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Build or buy?- standard CPUs for customized embedded computers

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Matthias Huber, product manager at JUMPtec Industrielle Computertechnik, examines a way in which off-the-shelf standard products can be better than designing your own.

Due to the fact that only a limited number of modular CPU boards have the full array of features desired by embedded system developers, 80 percent of the resulting solutions are comprised of custom-made products. The integration of newer processors and chipsets is more complex and more costly than in the past. In some cases, the lifetimes of the processors and other integrated components fall short of that which is required by the embedded system for which they have been selected. This has led to an increase in the demand for modular CPU board standards that meet the specifications of embedded computer systems.

Standardized CPU modules must be flat, scalable and exchangeable, free of expensive cable connectors and virtually free of moving parts such as fans. The DIMM-PC and ETX component SBC open standards, developed by JUMPtec, meet these embedded computer system requirements. The two modular CPU standards have been adopted by a number of different manufacturers, giving designers a wider variety of products to choose from.

Quick and easy

Among other factors, the development of 8-layer boards for CPU integration has resulted in the largest portion of project cost. By using either the DIMM-PC or ETX modules, the customer can concentrate on his core competence: application-specific development. Maintenance and further development of CPU and motherboard functionality are no longer necessary on-site tasks.

The CPU module supplier continues to be responsible for these tasks. For example, a 4-layer motherboard, with extended functions for measuring technology or system integration, can be developed quickly and economically.

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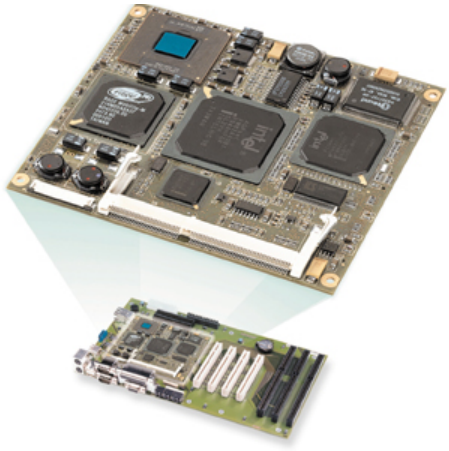

Fig 1: ETX component SBC open standard design

The CPU module itself is plugged in and fastened tightly to the motherboard with screws. The module can be exchanged for another DIMM-PC or ETX module without difficulty when higher computing capacity is required. No modification to the motherboard is necessary. The solution remains scalable and is open to future performance upgrades. Since external interfaces on the application-specific motherboard remain unchanged, no additional cost for existing systems and/or housing modifications is required.

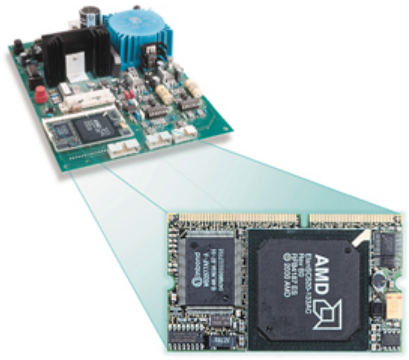

Fig 2: DIMM-PC concept

The DIMM-PC Standard

JUMPtec introduced the DIMM-PC standard for customized embedded systems in 1998. DIMM-PC computers include a complete set of peripheral interfaces and are smaller in size than a business card (40 mm x 68 mm). Compared to traditional systems or individual developments, the use of DIMM-PC offers potential savings as a result of the following:

* DIMM-PCs use standard 144-pin DIMM sockets for connection to the motherboard. Unlike traditional plug-in connectors that are frequently more expensive than the chips they are to be used with, the DIMM socket is economical, sturdy and space saving. With 144 connections, it is suitable for the ISA bus and common I/O connectors needed by keyboards, floppy and IDE hard drive, printers, and serial interfaces.

* If the performance requirements within the embedded system increase, only the exchange of CPU modules is necessary.

* Unlike some proprietary industrial controls, DIMM-PCs are driven by standard PC software. As compared to micro-controller programming software, development software for PCs and the DIMM-PC is less expensive, more versatile, and available from many suppliers. Developmental know-how is widely available throughout the market. I A bootable flash hard drive replaces the rotating mass memory (floppy, hard disk). This is especially important for mobile applications as problems caused by shock and vibration are avoided.

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* The variety in modules and second sourcing required for industrial applications is guaranteed.

In addition to two serial and one parallel interface, DIMM-PC modular CPUs also provide an I2C bus. This feature enables fast and easy connection to simple peripherals, such as temperature measuring gages or digital liquid level sensors. Developers also can use DIMM-PC I/O modules that connect to the customer-specific motherboard via standard 144-pin DIMM sockets. JUMPtec supplies DIMM-PC modules for graphics, ISDN, Bluetooth, and a variety of other I/O functions. Additional peripheral devices can be connected either via DIMM-PC interface modules from other manufacturers or by using customized motherboard functions.

The most recent DIMM-PC addition to JUMPtec's DIMM-PC product line is the DIMM-PC/586. Equipped with a USB interface and 10/100Base-T Ethernet, the new ZFx86 processor based DIMM-PC module has even more connectivity than its predecessors. This increased density makes the credit card-shaped DIMM-PC module perfectly suited for embedded systems with space limitations. The DIMM-PC/586 is synchronized at 128 MHz, supplied with 5V according to DIMM-PC specifications, and consumes as little as 1.5W. With up to 32MByte DRAM and 32MByte IDE flash, the DIMM-PC/586 has sufficient memory and performance for embedded systems operating under Linux, Windows CE or VxWorks. DR-DOS comes pre-installed. Sample and evaluation boards will be available starting this month.

The ETX standard

ETX (Embedded Technology eXtended) is the most recent open standard developed by JUMPtec. As an all-in-one multimedia PC, it distinguishes itself from the application ranges for the DIMM-PCs and PC/104 modules. Its 95x114 mm dimensions are similar to those of PC/104 modules, but a plug-on height of about 10 mm makes ETX component SBCs considerably flatter.

In contrast to PC/104, the ETX and DIMM-PC standards completely define the CPU board functionality, facilitating multi-vendor designs and second sourcing. All PC interfaces and the power supply are defined in addition to the ISA and PCI bus.

The density and functionality of the ETX are extremely high. The ETX design transmits all signals available at the CPU board over four very flat, industry compatible 100-pin SMD plugs. All plugs are situated on the underside of the ETX boards and no cables are required for these plug-in connections. All 400 signals are transmitted directly to the motherboard, which establishes the mechanical and electrical connection between ETX and the actual application.

ETX provides all traditional PC interfaces to the motherboard, including graphics, sound, Ethernet, and more. Additional application-specific functions may be designed into the motherboard.

ETX solutions typically function without the need for sensitive and expensive cables. The signals are routed to the correct locations by the motherboard design. In short, all required interfaces are exactly where they are needed. This reduces cable paths and total expenses when the embedded system goes into mass production. There is no need to select, purchase, stock, roll out, mount or test non-required components and plug-in connectors.

The ETX mechanical definition includes a thermal cooling concept. All ETX boards are equipped with a cooling plate over the entire board surface. This 'heat spreader' plate forms the mechanical interface to system cooling and is generally connected to the system housing. This makes it possible to deploy systems without active cooling yet provides excellent thermal conduction, even when using 700MHz Intel Pentium III processors.

Fig 3: DIMM-PC with USB and 10/100BaseT Ethernet

ETX modules by JUMPtec are available with CPU cycles from 66MHz up to 700MHz. The two newest ETX component SBCs are the ETX-P3e, based on the 700MHz Intel Pentium III processor, and the ETX-C3e, based on the 300MHz Intel Celeron processor with low power consumption (<8w). the="" etx-p3e="" with="" via="" twister="" chip="" set="" is="" highly="" integrated="" and="" includes="" a="" fast="" 133="" mhz="" front="" side="" bus,="" allowing="" high="" performance="" with="" an="" extremely="" good="" price="" performance="" ratio.="" in="" addition="" to="" all="" standard="" pc="" interfaces,="" the="" etx-p3e="" offers="" high="" performance="" graphics="" with="" lvds="" flat="" panel="" support,="" 10/100baset="" ethernet,="" sound,="" 2xeide="" and="" 4="" usb="" ports.="">

Fig 4: ETX-P3e with 700MHz Intel Pentium III processor

Only energy saving processors and Advanced Power Management (ACPI), commonly found in notebook-type computing environments, are used in order to ensure maximum performance with minimum power consumption. This combination allows embedded applications with high computer density and capacity to run with purely passive cooling. Both of these ETX components SBCs have been available since November 2001.

ETX Certified Partner Program

The ETX Certified Partner Program, founded by JUMPtec, provides a means of sharing knowledge about ETX module design. In order to become an ETX Certified Partner, manufacturing companies must first complete an intense training program and successfully pass the corresponding exam. This partnership allows members to become part of the JUMPtec ETX community, which offers opportunities for technology transfer and exchange of experience. The purpose is to make sure that ETX Certified Partners can meet the most complex requirements for OEMs within the shortest period of time.

The ETX Certified Partner Program was launched in Germany, is currently spreading throughout Europe, and should reach a worldwide audience soon within the coming months. CSS and IBR, JUMPtec owned subsidiaries, were the first companies to achieve ETX Certified Partner certification. Italy-based Rafi and IES also are ETX Certified Partners. Other global companies currently are going through the certification program. Interested firms should contact JUMPtec at the beginning of each quarter.

ETX Industrial Group

At the SPS/IPC/Drives trade show last November, JUMPtec and Advantech officially founded the ETX Industrial Group. This open consortium is dedicated to the further development of the ETX standard, which was initially developed to enable the modularization of embedded computer systems designs. The total number of ETX Industrial Group members is expected reach fifteen by the opening of the Hanover Fair. ETX module users also are invited to join the ETX Industrial Group.

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