Rapid Development of Boot Loaders using Intel® Boot Loader Development Kit (Intel® BLDK) for Embedded Designs

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EMBS002
Agenda

• Intel® Boot Loader Development Kit (Intel® BLDK)
  – Product Overview
  – Code Base Architectural Overview
  – Features and Capabilities

• Intel BLDK Development Application
  – Rapid Development Environment
  – Building and Configuring Boot Loader Image
  – Debugging
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Intel® Boot Loader Development Kit (Intel® BLDK)

Intel® Boot Loader Development Kit provides the mechanism for customers to develop their own boot loader solutions for embedded Intel® architecture designs.

Intel BLDK is on [http://www.intel.com/go/bldk](http://www.intel.com/go/bldk)
Intel® Boot Loader Development Kit (Intel® BLDK)

Documentation & Sample Reference Code

- Comprehensive instructional documents enable self-sufficiency and effective, scalable support

CRB Example Image & Boot Code

- Sample CRB image and boot code provide baseline from which customers can modify their system firmware image

Development Application with GUI Interface

- GUI Module Selection & Build Tool allows custom image creation without direct code changes
- Development Application facilitates easy navigation and modification of the code

Customer’s Own Boot Loader Solution

CRB: Customer Reference Board
**Intel® Boot Loader Development Kit (Intel® BLDK)**

**Availability**

- Intel® BLDK initially supports:
  - Intel® Atom™ Processor E6xx Series with Intel® Platform Controller Hub EG20T
  - Intel Atom Processor E65xC Series

- Alpha Release: April, 2011
- Gold Release: July, 2011
- Alpha Release: August, 2011
- Gold Release: October, 2011

- Alpha releases contain all features based on Intel® UEFI Development Kit 2010 (Intel® UDK2010)
- Gold releases include feedback/Issues from customers

**Gold releases will be available for download on**

http://www.intel.com/go/bldk
Intel® Boot Loader Development Kit (Intel® BLDK)
Value Proposition

**Cost:** Reduced BOM cost potential with no royalties to Intel

**Features:** Rich set of boot time features and capabilities

**Flexibility:** Provides flexibility and control for customization

**Rapid Development:** Tools speed development by abstracting underlying code

**Performance:** Allows for optimization for reduced boot times and firmware size

**Reusability:** Modularity and UEFI standards ensure greater reusability across platforms

**Ecosystem:** Value-added products and services from companies in the Intel® Embedded Alliance
Intel® Boot Loader Development Kit (Intel® BLDK) Ecosystem

- **Operating System Vendors (OSV)**: A more integrated stack with firmware and OS
- **Independent BIOS Vendors (IBV)**: Development tools, custom boot loader implementations and engineering services
- **Independent Software Vendors (ISV)**: Engineering services for boot loader customization
- **Embedded Board Manufacturers (EBM)**: COTS platforms with customized boot loaders and integrated Board Support Packages, ready for software development

Intel is enabling many levels of 3rd party companies to develop a broad boot loader ecosystem supporting embedded designs.
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**Code Base Architectural Overview**

- Intel® Boot Loader Development Kit (Intel® BLDK) code base provides a reference firmware implementation of the boot loader for the specific Customer Reference Boards (CRBs), based on Intel® UEFI Development Kit 2010 (Intel® UDK2010).

- Intel BLDK code base
  - Over 80% is source code
  - Modular code base
  - Reuse source code for different platforms
The primary purpose of the Intel® Boot Loader Development Kit (Intel® BLDK) is to initialize a platform and boot to a shell application or an operating system.
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**Supported**
- CPU, Memory, Basic IO Init
- Boot from ATA, CF, SD, USB, PXE, FWH, SPI
- Feature configuration
- Linux* OSes, Embedded OSes, UEFI shell 2.0
- Windows* Tool Chain
- UEFI Specification
- Fast Boot < 3s
- TCP/IP File Transfer
- ACPI 3.0
- Intel® UEFI Development Kit Debugger Tool

**Not Supported**
- Windows* OSes
- Legacy USB
- Virtualization
- Intel® Active Management Technology
- Intel® Trusted Execution Technology
- Plug and Play Systems (Hardware Detection)
- Intel® vPro™ Technology
- Custom Remote Access Services
- Compatibility Support Module

*Intel® BLDK boot loader does not replace BIOS, instead it performs basic initialization*
Features and Capabilities of Intel® Boot Loader Development Kit (Intel® BLDK)

Supported
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- Boot from ATA, CF, SD, USB, PXE, FWH, SPI
- Feature configuration
  - Linux* OSes, Embedded OSes, UEFI shell 2.0
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- Fast Boot <3s
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- Intel® UEFI Development Kit Debugger Tool

Configurability means flexibility for developers

Boot Performance is everything for some embedded designs

Good Debugging Tool can reduce time to market

Intel® BLDK delivers key features for developing firmware images quickly
Intel® Boot Loader Development Kit (Intel® BLDK) - Configurability

- Intel® BLDK offers a way to configure firmware settings by patching binary without rebuilding
- Intel BLDK has hundreds of feature setting options
- Intel BLDK Development Application makes the patching process easy

Intel® BLDK provides an easy-to-use configuration solution without rebuilding
The Intel® BLDK firmware configuration feature is based on the Intel® UEFI Development Kit 2010 (Intel® UDK2010).

The mechanism of Intel BLDK firmware configuration features
## Intel® BLDK Fast Boot Path vs Full Boot Path

<table>
<thead>
<tr>
<th>Intel® BLDK</th>
<th>Fast Boot Path</th>
<th>Full Boot Path</th>
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<tr>
<td><strong>Difference</strong></td>
<td>Only initialize the required devices</td>
<td>Initialize all devices</td>
</tr>
<tr>
<td><strong>Usage Model</strong></td>
<td>Statically configured</td>
<td>Used when the hardware configuration is changed</td>
</tr>
<tr>
<td><strong>Time elapsed from power on to Boot Loader enabled</strong></td>
<td>$&lt; 3s$</td>
<td>$&gt; 5s$</td>
</tr>
<tr>
<td><strong>Test Platform</strong></td>
<td>CPU: Intel® Atom™ Processor E600 Series PCH: Intel® Platform Controller Hub EG20T Memory: DDR3 1Gb</td>
<td></td>
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</table>

*Intel® BLDK accelerates boot performance*
How to maximize performance in the Intel® BLDK?

1. Make good use of system cache
2. Avoid initializing unnecessary devices
3. Organize the FLASH layout effectively
4. Use saved data during boot time

More details in a whitepaper “Reducing Platform Boot Time” which is located at: http://edc.intel.com/Link.aspx?id=4603
Intel® Boot Loader Development Kit (Intel® BLDK) - Debugging

Intel® BLDK has a software-only debugger solution

- Allows target debugging without need for exposed JTAG
- Leverages various debug ports (e.g. USB, Serial)
- Supports WinDbg as a front-end
- Few differences between this solution and a high-end hardware-based debugger
  - To break into target, SEC startup code must have established a stack
    - Typically a few dozen instructions from the reset vector
    - This is also true of first few dozen instructions in SMI entry
  - Some CPU mode transitions are difficult to debug

Intel® UEFI Development Kit Debugger Tool speeds development
Intel® Boot Loader Development Kit (Intel® BLDK) - Debugging

Intel® UEFI Development Kit Debugger Tool (Intel® UDK Debugger Tool) Architecture:

WinDbg Interposer interprets the commands from WinDbg

Debug Channels are in charge of communication between Host Machine and Target Machine

Debug Interrupt Handler handles the commands from Debug channel

Intel® BLDK includes UEFI-based open source debugger

For more details about the Intel UDK Debugger tool, please refer to: http://sourceforge.net/apps/mediawiki/tianocore/index.php?title=EDK2
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Intel® Boot Loader Development Kit (Intel® BLDK) Development Application

- Intel® BLDK Development Application is used to build and customize target Boot Loader Images

Main Features
- Graphical User Interface (GUI)
- Project Driven
- Build Environment
- Binary Configuration
  - Enable/Disable FW Features
  - Configure Feature Settings
- Source Code Editor with Syntax Highlighting
Development Environment & Build Tree

• Code Base Build Tree
  – Package concept for each directory
  – Platform is contained in a package

• Operating System
  – Build machine runs Microsoft* Windows*

• Compiler Tool Chains
  – iASL
  – Microsoft Visual Studio* .NET 2005 Team Suite Edition
  – Microsoft Windows Server 2003* DDK version 3790.1830
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Create a Project & Build the Image

• What is the project in the Intel® Boot Loader Development Kit (Intel® BLDK)?
  – The project is the starting point for developing, configuring and building a boot loader. It acts as a container that manages the source code and configuration.

• Run the development application

• Follow these steps to Create a Project
  – Click Project → New Project
  – Enter Project Name & Directory
  – Enter Workspace Directory & Configuration File (*.bsf)
  – Click Start Configuration
Create a Project & Build the Image

- Select Build Features & Build Binary
  - Select the features enabled or disabled in the build
  - Select Build Binary to start the build process
  - The final image is in: 
    C:\DemoTree\Build\TCPlatform\RELEASE_MYTOOLS\FV\TUNNELCREEK.fd
  - Also, a copy of the final image is in: 
    C:\DemoTree\TCPlatformPkg\FV\TUNNELCREEK.bin

- Alternatively, build the image from the command line as follows:
  > EdkSetup
  > build -p TCPlatformPkg\TCPlatformPkg.dsc -a IA32
Configuring Settings in Binary Image

- Provides board customization and porting without rebuilding image
- Post-build firmware configurations are accessed through development application
  - Expand Post-Build Firmware Configuration in tree-view
  - Modify all parameters according to the Target Board Configuration
  - Save Configuration: Select Project → Save Configuration from the menu
  - Create binary file: Select Build → Create Final Firmware Image from the menu
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Start Software Debugger from Intel® Boot Loader Development Kit (Intel® BLDK)

- **Launch**
  1. Launch Intel® UEFI Development Kit Debugger Tool (Intel® UDK Debugger Tool)
  2. Start up the target system using the Intel UDK Debugger Tool based firmware with the debug feature enabled (within 30 seconds after step 1)
  3. Wait two or three seconds, until WinDbg is connected and is ready to accept commands
Using the Software Debugger

- Bottom window allows commands to be entered
  - .reboot
  - g - Go
  - Q - quit
  - ? – Command list

- Launch debug commands from the toolbar
  - Go – “G”, “F5”
  - Halt – Control Break
  - Step Into “F8”
  - Step Over “F10”
  - Step Out “Shift F11”
  - Run to Cursor

Similar user interface as other debuggers
Demo: How to use Intel® BLDK Development Application

Procedure:
- Create a project
- Enable Fast boot feature setting
  (a) Expand “Boot”
    ▪ Select “Enabled” under the "Fast Boot" option and the "Silent Mode" option
    ▪ Select “Yes” under the “Enforce Boot Order” option
    ▪ Set "Hard Disk" as the first boot option
    ▪ Fill “OEM Boot Option Path”
  (c) Save the configuration
  (d) Click “Start build process” button to build the binary image if the binary has not been built out
  (e) Click “Create final firmware image” button to patch the final image
- Debugging using software debugger tool
Summary

• Currently Intel® Boot Loader Development Kit (Intel® BLDK) is targeted for Intel® Atom™ Processor-based embedded designs

• Intel BLDK helps developers to develop their own boot loader rapidly

• Intel BLDK helps customers to win Intel® Architecture embedded market
Additional sources of information on this topic:

- **Other Sessions and Q&A:**
  - EFIS004 Intel® UEFI Development Kit 2010 (Intel® UDK2010) and Intel® Boot Loader Development Kit (Intel® BLDK): Foundations for Advanced Embedded Development for detailed technical information – 16:10 in room 306A
  - SPCQ001 Hot Topic Q&A: Intel BLDK – 17:00 in room 306A

- **Demos in the showcase** – Intel BLDK Booth in IDF Embedded Zone

## Technical Sessions the EMB Track

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<td>14:05</td>
<td>311B</td>
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<td>EMBS003</td>
<td>Intelligent HD Digital Security Surveillance Solution Based on Intel® Architecture</td>
<td>15:10</td>
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