB; If there is an interrupt, judge whether the interrupt source is temperature sensor or SMC, and deal with it according to the actual situation.

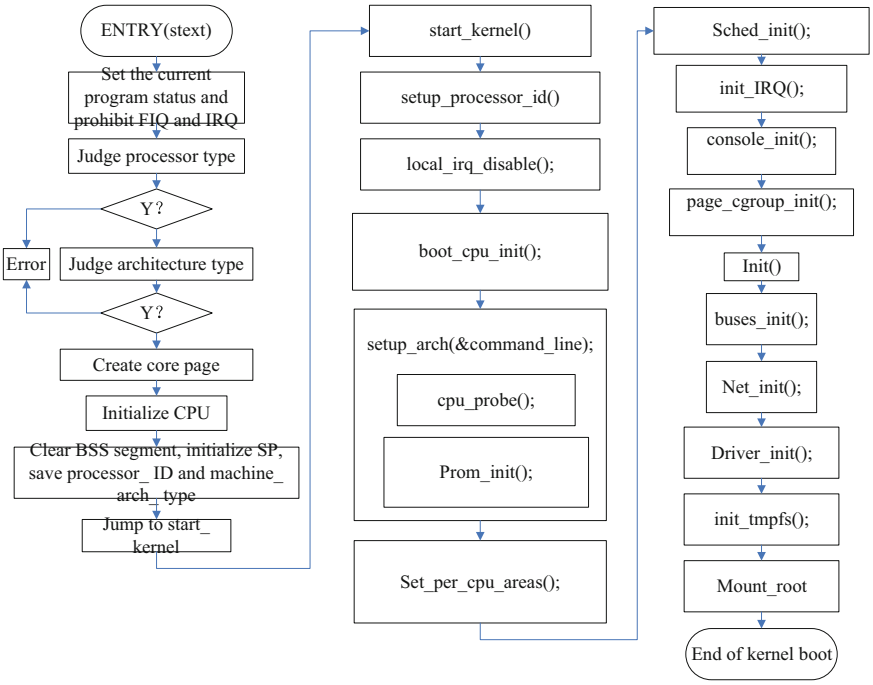

Fig. 4. Operating system transplantation and driver design flow chart

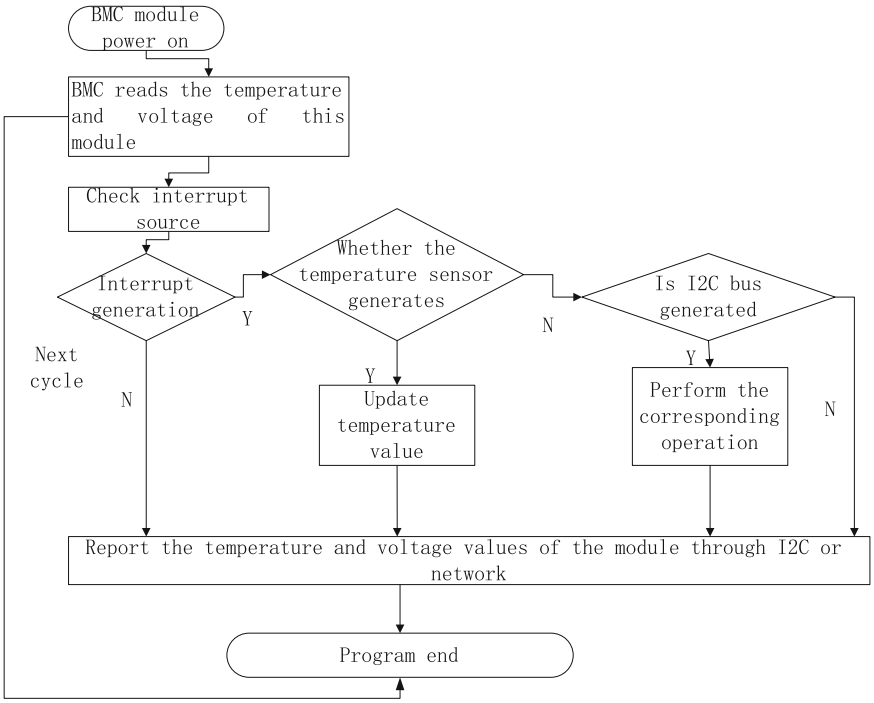

Fig. 5. Flow chart of voltage and temperature acquisition

5 Research on Kunlun Firmware Design

Over the years of development, UEFI Kunlun firmware has gradually completed the support of series of processors and their supporting chipsets, and can complete the basic functions of firmware on various domestic processor platforms. FT2500 computing module is the main module of server computing unit and storage unit based on dual FT2500 high-performance general microprocessor. Kunlun firmware of FT2500 computing module adopts the following ideas for design [4]:

a) The hardware abstraction layer is closely related to the underlying hardware equipment, which is the most different part of the firmware of various types of computers. It is necessary to implement the corresponding hardware abstraction layer according to the main board hardware design of FT2500 computing module;
b) The modules contained in the device protocol layer and firmware core layer can be universal to a great extent, that is, they can be applied to all types of computer systems without modification or simple modification. The device protocol layer and firmware core layer of FT2500 computing module adopt the general design part of Kunlun firmware;

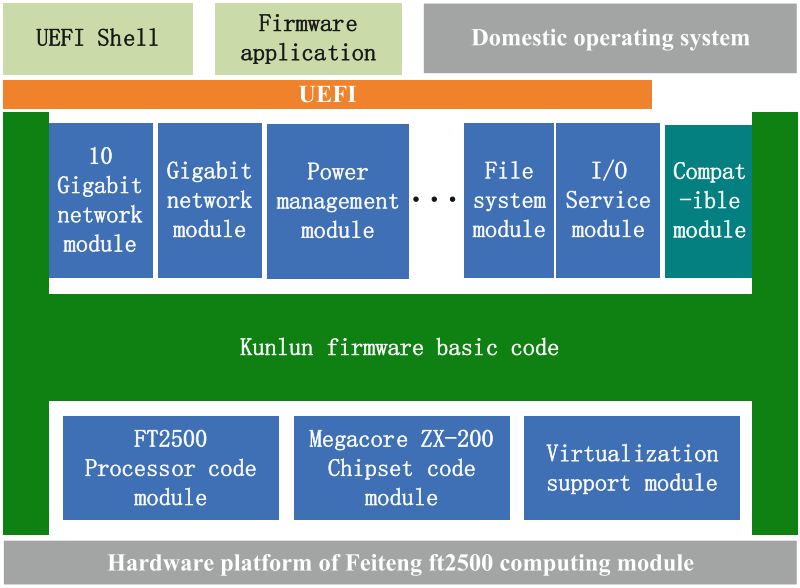

Fig. 6. Kunlun firmware structure diagram of FT2500 computing module

c) Many modules of the firmware application layer are also common, but they need to be customized according to the characteristics and functional requirements of various computer systems. FT2500 computing module has no special requirements for the firmware application layer and is based on the general design of Kunlun firmware.

The internal structure of Kunlun UEFI firmware, a computing module based on FT2500 processor, is shown in Fig. 6.

The bottom layer of Kunlun firmware structure of FT2500 computing module is the hardware platform based on FT2500 processor computing module [5]. The hardware abstraction layer mainly includes packaging and abstracting FT2500 processor, ZhaoXin ZX-200 chipset and other board level hardware implementations, realizing the initialization of processor and hardware, and providing the upper module with standard interfaces to access processor and hardware equipment [6]; The device protocol layer and firmware core layer of FT2500 computing module adopt the general design part of Kunlun firmware, mainly including Intel xl710 Gigabit Ethernet driver module, Netcom WX1860 gigabit network card driver module, BMC function and VGA display module based on AST2500 processor and other general component modules; The firmware application layer adopts the universal design part of Kunlun firmware. The basic functions of domestic Kunlun BIOS include obtaining system control after the hardware platform is powered on, initializing key components such as ft-2500 processor, RDIMM memory module and ZX-200 chipset, enumerating peripherals and allocating resources, initializing necessary peripherals such as graphics card, hard disk and network card, establishing a running environment for the operating system, and then handing over the control to the

operating system. In addition, Kunlun BIOS can also customize the configuration interface, system monitoring, power management, trusted computing and other functions to meet the different needs of machine manufacturers, security equipment manufacturers and end users [7].

6 Conclusion

In this paper, we design and implement a rich interface, strong computing performance and high bandwidth transmission function. Based on FT2500, which supports health management, the interface can be configured flexibly according to the characteristics of the application field The CPU and the operating system have been made in China, which can realize complete self-control. The computing module can meet the needs of the industrial domain.

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