Introduction to
Intel® Boot Loader Development Kit
(Intel® BLDK)

Intel SSG/SSD/UEFI
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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) 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) Components

- Intel® UDK2010
- Intel® BLDK Source Code
- CPU & Chipset Initialization Binary Code
- Platform BSF
- Binary Boot Loader
- To Flash Memory

Intel® BLDK Development Application
Intel® BLDK Documentation
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

• Available Releases from EDC website are:

  Intel® BLDK – Code Bases (Reference Firmware Packages)
  Intel® Atom™ Processor E6xx Series with Intel® Platform Controller Hub EG20T
  Formerly Queens Bay (Tunnel Creek + Topcliff)
  • Intel® BLDK Core for Crown Bay—Windows
  • Intel® BLDK Core for Crown Bay—Linux
  • Release Note: Intel® BLDK Core for Crown Bay—Windows & Linux

  Intel® Atom™ Processor E6x5C Series
  • Intel® BLDK Core for Foxbrook—Intel® Atom™ Processor E6x5C Series (UEFI Standard Based)—Gold Release
  • Release Note: Intel® BLDK for Foxbrook—Intel® Atom™ Processor E6x5C Series—Gold Release

The latest releases for download are 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® BLDK is a reference implementation for Intel Customer Reference Boards (CRBs)

- Intel BLDK codebase
  - Distributed as a combination of source files and binary modules
  - Modular codebase allows for reuse of source code for different platforms
  - Compatible with latest UEFI standards
  - CRB reference implementations are publicly available

Intel BLDK for Intel® Atom™ Processor E6xx Series with Intel® Platform Controller Hub EG20T is available for download
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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Features of Intel® BLDK

**Supported**
- CPU, Memory, Basic IO Initialization
- Native UEFI Boot from SATA, SD, USB
- Feature configuration via Development Application
- Target OS: Windows* CE, Linux*, UEFI Shell
- Windows* Tool Chain for development
- UEFI Specification 2.3 & PI Specification 1.2
- Fast Boot < 3s
- TCP/IP File Transfer
- ACPI 3.0
- Intel® UDK Debugger Tool
- HD Audio

**Not Supported**
- Linux Tool Chain for development
- Legacy Operating Systems
- Operating System Boot via Int19h
- Legacy USB
- Compatibility Support Module
- Virtualization
- Intel® Active Management Technology
- Intel® Trusted Execution Technology
- Intel® vPro™ Technology
- Custom Remote Access Services

Intel® BLDK is targeted at fixed-function devices. It does not replace a full-featured BIOS.
Features of Intel® BLDK

**Supported**

- CPU, Memory, Basic IO Initialization
- Native UEFI Boot from SATA, SD, USB
- **Feature configuration via Development Application**
- Target OS: Windows*, CE, Linux*, UEFI Shell
- Windows* Tool Chain for development
- UEFI Specification 2.3 & PI Specification 1.2
- **Fast Boot < 3s**
- TCP/IP File Transfer
- ACPI 3.0
- **Intel® UDK Debugger Tool**
- HD Audio
- Linux Tool Chain for development

**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.

The mechanism of Intel BLDK firmware configuration features:

- MRC
- USB
- SIO
- PCI

FLASH Map:

- UEFI Boot Loader in FLASH block
- Binary Patchable Element
- Restricted Files without source
- File with open source reference
# Intel® Boot Loader Development Kit (Intel® BLDK) – Boot Performance

<table>
<thead>
<tr>
<th>Intel® BLDK</th>
<th>Fast Boot Path</th>
<th>Full Boot Path</th>
</tr>
</thead>
<tbody>
<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>
</tbody>
</table>
| **Test Platform** | CPU: Intel® Atom™ Processor E600 Series  
PCH: Intel® Platform Controller Hub EG20T  
Memory: DDR3 1Gb | |

*Intel® BLDK accelerates boot performance*
Intel® Boot Loader Development Kit (Intel® BLDK) – Boot Performance

How to maximize performance in the Intel® BLDK?

- Make good use of system cache
- Avoid initializing unnecessary devices
- Organize the FLASH layout effectively
- Use saved data during boot time

## Platform Debug Methodologies

<table>
<thead>
<tr>
<th>Debug Method</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port 80h</td>
<td>• Simple</td>
<td>• Limited information</td>
</tr>
<tr>
<td></td>
<td>• Low overhead</td>
<td>• No execution tracing / flow control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• May require several build iterations to isolate failure</td>
</tr>
<tr>
<td>Serial Out</td>
<td>• Simple</td>
<td>• Additional hardware and initialization</td>
</tr>
<tr>
<td></td>
<td>• Low overhead</td>
<td>• No execution tracing / flow control</td>
</tr>
<tr>
<td>Software Debugger</td>
<td>• Freely available</td>
<td>• Debug agent on target</td>
</tr>
<tr>
<td></td>
<td>• Source level debug</td>
<td>• Cannot debug all flows</td>
</tr>
<tr>
<td></td>
<td>• Execution tracing / flow control</td>
<td></td>
</tr>
<tr>
<td>Hardware Debugger</td>
<td>• Source level debug</td>
<td>• Requires purchase of JTAG debugger</td>
</tr>
<tr>
<td></td>
<td>• Ability to step through code</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Greater visibility to HW</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Ability to debug complex execution paths</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(CPU init, SMM)</td>
<td></td>
</tr>
</tbody>
</table>
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:
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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\CrownBayPlatform\RELEASE_MYTOOLS\FV\CROWNBAY.fd
    ```
  - Also, a copy of the final image is in:
    ```
    C:\DemoTree\CrownBayPlatform\FV\CROWNBAY.bin
    ```

- Alternatively, build the image from the command line as follows:
  > EdkSetup
  > Build_TC.bat -r32

```
Build ... done.
C:\DemoTree\Build\TCPlatform\RELEASE_MYTOOLS\FV\FVMAIN.Fv
C:\DemoTree\Build\TCPlatform\RELEASE_MYTOOLS\FV\FVMAIN_COMPACT.Fv
C:\DemoTree\Build\TCPlatform\RELEASE_MYTOOLS\FV\FVRECOVERY.Fv
C:\DemoTree\Build\TCPlatform\RELEASE_MYTOOLS\FV\FVRECOVERY_COMPONENTS.Fv
5 file(s) copied.
```

```
5 file(s) copied.
```
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
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
Intel Cup Embedded System Design Contest