BIOS and CMOS

Overview

• In this chapter, you will learn to
  – Explain the function of BIOS
  – Distinguish among various CMOS setup utility options
  – Describe BIOS and device drives
  – Troubleshoot the Power-On Self Test (POST)

The Function of BIOS

Northbridge & Southbridge

• Northbridge
  – Chip or chips that connect the CPU to memory, Level 2 cache, the PCI express bus, and AGP activities
  – Northbridge chips communicate with the CPU thru the Frontside Bus

• Southbridge
  – Handles all of the inputs and outputs to the many devices in the PC
  – A chipset is a set of Northbridge and Southbridge chips that work together

The Bus

• The external data bus joins the various parts of the PC together
• The address bus also connects to various parts

Talking to the Keyboard

• The keyboard talks to the external data bus using the keyboard controller chip (8042)
• BIOS

- A special kind of program is required to enable the CPU to talk to other devices
- A ROM chip stores these programs
- These programs are collectively known as the Basic Input/Output Service (BIOS)

• Each program is called a service
- Programs stored on ROM chips are known as firmware
- Programs stored on erasable media are called software

• BIOS and its relation to memory addressing:
  - The wire pattern generated by the address bus is called the address space
    - Last 65,536 reserved for system BIOS
    - Total of 284K reserved for ROM
  - The BIOS stored on the ROM chip attached to the motherboard is called the system BIOS
  - The ROM chip that stores the system BIOS is called the system ROM

• Hardware that is common, necessary and never changes
  - Keyboard, speaker

• Stored on the system BIOS chip

  BIOS is a group of programs.
  ROM is a hardware chip used to store BIOS.

• Hardware that is common, necessary but may change
  - RAM, hard drives, floppy drives, serial and parallel ports
  - Complementary metal-oxide semiconductor
  - Programs are stored on the system BIOS chip, while the changeable data is stored on a CMOS chip

  All other hardware is non-core like mice, sound cards, and CD-ROMs.
The CMOS Setup Program

- The data on the CMOS chip can be accessed and updated via the CMOS setup program.
- Main manufacturers of BIOS
  - American Megatrends (AMI)
  - Award software
  - Phoenix Technologies
- The CMOS setup can be accessed when the system boots, but there are different ways of doing that

Accessing the CMOS

- AMI and Award
  - Press DEL
- Phoenix
  - Press Ctrl-Alt-Esc or F2

Other possible key combinations are:
DEL, Ctrl-Alt-Ins, Ctrl-A, Ctrl-D, Ctrl-F1, F2, F10

CMOS Setup

- The floppy drive, hard drive, and the date/time settings can be changed using the standard CMOS setup
- Modern computers provide extra CMOS settings for memory management, password and booting options, error handling, and power management

CMOS Setup

- The following CMOS setting options are available:
  - CPU soft menu – Enables you to set the voltage and multiplier settings on the motherboard for the CPU.
  - Advanced BIOS features – Used for selecting boot options.
  - Advanced chipset features – Deals with extremely low-level chipset functions.
The following CMOS setting options are available (continued):

- Integrated peripherals – Allows you to configure, enable, or disable onboard ports.
- Power management setup – Used to setup power management settings for the system.
- PnP/PCI configurations – Used for assigning IRQs to certain resources.

Other options include:

- Load Fail-Safe Defaults: used when low-level problems occur
- Load Optimized Defaults: sets the CMOS to the best possible speed and stability of the system
- Set Password
- Save and Exit Setup
- Exit Without Saving

Soft Menu

Standard CMOS Features

Advanced BIOS Features

Advanced Chipset Features
CMOS Maintenance

- Common causes of losing CMOS data are
  - Battery run out, dirt, faulty power supply, electrical surges, and chip creeps
  - The CMOS settings can be checked by memorizing settings, using Optimized defaults, and backing up a copy of the CMOS

To backup your CMOS to a floppy, use a third-party program such as cmossave.zip

Battery

- Since the data stored on a CMOS chip can be saved, power is required when the computer is turned off
- Power is supplied by a battery on the motherboard
- Batteries are mounted in one of three ways:
  - External battery (now obsolete)
  - Onboard battery
  - Built-in battery (built into the CMOS chip and very common today)

Clues to a Weak Battery

- Clock in Windows begins to slow down
- System keeps losing CMOS data when you turn it off
- If you have an external battery, check it with a voltmeter (3.6 or 6 volts)
- If a built-in battery dies, replace the motherboard (seldom happens)

ROM

- Read Only Memory
  - EPROM
    - Ultraviolet light erase
  - EEPROM
    - Electricity erase
    - Flash BIOS / BIOS update
  - Flash ROM

Flash ROM

- Flash ROM is a new type of ROM chip developed by Intel
  - Can be reprogrammed without the chip being removed
  - Running a small command line program combined with an update file can change or update the BIOS
  - In reality, CMOS no longer exists because flash ROMs (and now Non-Volatile RAM or NVRAM) now hold the system BIOS and CMOS settings - but the term is still used
  - The battery only keeps the clock running nowadays

BIOS and Device Drivers
BYOB

- Because computer makers could not predict all the new types of hardware that may come out, ways to bring your own BIOS (BYOB) were invented:
  - Option ROM
  - device drivers
  - Most devices with onboard BIOS use it only for internal needs (internal function) and use a device driver to talk to the CPU

Device Drivers

- A device driver is a file that contains the BIOS commands necessary to communicate with the devices they support
  - Loaded in to the RAM when the system boots
- All devices come with their own device drivers

Where are the Device Drivers?

- Registry
  - Binary file that contains the configuration settings and device driver information
- Control Panel
  - Applets that enable the configuration of a broad range of system devices
- Device Manager
  - Used for changing or removing drivers for any particular device
- REGEDIT and REGEDIT32
  - Enables you to access and update the Registry directly

CONFIG.SYS

- CONFIG.SYS is a special file through which DOS loads the device drivers
  - Located in the root directory of the C: drive
  - The EDIT/SYSEDIT program is used for editing such files
  - Used to load extra BIOS for hardware that is not supported by the system BIOS

SYSTEM.INI

- The SYSTEM.INI file is located in the \Windows directory
  - Broken up into groups and each group is identified by the name in square brackets that starts the section
  - Standard sections are [boot], [keyboard], [boot description], [386Enh], and [drives]
  - Most drivers that load are located in the [386 Enh] section
Power-On Self Test (POST)

- The **Power-On Self Test (POST)** is a special program stored on the ROM chip
  - Initiated when the computer is turned on, or is reset
  - Checks out the system every time the computer boots
Beep Codes

- When the computer is booted it first tests the most basic parts
  - It generates a series of beeps if anything is wrong
- Computers with a bad power supply generate intermittent beep codes
  - Turn the computer on and off several times – if you get different beep codes, then it’s probably the power supply

AMI Beep Codes

<table>
<thead>
<tr>
<th>Beeps</th>
<th>Post Routine Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BIOS ROM checksum</td>
</tr>
<tr>
<td>1-2-3</td>
<td>Test DRAM refresh</td>
</tr>
<tr>
<td>1-3-3-3</td>
<td>Test 0742 keyboard controller</td>
</tr>
<tr>
<td>1-3-5-5</td>
<td>RAM failure on address line xxx</td>
</tr>
<tr>
<td>1-3-5-5</td>
<td>RAM failure on data bit xxx of low byte of memory bus</td>
</tr>
<tr>
<td>2-2-2-3</td>
<td>Check ROM copyright notice</td>
</tr>
<tr>
<td>2-2-3-1</td>
<td>Test for unexpected interrupts</td>
</tr>
<tr>
<td>1-2</td>
<td>Search for option ROMs; one long, two short beeps or checksum failure</td>
</tr>
<tr>
<td>1</td>
<td>One short beep before boot</td>
</tr>
</tbody>
</table>

Phoenix Beep Codes

<table>
<thead>
<tr>
<th>Beeps</th>
<th>Post Routine Description</th>
</tr>
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<tbody>
<tr>
<td>1-2-3-3</td>
<td>BOS ROM checksum</td>
</tr>
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</tr>
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Table 4.2 Phoenix Beep Codes

Common Errors

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAM refresh failure</td>
<td>(1) Reset and clean the RAM chips.</td>
</tr>
<tr>
<td>Parity error</td>
<td>(2) Replace individual chips until the problem is corrected.</td>
</tr>
<tr>
<td>RAM Hit error</td>
<td></td>
</tr>
<tr>
<td>Base 64 K error</td>
<td></td>
</tr>
<tr>
<td>HDD error</td>
<td>(1) Reset and clean keyboard chip.</td>
</tr>
<tr>
<td>Gate A20 error</td>
<td>(2) Replace keyboard.</td>
</tr>
<tr>
<td>RAM checksum error</td>
<td>(3) Replace motherboard.</td>
</tr>
<tr>
<td>ROM checksum error</td>
<td></td>
</tr>
<tr>
<td>Video error</td>
<td>(1) Reset video card.</td>
</tr>
<tr>
<td>Cache memory error</td>
<td>(2) Replace RAM chip.</td>
</tr>
<tr>
<td>Everything else</td>
<td>(1) Shut off cache in CMOS.</td>
</tr>
<tr>
<td></td>
<td>(2) Replace CPU.</td>
</tr>
</tbody>
</table>

Error Messages

- If anything other than the most basic parts does not pass the POST, then a text message will appear on the screen:
  - Numeric error codes
  - Text error codes

Text-Based Error Message

PhoenixBIOS 4.0 release 6.0
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CPU: Pentium III 1000MHz
C0R8 System RAM Passed
4MB Extended RAM Passed
USB upper limit segment address: EFFE
Mouse initialized

HDD Controller Failure
Press <F1> to resume
**POST Cards**

- **POST cards** are devices that monitor POSTs and report on the hardware that may be causing problems
  - Turn the PC off, plug in the card, and reboot
  - POST error codes do not fix the computer – they just tell you where to look
  - If all else fails, replace the motherboard

**The Boot Process**

- The CPU is the first component that gets initialized when the computer is turned on
- It reads a special wire called **power good** once the power supply provides the proper voltage to the CPU
- Every CPU has a built-in memory address with the first line of the POST program on the system ROM

**The Boot Process**

- The last BIOS function called by POST is the **bootstrap loader**
- The bootstrap loader loads the operating system either from the floppy or the hard drive
- The bootstrap loader generates an error if it cannot find the bootable disk

**Non-System Disk Error**

![Image of boot configuration]

- Changing the Boot Order:
  - Many BIOS programs have CMOS settings that allow you to change the order in which the boot loader searches for an operating system