Trends In Embedded Microprocessor Design

Schlett, M.
Computer, Volume: 31 Issue: 8, Aug. 1998
Page(s): 44 - 49

Presenter: ccg
Motivation

- Designed primarily for the desktop market, the processors have dominated the scene—with the x86 begin the clear winner.

In concentrating on the desktop, however, we may be missing the next big thing in microprocessor design: Embedded CPUs.
Introduction

- Intel is no longer be the most important microprocessor for the desktop PC, but its successor may be a personal mobile computer that integrates the portable computer with a cell phone, digital camera …Such devices require low-cost, energy-efficient microprocessors, and Intel is far from a leader in this area.
Introduction (cont.)

- More recently, the market for 32-bit embedded processors has been growing.
- As demand for security and central control stations rises – or as refrigerators begin to include artificial intelligence – this trend becomes more understandable.
Desktop versus embedded

Traditional view to partition the microprocessor

- 32- or 64-bit desktop processors
- 32-bit embedded controllers/processors
- 8- or 16-bit controller
- 4-bit controller
Recently, such issues as power consumption, cost, and integrated peripherals and include the interrupt response time the amount of on-chip RAM or ROM differentiate a desktop CPU from an embedded processor.

An embedded microprocessor must do the job for particular application at the lowest possible cost.
New applications drive requirements

- Ex: Video game consoles, Handheld PCs, Cellular phones ...
- The requirements of these markets force embedded microprocessor designers to reduce manufacturing cost while simultaneously increasing the level of integration and performance.
The evaluation parameters for embedded processors

- Power consumption
- Code density
- Peripheral integration and chipsets
- Multimedia acceleration and acceleration of special application software
- Price/performance ratio
Most embedded microprocessors have three different modes:

1. **Fully operational**: All functional units are available to execute instructions.
2. **Standby**: The processor is not actually executing an instruction.
3. **Clock-off**: The system has to be restarted.
Reducing power consumption

- Most new processors focus on fully operational and standby modes by stopping transistor activity when a particular block is not in use.
- The simplest way to reduce power consumption is to reduce the voltage level. (This could depend on the process technology.)
Reducing power consumption

- Increasingly, the processor core is only a small part of the entire system, so that core voltage means less as a performance metric, because the activities inside a core are normally related to the activities of the peripherals.
Code density

- CISC traditionally have better code density as their more complex inst.
- RISC(Pipeline) have some new strategies.

EX: Hitachi(16 bit) ; ARM (32 or 16bit);
Variable instruction length(16,32,48).
Peripherals and higher Integration

- **Yield** and **pin-count** are essential measures for the final price and market success.

Thus, integrated peripherals must **simplify system design and shorten the development cycle of complete systems.**
There are two strategies for integrating peripheral logic:

1. To provide the basic core and integrate additional logic for a custom device to create an ASIC.
2. To offer a standard microprocessor together with a companion chip that serves application specific needs.
Peripherals and Integration (con’d)
Multimedia acceleration

- Functions that a separate DSP performed in the past – are now more frequently executed by the embedded microprocessor itself.
- Besides general purpose architectures with multimedia extensions, new high-end processors can handle several MPEG streams while running modem code and so forth.
Multimedia acceleration (con’t)
The growing interest has created a demand for a standard OS that could unify the embedded processor market.

By using standardized platforms, design houses can drastically reduce design cycle time and learning curves - and this is what matters to management.
The ideal processor of the future will offer plenty of MIPS, run DSP programs like a dedicated DSP processor, integrate all its peripherals, cool the environment like a refrigerator, and cost but a few cents.
Conclusions (con’t)

- The embedded world will probably not have a dominating architecture like x86 in the desktop arena.
- A very realistic possibility is that each market segment will have its dominating architecture – and perhaps vendor.