

Chaos to Zen: Simplifying x86 BIOS Management

Introduction

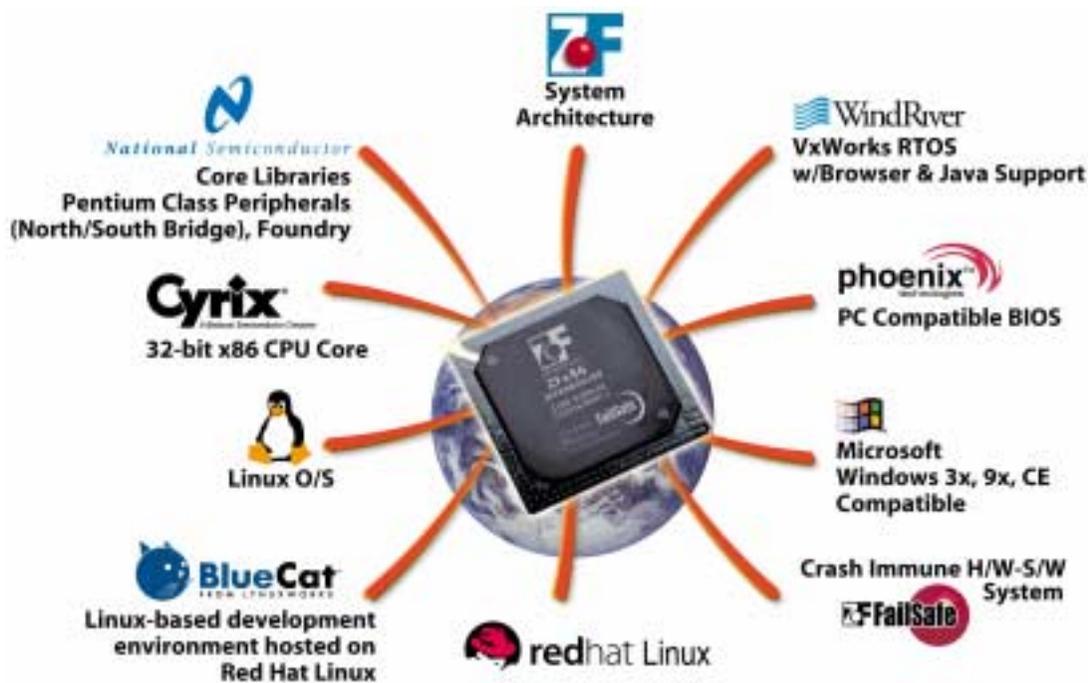
Have you ever programmed a new VCR without the owner's manual? Many semiconductor companies approach the embedded marketplace with the same mind set: delivering processor chips with no more supporting technical collateral than a developers manual. ZF Micro Device's strategy provides the ZFx86 customer with many more pieces of the puzzle to facilitate and speed designs to market. See [Figure 1](#)

As the silicon devices complexity intensifies, the developer's need increases for various design tools:

- Design-specific BIOS
- Diverse operating system support (Linux, Windows CE, VxWorks, and others)
- Drivers
- Software utilities

In order to create successful tools and reference designs, ZF formed a four- way coalition using Phoenix Technologies BIOS, design services from CS Technical Services, Inc., design services from Artec Design Group, and ZF's own embedded engineering knowledge.

Figure 1. World Class View





A very comprehensive set of ZFx86 support documents can be found on ZF's web site (<http://www.zfmicro.com>). The support documents cover many areas of an x86-based design and manufacturing effort as shown in Table 1. This article explores the requirements associated with an embedded x86 BIOS, and the firmware customization needed for embedded applications.

Table 1. Classes of Documents in the ZF Download Library

Marketing/Sales Documents	Data Sheets, Charts, Product Comparisons
Manuals	Technical Manuals
Release Notes	Software Release Notes and errata
Application Notes and Technical Bulletins	Application Notes and Technical Bulletins. Documents operation or use of ZFx86
ZFx86 BIOS Updates	ZFx86 BIOS files, including image files, documentation, and associated files
Reference Designs	Reference design schematics and files Designs built, tested, and validated
Reference Design Cells	Tested/Validated hardware and/or software. Tested via IDS or known ZFx86 test platform
Reference Designs, Paper	A paper-only description including software code or schematics not tested or validated.
ZFx86 Software and Drivers	ZFx86 interfaces and miscellaneous software
ZFx86 Software Tools and Utilities	Software tools for development and testing
Shareware and Non-ZF-Supported Software (user contributed)	Software contributed by ZF customers. Not supported by ZF, but may be helpful

Embedded BIOS Concepts

The typical x86 BIOS is designed to be used in a desktop arena. These embedded BIOS designs place many additional requirements on the system firmware: some as simple as booting without a keyboard, or transmitting POST codes through the serial port, or others as complex as contemplating a PCI interrupt table that has sufficient entries to accommodate virtually any combination of embedded design features. The firmware variations to consider include: no display, no keyboard, no floppy disk, no removable storage media, and many more, resulting in situations where the manufacturer builds the product using nontraditional methods. Typically, the embedded designer desiring flexibility is not concerned with understanding the intricacy and legacy associated with an x86 BIOS environment. The built-in ZFx86 BIOS features address this dilemma by allowing the embedded designer this very flexibility. See [Table 2](#).



Table 2. ZFx86 Embedded Features

Features	Description
ZFlash OS Loader Hook	Enables operating systems such as Linux and VxWorks to boot from the same flash chip that contains the BIOS
ZFlash legacy ISA extension processor	Allows user extension ROMs to be placed in the same flash device as BIOS
ZF Logic support	Configuration settings that manage ZFx86 ZF Logic Memory and I/O Chip Selects for Disk On Chip, flash based extensions and custom I/O hardware
Power Management	Advanced Power Management 1.2 Functions
USB controller	Universal Serial BUS Host Controller and Legacy Configuration Settings
Infrared	Infrared support based upon ZFx86 hardware
Watchdog Timer Function	Dual Watchdog timer support
Headless Operation	Allows text mode console re-direction to a serial port
Resident Flash Disk Function	Allows on-board AMD flash chips to be seen as a floppy drive under DOS
ZEB	Utility to re-configure BIOS binary image including: <ul style="list-style-type: none"> • Custom PCI Video BIOS • Custom splash screen (graphic icon)
PCI Interrupt Table	Extended PCI Interrupt routing table
Diagnostic POST re-direction	POST code re-direction to a serial port

The above features allow for a very flexible BIOS, but can also increase the configuration complexity, leading to potential set-up problems in manufacturing. This creates a need for a mechanism that allows the manufacturing or test engineer to controls 100% of the image burned into production units. Using two ZF-created SW tools in conjunction with the ZFx86 BIOS and a hardware download tool (dongle), we insure a reliable, repeatable, and controllable manufacturing process. The first SW tool, the subject of this article, is the **ZF Edit Bios** utility (ZEB). The second tool is the Z-tag Manager (see the ZF website for additional Z-tag Manager information at: www.zfmicro.com).

ZF Edit BIOS (ZEB) Utility

The ZEB utility allows a test engineer to create a new unique BIOS image that matches the exact product configuration without requiring access to source code, and without the need to re-compile or understand the details of the BIOS structure. Both the BIOS and ZEB use a pointer table to locate complex variables that need changing. You only find this feature included in a BIOS specifically designed for the embedded marketplace.



Combine the ZFx86 BIOS with your own PCI video BIOS (the BIOS shadows the PCI video BIOS and treats it as if it were a standard PCI Extension ROM and initializes the matching embedded PCI Video chip) , and/or embed your custom splash screen (graphic icon) into the BIOS, and eliminate the need to implement a separate video BIOS Option ROM, thereby reducing BOM cost.

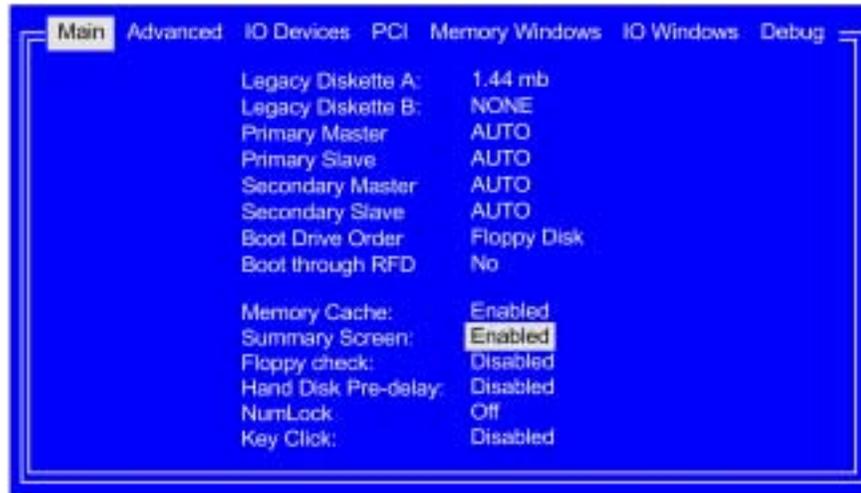
Using ZEB

The ZF Edit BIOS utility, ZEB.EXE, allows the test engineer to establish and automate custom default BIOS settings. The editor is ideal for those ZFx86 embedded systems with no battery backed CMOS storage, and allows additional debug flexibility when bringing up new designs. ZEB runs on either DOS or Windows. (Remember to disable the CMOS battery, if the system contains one, and to completely re-power the system with each BIOS-change experiment. The power-reset guarantees that the BIOS reboot with the new defaults enabled.) The ZEB utility supports the creation a debugging BIOS that outputs POST Codes on the serial port. See the ZEB Debug menu item. Selecting menu items works in much the same way as selecting features on a standard BIOS CMOS setup screen (see Figures 2 and 3). For more detailed information please refer to the ZF Micro Devices website.

Figure 2. The ZEB Utility Main Menu



Figure 3. Summary Screen Change



Meeting Manufacturing Needs

Two typical manufacturing assembly line scenarios exist. In the first scenario, the product volume justifies a fully automated assembly line, whether manufacturing large or small product volumes. The second scenario exists where manufacturing personnel work at stations where they complete all the operations required to assemble and test the units. Both scenarios require a slightly different approach. In the first case, a programming device with the firmware that requires installation resides near the workstation on the automated line. The installer uses the ZF dongle in pass through mode to install all the information into the unit from the programming device (typically a PC). In the second scenario, the manufacturing personnel moves the programming station to the unit under test (UUT) or extends a long cable to the UUT. This results in hazardous conditions or potential damage to the test equipment. ZF has designed and provides a dongle unit that contains the entire SW image. Plug this unit into the product and rapidly download the full SW image to the UUT. See Figures 4 and 5.

Figure 4. ZF Dongle



Figure 5. Dongle Connected To The IDS Board



Summary

Many potential pitfalls exist when designing an embedded product. ZF has created a set of collateral material, including various SW utilities, to help resolve design and manufacturing bottlenecks present in virtually every product cycle. Use the ZEB utility to remove these bottlenecks and customize the embedded BIOS. The output file from this tool creates a binary image ready to be downloaded into the target product avoiding all need to re-compile or understand the BIOS source code. This binary image also allows for manufacturing control and repeatability by removing all manual intervention in the product test and configuration cycle.

About CS Technical Services, Inc.

CS Technical Services, an independent authorized Phoenix Technologies, Ltd. developer, provides affordable custom BIOS development, design support, and code maintenance using Phoenix BIOS source code.

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About Artec Design Group

Artec Design Group provides guidance to companies that need innovative ideas but lack the technical expertise or manpower required to see the design through to market.

Artec Design Group focuses on the following areas of engineering design:

- Developing state-of-the-art electronic devices
- Providing contract design services and consulting
- Prototyping and medium scale manufacturing
- Developing software for systems supporting various OS platforms
- Designing VLSI silicon services

Artec Design Group will assist or help remove bottlenecks from your ongoing or new designs.

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About ZF Micro Devices

ZF Micro Devices provides the ZFx86 PC-on-a-Chip that enables customers to deliver innovative products faster. A low power consumption device measuring only 35mm by 35mm, the ZFx86 comes bundled with the run-time license for a fully implemented PhoenixBIOS™ from Phoenix Technology. The ZFx86 is fully x86 PC compliant, and has been tested to run with a wide variety of O/S's, including DOS, Linux, Windows 95/98/NT and Windows CE 3.0.

The ZFx86, with the FailSafe™ System, boots autonomously on application of power and operates even if system DRAM and Flash are unavailable. The patented FailSafe™ System also allows upgrades over the Internet, while eliminating the possibility of irrecoverable crashes. Using its proprietary Z-Tag™ interface, the ZFx86 re-programs system Flash at a fast 2M-bits per second, rather than the usual 19.6Kbaud, reducing potential downtime dramatically.

With an expanding range of reference design material available from the ZF Micro Devices web site, the ZFx86 delivers key enabling technologies for embedded applications by providing PC system functionality at a chip-level size and price. The ZFx86 is available from distributor stock on a worldwide basis at around \$60 in low volume. ZF Micro Devices enables its customers to



bring profitable, innovative, crash-immune systems to market faster than their competitors, by delivering low power ($\frac{1}{2}$ Watt) PC systems at a chip size and price.

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