BIOS Boot Specification

Compaq Computer Corporation
Phoenix Technologies Ltd.
Intel Corporation

Booting Today

- Only Supports Fixed and Floppy Disks
  - Very Simple
  - Very Limited
    - Choose From the First Floppy or First Hard Drive
- Additional Devices
  - Hook INT 19
  - Hook INT 13
- Failure Conditions are Platform and Card Specific
Current Boot Issues

- Systems Are Now Booting From Several Sources, Not Just "A:" or "C:"
  - CD-ROM
  - PCMCIA
  - LAN
- Plug and Play Does Not Effectively Address Boot Device Selection
  - The PnP BIOS Spec Does Not Address the Subject of $PnP OP-ROM Selection
  - The PnP BIOS Spec Really Allows Only One INT 13 Hooker to Be Executed

Current Boot Issues (Continued)

- There is Nothing in PCI to Tell the BIOS About Boot Capability
- No Industry Specifications
  - Allocating memory to an OP-ROM
  - Choosing a Boot Device
  - PCI and PnP
  - Multiple O/S Compatibility
  - BIOS/OP-ROM Failure Behavior
Enter the BIOS Boot Specification (BBS)

Microsoft

COMPAQ

intel.

Phoenix

BBS Overview

- Provides a Method for Ordering Boot Devices
- Provides a Method for Ordering OP-ROMs Which Hook INT 13
- Provides Support for Legacy Devices
BBS Overview
Boot Devices

- Builds on the PnP Specification
  - Requires a PnP Header
  - Device May Be Boot Entry Vector (BEV)
  - Or, Device May Be BIOS Aware IPL Device (BAID)
- Provides Specifications for OP-ROM Vendors
  - Requires a PnP Header in PCI OP-ROMs
  - Provides Formatting Requirements for the Product ID String

BBS Overview
INT 13 Hookers

- Provides a Method for Ordering OP-ROMs Which Hook INT 13
  - Requires PnP Header
  - Device Must be Boot Connection Vector (BCV)
- Defines How $PnP OP-ROM Headers Apply to Booting
- Allows for BIOS Level Product Differentiation.
BBS Overview
Legacy Cards

◆ Allows Legacy Devices to be Installed in Any Order
◆ PCI Cards w/o the PnP Header are Treated as Legacy Devices
◆ Provides a Runtime Interface for Managing Boot Devices
  ➢ Extends the PnP Interface by Using PnP Function Numbers
    ➢ Numbers 60-6F are now Reserved for BBS
  ➢ 32 Bit Protect Mode Capable

Initial Program Load (IPL) Devices

◆ Requirement for IPL Devices
  ➢ Must invoke INT 18 if O/S fails to boot
    ➢ PnP Spec Defines the Operating Environment on INT 18 Invocation
  ➢ Legacy Cards Which Hook INT 19 Will Short Circuit the BBS Process
◆ IPL Table
  ➢ Contains an Entry for Each BAID/BEV Device
  ➢ Format is Specified for Runtime Interface
  ➢ Internal Format is Implementation Specific
Initial Program Load (IPL) Devices

- BIOS Aware IPL Devices
  - Floppy (INT 13, DL=00h)
  - Hard Drive (INT 13, DL=80h)
  - Any other device with Motherboard BIOS support
    - ATAPI CD-ROM
    - PCMCIA Devices
    - USB Devices

Initial Program Load (IPL) Devices

- Devices With $PnP Headers
  - Must Follow the Present PnP Spec, and one of the following fields must be supported
    - Boot Entry Vector (BEV)
    - Boot Connection Vector (BCV)
  - BEV Devices Typically are LAN Cards
  - BCV Devices Typically are SCSI Cards

- Product Name String
  - This is a Required Field
    - Must be NULL Terminated (ASCII)
    - Significant to 32 Characters
Initial Program Load (IPL) Devices

- **Legacy IPL Devices**
  - Do Not Contain PnP OP-ROM Headers
  - Behavior May be Outside the Scope of BIOS Control
  - Should Hook INT 13 to Install Drive Support
  - If they Hook INT 18/19, Failures Can Occur

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Initial Program Load (IPL) Devices

- **Identifying IPL Devices**
  - BAIDs are automatically added to the IPL Table by the BIOS
  - BEVs are Added to the IPL Table following the System ROM Scan
    - Must have a $PnP Header
  - PCI Devices without a $PnP Header are Treated as Legacy Devices
    - Risk *NOT* being Presented to the User
    - Presentation of these Devices is Implementation Specific
Boot Priority

◆ Attempted Booting Order
  ➢ First Invocation of INT 19 will Attempt to boot the Highest Priority Device
  ➢ Device Failures Should Invoke INT 18 to Try Lower Priority Items

◆ Maintaining the Boot Priority
  ➢ Must be Stored in Non-Volatile Memory
    ⇒ CMOS, ESCD, ETC...

Boot Priority

◆ Must Not Change Until one of the Following Events Occur
  ➢ System Configuration Changes
  ➢ User Requests a Change

◆ Sample IPL Table

<table>
<thead>
<tr>
<th>IPL Table</th>
<th>Boot Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floppy (INT 13, DL=00)</td>
<td>3 4 1 2 0</td>
</tr>
<tr>
<td>Hard Drive (INT 13, DL=80h)</td>
<td></td>
</tr>
<tr>
<td>CD-ROM</td>
<td></td>
</tr>
<tr>
<td>LAN</td>
<td></td>
</tr>
<tr>
<td>BEV #2</td>
<td></td>
</tr>
</tbody>
</table>

BIOS Boot Presentation Copyright Phoenix Technologies July, 1995 Page 8
Boot Connection Vectors

- The Hard Drive BAID/IPL Device
  - Represents INT 13 Device 80

```
IPL Table
0  Floppy (INT 13, DL=00)
1  Hard Drive (INT 13, DL=80h)
2  CD-ROM
3  LAN
4  BEV #2
5
6
7

Boot Priority
0 1 2 3 4 5 6 7
3 4 1 2 0
```

```
BCV Table
0  ATA Drive Support
1  SCSI #1
2  Legacy Cards
3
4
5
6
7

BCV Priority
0 1 2 3 4 5 6 7
2 0 1 3
```

Boot Connection Vectors

- BCV Devices are Expected to Perform the Following Functions
  - Place Themselves at the Head of the INT 13 Chain
  - Use 40h:75h to Determine If They are the Boot Device
  - Use 40h:75h to Determine the Starting Drive Number for all new Drives Added to the System
  - Increment 40h:75h to Reflect the Number of Drives in the System
  - Leave INT 13 Untouched If NO Devices are Present
Boot Connection Vectors

◆ Specify the Call order of INT 13 Hookers
  ▶ Specify OP-ROM Order, NOT Drive Order
  ▶ Allow Legacy Controllers Such as SCSI to Install Before the Conventional ATA Interface
    ⇒ Does Not Allow Automatic Identification of Legacy Cards to the User
  ▶ Requires that the Product ID String and the BCV Elements of the PnP Header be present
    ⇒ Provides the BIOS with a way of Identifying the Adapter to the User

Boot Connection Vectors

◆ The Following Device Classes Can Hook INT 13
  ▶ BIOS ATA Support
  ▶ PnP Cards w/BCV Support
    ⇒ Includes PCI Cards with PnP Headers
  ▶ Legacy Cards with Option ROMs

◆ Installation Ordering
  ▶ All BCV Devices are Installed Prior to Invoking INT 19
  ▶ Ordering is Controlled in the Same Fashion as IPL Devices
Motherboard
Power On Self Test (P.O.S.T.)

◆ The Following Device Classes are Initialized During POST

➢ BAIIDs
  ➢ All BIOS Aware IPL Devices Must be Initialized Prior to the Initial INT 19 Call

➢ PnP Boot Devices
  ➢ All BEV and BCV devices will be Initialized Prior to the Initial INT 19 Call
  ➢ Only one Device Will Boot. All Other Devices Must Handle the Condition Where they are Initialized but do not Boot

P.O.S.T.

◆ $PnP Option ROM Initialization

➢ PnP Devices Must Return Control to the BIOS After They Initialize
  ➢ A PnP OP-ROM Which Does not Return is not BBS Compatible

➢ OP-ROM Initialization Occurs From the Lowest to the Highest Memory Address

➢ $PnP OP-ROMs Which Hook Vectors During Initialization Violate the PnP Specification and are not BBS Compatible
P.O.S.T.

◆ IPL and BCV Priority
  > Must be Validated
    ⇒ If there is a Discrepancy Between the Devices and the Priorities, Then Error Recovery Must be Performed

◆ INT 13 Device Controller Installation
  > All BCVs Must be Installed Prior to Calling INT 19
  > Any BCV Which Does not Have INT 13 Devices to Install Must Exit without Changing the System

P.O.S.T.

◆ The PnP Disconnect Vector
  > Unimplemented Today
  > Will Never be Invoked by BBS
  > Must be Null

◆ Legacy ROM Scan
  > Ignores ALL OP-ROMs Which Have a PnP Header
  > Scan is From Low to High (C0000h-EFFFFh)
P.O.S.T.

- On-Board ATA Support
  - All ATA Devices Must be Initialized Prior to Installing the Devices in the BCV Table
  - ATA Devices are Installed at the Point Selected by the User

P.O.S.T.

- INT 19
  - BAID Devices Boot from Internal Addresses
  - BEV Devices Boot from Addresses Stored in the $PnP Expansion Header
  - Hard Drive (C:) BAID is the INT 13 Device Controller that Installs as Drive 80h
  - *OS Load Failures Must Result in an INT 18 Call*
  - Display the IPL Table if no Bootable Devices were Found?
P.O.S.T.

- INT 18 -- Recovery Interrupt
  - This Call Performs the Following
    - Informs the Motherboard BIOS That an IPL Failure has Occurred
    - Invokes the Next Highest Priority IPL Device
    - Generates an Error Message?

Runtime Function Overview (Optional Interfaces)

- Boot Priority Functions
  - Installation Check
  - Get/Set Boot Priority
  - Get IPL/BCV Tables

- Boot First Functions
  - Get Boot First
  - Set Boot First
Runtime Functions (Boot Priority)

- Get Version and Installation Check
  - If the Installation Check is Present, all Remaining Boot Priority Functions Must be Supported
  - Must be the First Runtime Service Invoked
  - Returns Motherboard BIOS Version Number, if a BBS-compliant System is present

Runtime Functions (Boot Priority)

- Get IPL Device Count
  - Returns the Number of Entries in the IPL Device Table
  - Should be the Second Call

- Get Boot Priority and IPL Table
  - Fills a Buffer Supplied by the Caller
    - Boot Priority
    - IPL Table (See Specification for Format)
Runtime Functions (Boot Priority)

- Get IPL Device from Last Boot
  - Returns the IPL Table Index that Successfully Booted the System
- Set Boot Priority
  - Writes the Caller's Specified Boot Priority into Non-Volatile Memory

Runtime Functions (Boot Priority)

- The Jury is Still Out on the Usefulness of this Interface
Runtime Functions (Boot First)

- These Functions Provide Support for Setting the Device which will Boot on the Next Reset
- Software Equivalent of the Boot Menu

Runtime Functions (Boot First)

- Get Boot First
  - Returns the IPL Index of the Boot Device Currently Selected as Boot First
  - If this Call is Successful, Set Boot First Must be Supported
- Set Boot First
  - Sets the Device Which Will Boot on the Next Journey Through P.O.S.T.
Boot Menu
(Optional)

- In BBS's Lust for Defining New System Capabilities an Optional Pop-Up Menu System has Been Defined
  > Accessed via a Hot Key During P.O.S.T.
  > Allows the User to Select the Boot First Device
  > Free's the User From Entering the SETUP Utility for a One-Time Boot Order Change

In Summary

- BBS Provides for Booting from Newer Technology
- BBS Makes Boot Device Ordering Possible
- BBS Clarifies Option ROM Design Based on Plug and Play Specification
  > Clearly Defines "Bootable" Devices
  > Requires Better, More Consistent Error Recovery
Which Benefits...

- Users, by Giving Them
  - Better Control Over Their Systems
  - Consistent Access to All Their Bootable Devices
  - A Method of Controlling Their Drive Letter Assignments
    - This is Not 100% Full Control
    - Actual Control is OS Dependent

In Closing

- The BIOS Boot Specification is Open to Public Review Until August 25, 1995
- Please Submit Your Comments via E-Mail to
  - Scott_Townsend@PTLTD.COM
- Other Contact Points
  - MGlass@Microsoft.COM (Mike Glass)
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