UEFI Development and Innovations for System-On-Chip (SoC)

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EFIS002

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Agenda

- Why use Intel® UEFI Development Kit 2010 (Intel® UDK2010) in System-On-Chip (SoC)
- Enable Intel® Atom™ Processor E6xx with Intel® UDK2010
- Byosoft* SoC Boot Loader Development

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System-On-Chip (SoC) & SoC Firmware

- What is SoC
  - SoC is a single chip which integrates a complete set of system components
  - Usually contains a processor core, utilizes standard interconnects & busses and requires software components for full operation
- What is SoC firmware?
  - SoC firmware is coded instructions that are stored permanently in read-only memory
  - When the device starts up, the SoC firmware is to initialize and identify system devices. The primary function of the firmware is to load and start an operating system.

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The Requirements of SoC Firmware

Perspective of Product

Stable

Stability is essential for industry control devices

Performance

Like in IVI devices, boot speed is one of the key indicators

Perspective of Development

Low Technical Threshold

Easy to learn, easy to use

Customization

Meet the requirements of time to market for different segment devices

Need a Firmware Solution for SoC

IVI: In-Vehicle Infotainment

SoC: System-on-Chip

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Intel® UDK2010 Enables a Common Firmware Development Foundation Across the Compute Continuum

The Intel® UDK2010 is an open source build environment and tools that supports the development of UEFI Firmware, drivers and applications.

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Intel® UDK2010 is a Good Option for SoC

Perspective of Product

Stable

Like in some industry control devices

The core of Intel UDK2010 has been verified on server, desktop, laptop…

Performance

Like in IVI devices, boot speed is one of the key indicators

Intel UDK2010 has a leading boot performance

Perspective of Development

Low Technical Threshold

Intel UDK2010 is C language and development environments are Windows*/Linux*/Ios*

Customization

Meet the requirements of time to market for different segment devices

Intel UDK2010 naturally supports customization with its special features, like modular packages…

Intel® UDK2010 meets the requirements of SoC firmware

Intel® UDK2010: Intel UEFI Development Kit 2010

SoC: System-on-Chip

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Other Reasons to Choose Intel® UDK2010 for SoC Firmware

- ✓ Compatible with Industry standards, like UEFI spec, PI spec
- ✓ Bundle of complex features, like ACPI
- ✓ Open source community contribution
- ✓ Support by ecosystem, IBVs/ISVs/OSVs/IHVs

Intel® UDK2010 is on http://www.tianocore.sourceforge.net

SoC: System-on-Chip
Intel® UDK2010: Intel® UEFI Development Kit 2010

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- **Enable Intel® Atom™ Processor E6xx with Intel® UDK2010**
- Byosoft* SoC Boot Loader Development

Intel® Atom™ Processor E6xx Series Architecture

North complex

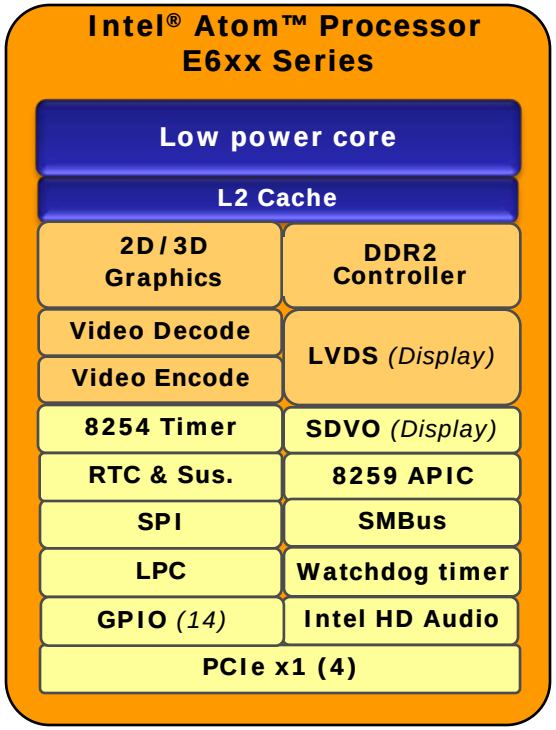
Single Intel® Atom™ Processor Core
- 45nm Hi-K process
- Max 512K L2 cache
- 0.6 to 1.6GHz Low power core

Memory controller
- 32-bit DDR2 667/800
- Max 1GB
- Single Memory Channel

Graphics
- 2D and 3D HW accelerator

Integrated High Definition Video Decoder & Encoder

Display
- LVDS & *SDVO interface*



South complex

LPC
- 8254
- HPET
- Watch Dog
- RTC & CMOS
- 14-pins GPIO
- 8259

SPI Interface

SMBUS1.0

Intel® High Definition Audio

4 x1 PCI Express* Gen1.0 Ports

Intel® Atom™ E6xx Series integrates Processor, GMCH and ICH

PCIe: PCI Express* Technology

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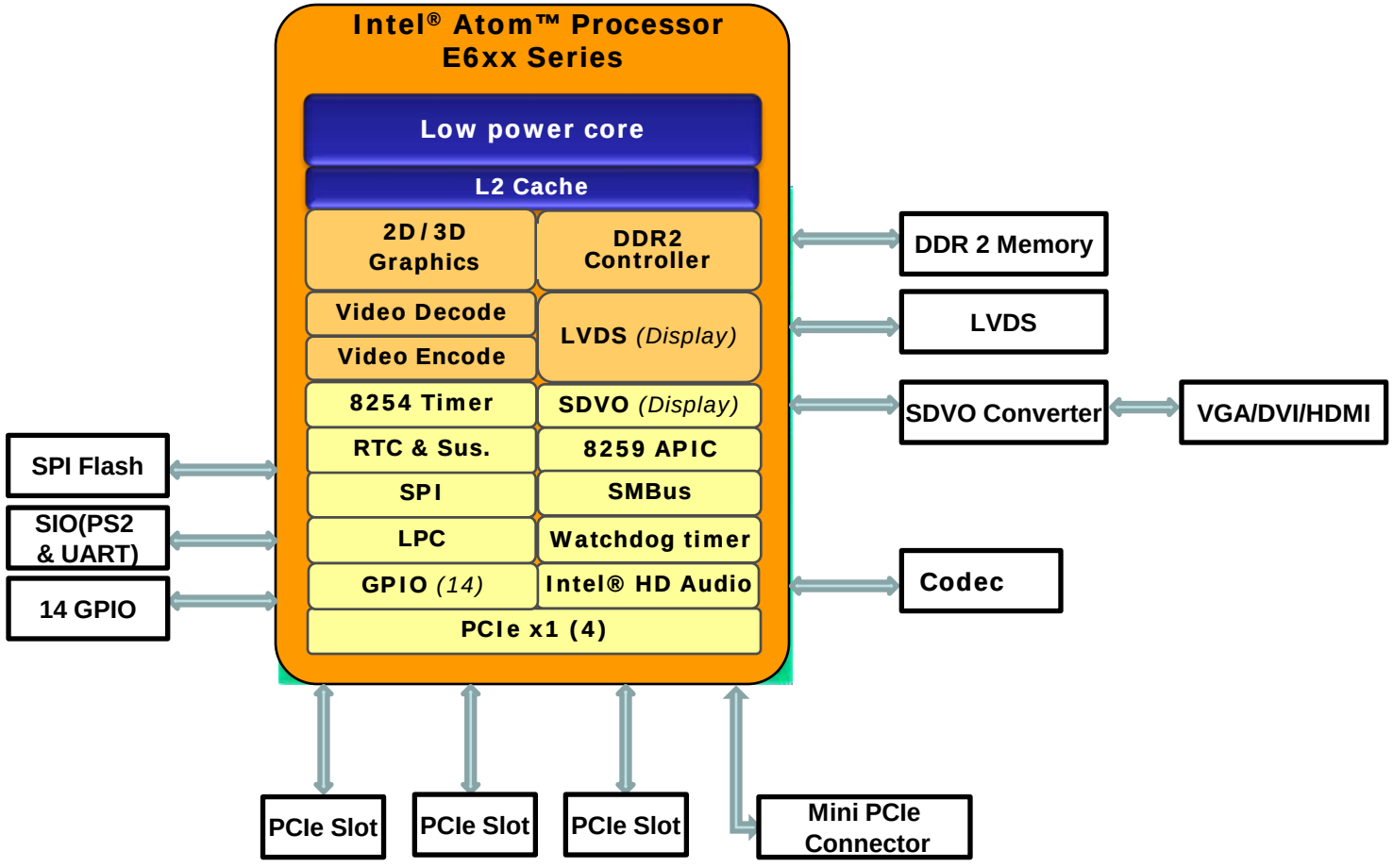
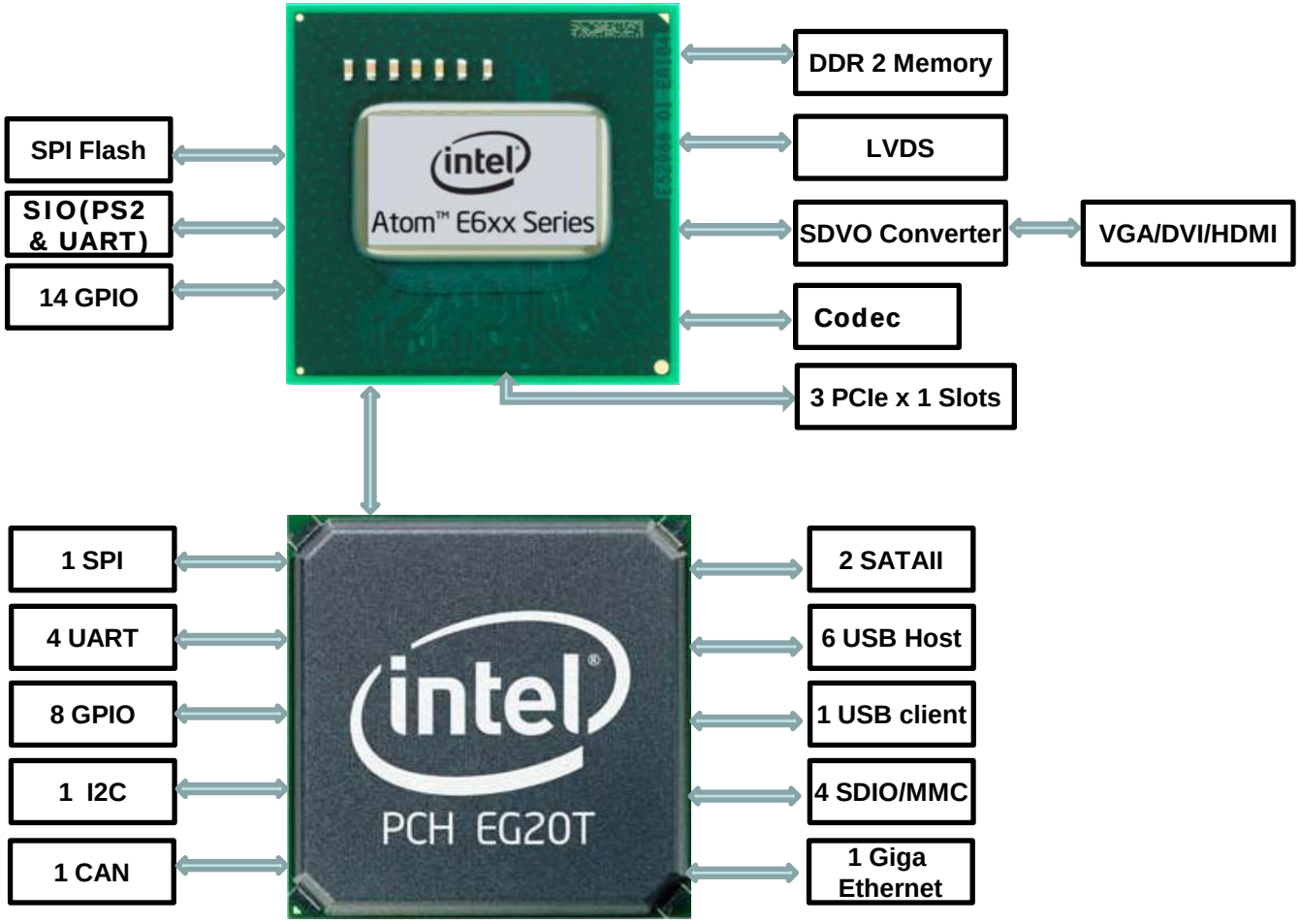
Build Single Chip System with Intel® Atom™ Processor E6xx Series



Intel® Atom™ E6xx Series are a complete system by itself

PCIe: PCI Express* Technology

CRB Diagram of Intel® Atom™ Processor E6xx Series with Intel® PCH EG20T



Intel® Atom™ Processor E6xx Series-based Platform for General Embedded Purposes

PCH:Platform Controller Hub
CRB: Customer Reference Board

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Firmware requirements of the CRB

- Support all SKUs of the Intel® Atom™ processor E6xx series
- Support updating the firmware image on the SPI flash
- Support loading EFI Option Rom on devices connected to the PCI/PCIe ports
- Support the ACPI 3.0 states
- Support Booting from SPI flash, USB, SATA, SD, PXE, CD/DVD
- Support booting to Windows* CE 6.0, MeeGo* 1.1 and Fedora* 13
- Support to **scale** to other system
- Support feature **configuration**
- Support to **boot** to the OS loader within 2000 milliseconds
- Support to present the **splash screen** within 1.0 second

Use Intel® UDK2010 to achieve these goals

CRB: Customer Reference Board; PCIe: PCI Express* Technology; Intel® UDK2010: Intel® UEFI Development Kit 2010

Develop the SoC Advanced Features

Scalable

Scale firmware for fragment Intel® Atom™ E6xx based platforms

Configurability

Customize the platform with PCD

Performance

How make Intel Atom E6xx based platform boot fast

Splash Screen

How to present splash screen earlier

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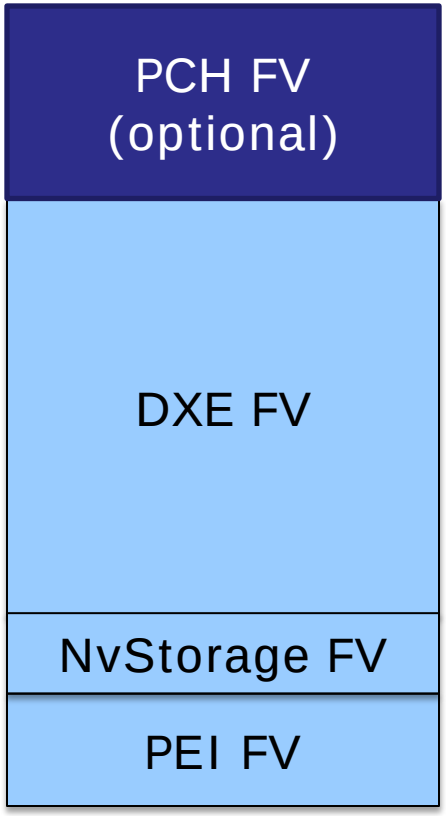
SoC Firmware Flash Layout Organization



- FD (Flash Device image) sections can be customized
- The PCH drivers are gathered in a FV, PCH FV
- Drivers in other FVs have no dependency to drivers in PCH FV

Easy to scale to different Intel® Atom™ E600 platforms

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Configurable - PCD Introduction

- Platform Configuration Database (PCD) is an important feature of Intel® UDK2010
- Platform level PCD file describes the content of the build for a specific platform
- PCDs can be used to store Platform Information
  - Vital Produce Data (VPD)
  - Setup Options
  - Serial Number
  - …

Using PCD can centralize platform configuration items

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PCD Implementation for CRB

- More than 400 PCDs are exposed

  - Pre-allocated memory for IGD
  - Internal Device Enable
  - PCI Express* Root Port Configuration
  - Processor Power Management
  - SMBIOS configurations
  - BDS related configuration including boot order
  - ACPI PCI Routing
  - ACPI MADT
  - Process features switch
  - Others

- The PCD setting can be changed in either source code or binary image

PCD configuration makes the firmware workable on similar platforms

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Boot Performance Enhancement for SoC

Some tips to tune boot performance

- Minimize code/data access without cache
- Minimize flash region access, organize flash layout effectively
- Hardcode some parameters (i.e. memory solder down)
- Remove interaction UI
- Connect less devices
- Cooperate with OSV, reduce duplicate work between firmware and Operation System

More details in a whitepaper located at: http://edc.intel.com/Link.aspx?id=4603

UI: User Interface
OSV: Operation System
SoC: System-on-Chip

Develop the SoC Advanced Features

Scalable

Scale firmware for fragment Intel® Atom™ E6xx based platforms

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Customize the platform with PCD

Performance

How make Intel Atom E6xx based platform boot fast

Splash Screen

How to present splash screen earlier

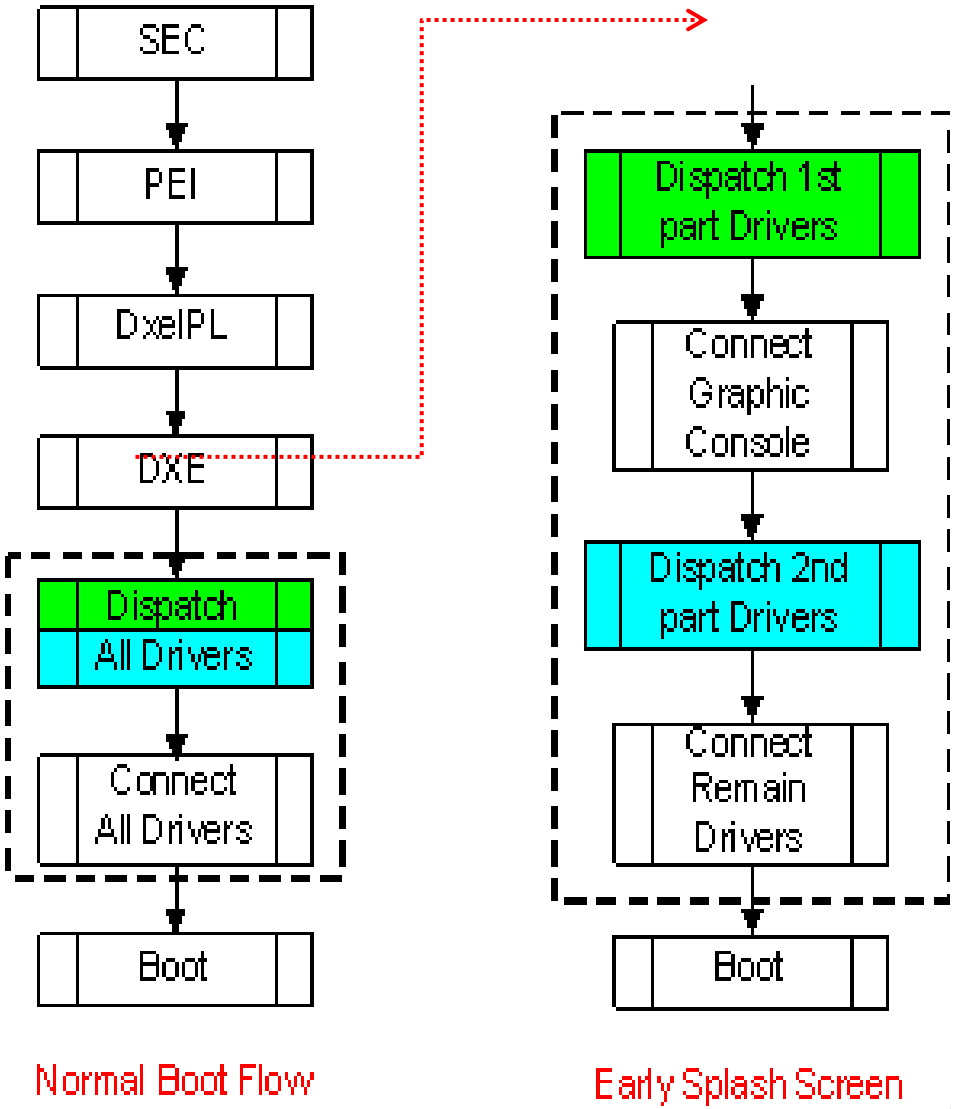
Splash Screen

- Change the boot flow to make splash screen present earlier
- Move part of drivers to another FV to reach this goal

Time Comparison

	Normal Boot	Early Splash Screen
Time[1]	1200 ms	980 ms

[1]The Time is from power on to showing screen



Normal Boot Flow

Early Splash Screen

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- **Byosoft* SoC Boot Loader Development**

Byosoft* SoC Boot Loader Development

- For Byosoft*, the boot loader solution for Intel® Architecture (IA) based SoC design is a key business area
- Leverage the advantages of Intel® UDK2010 for SoC designs
  - Reuse the function modules of other platforms
  - Develop new features based on the Intel UDK2010
    - IPv6 Network Stack
    - Security Framework
    - Library instances
    - Platform Configuration Database (PCD)

Intel® UDK2010 can accelerate the SoC boot loader development

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Byosoft* SoC Boot Loader Development

- For different market requirements, Byosoft has different solutions

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Identity Authentication Solution

- Byosoft* Identity Authentication Solution is to solve pirated designs

Identity Authentication Solution

Encrypt customer information to generate license key

Authenticate the license status

Automatically lock the non-licensed products to stop the infringement

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Identity Authentication Solution

Work flow of the initial phase in the boot loader

- ✓ Assign license key
- ✓ Based on license key to generate a new key through encryption module
- ✓ Save the new key into flash

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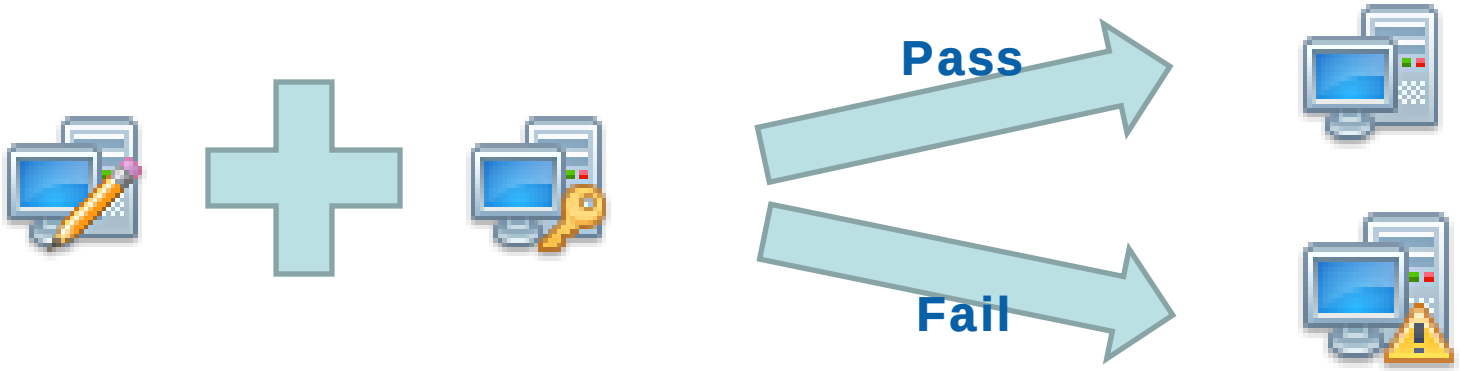
Identity Authentication Solution

Work flow of the execution phase in the boot loader



- ✓ Check the information of hardware & boot loader
- ✓ Check the license key through the decryption module
- ✓ Pass the authentication and boot the system normally
- ✓ Or, lock the non-licensed products and notice the customer

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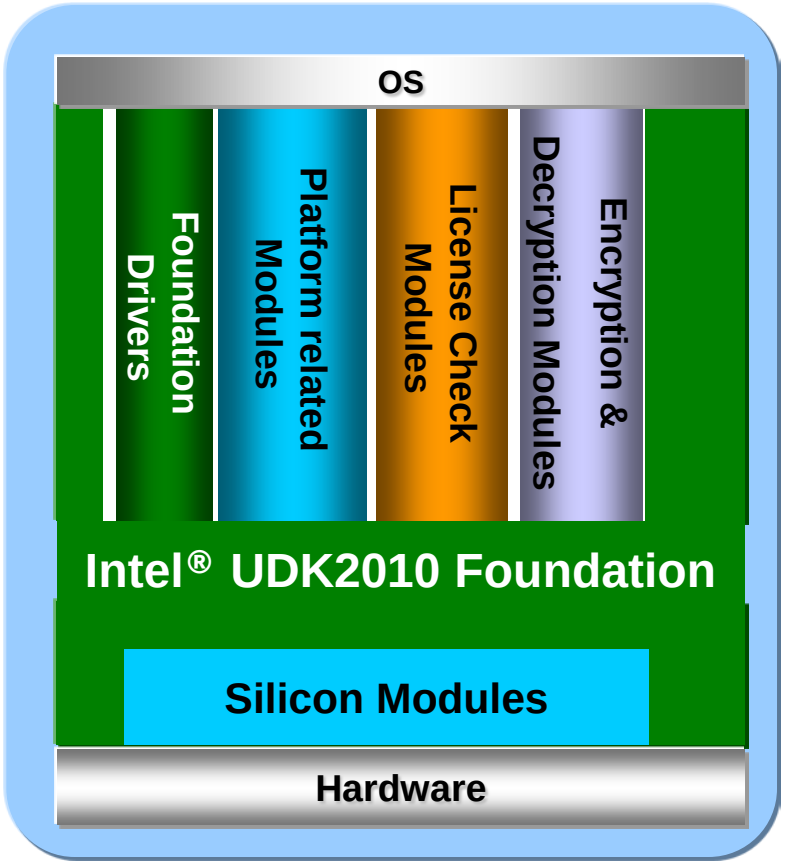
Identity Authentication Solution



- License Check Module - Customized credential provider under standard UEFI/UDK PBA Framework for platform authentication and identification
- Flexible key deployment & Derivation mechanism based on UEFI Key Management Service Protocol

Take full advantage of Intel® UDK2010 Security Infrastructure

Intel® UDK2010: Intel UEFI Development Kit 2010

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Error Report & Recovery Solution

- Byosoft* Error Report & Recovery Solution is used in Industry Control system

Error report & recovery solution

Report the error info through network in security way

Recovery the system if detects errors

Keep the system stable

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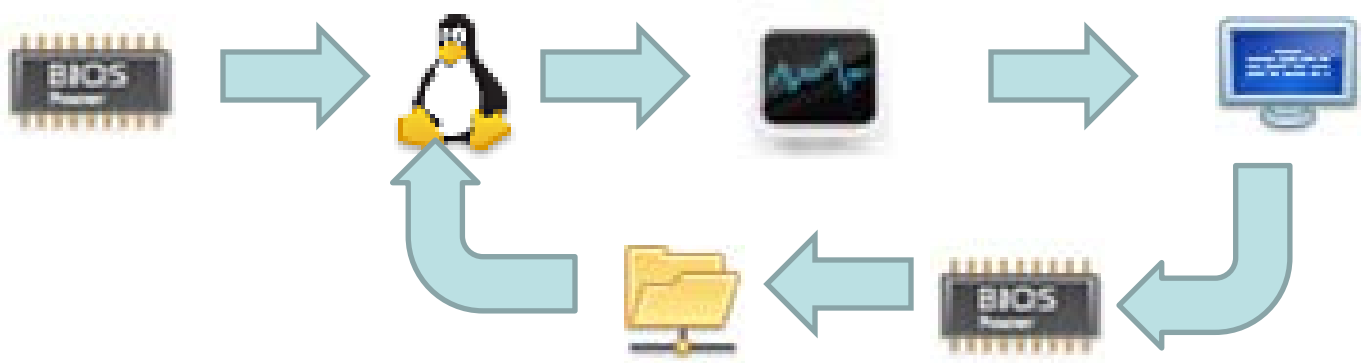
Error Report & Recovery Solution

Work flow of error handling



- ✓ Boot to OS
- ✓ Monitor System Status
- ✓ System meets error
- ✓ Recover the system
- ✓ Upload error information to the server
- ✓ Back to the normal state

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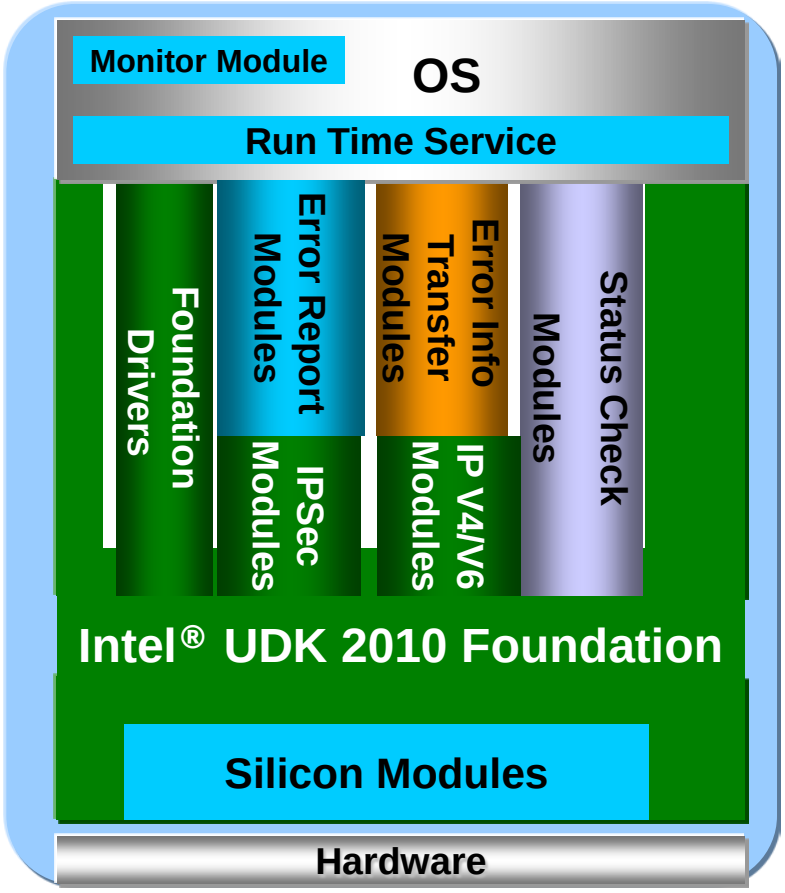
Error Report & Recovery Solution



- Error Info Transfer Module - Leverage Intel® UDK2010 IPV4/IPV6 stack to transfer error report
- Error Report Module - The error report is encrypted by Intel® UDK2010 IP Sec module.
- Use UEFI Runtime service to communicate between OS and firmware

Develop advanced features based on Intel® UDK2010 network fundamental components

Intel® UDK2010: Intel UEFI Development Kit 2010

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Fast Boot Solution

- Byosoft* Fast Boot Solution is used in the devices which have strict boot performance requirements

Fast Boot Solution

Only enable necessary devices

Improve the efficiency of code execution by making full use of cache

Use the fixed boot mode according the usages of the device

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Fast Boot Solution

- The core of Intel® UDK2010 is modular making it more efficient to optimize
- Intel® UDK2010 supports to integrate all required drivers into one FV image to save decompressing time
- It is easy to save and reuse data to avoid long time enumeration and hardware training in Intel® UDK2010
- Byosoft* can customize the boot loader to satisfy different requirements from customers

The architecture of Intel® UDK2010 supports performance tuning

Intel® UDK2010: Intel UEFI Development Kit 2010

Fast Boot Solution

- Boot performance comparison between Normal Boot and Fast Boot

Boot Phase	Normal Boot Performance	Fast Boot Performance
SEC	12 ms	16 ms
PEI	1592 ms	516 ms
DXE	594 ms	207 ms
BDS	13594 ms	1623 ms
Total Time	15792 ms	2362 ms

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Summary

- Intel® UDK2010 naturally supports SoC boot loader development
- Based on Intel® UDK2010, Byosoft makes the innovation for SoC boot loader
- Byosoft* will continue to commit itself on SoC boot loader service and development

Additional resources on UEFI:

- Other UEFI Sessions – Next slide
- More web based info:
  - Specifications sites www.uefi.org, www.intel.com/technology/efi
  - EDK II Open Source Implementation: www.tianocore.org

- Technical book from Intel Press: "Beyond BIOS: Implementing the Unified Extensible Firmware Interface with Intel's Framework" www.intel.com/intelpress

EFI Track Sessions

Session ID	Title	Day/ Time	Room
✓EFIS001	Microsoft* Windows* Platform Evolution and UEFI	Tuesday 11:10	306A
✓EFIS002	UEFI Development and Innovations for System-On-Chip (SoC)	Tuesday 14:05	306A
EFIS003	UEFI and Transparent Computing Technology	Tuesday 15:10	306A
EFIS004	Intel® UEFI Development Kit 2010 and Intel® Boot Loader Development Kit: Foundations for Advanced Embedded Development	Tuesday 16:10	306A
SPCQ001	Hot Topic Q&A: Intel® Boot Loader Development Kit (Intel® BLDK)	Tuesday 17:00	306A
EFIS005	Security and Networking Advancements Today's UEFI and Intel® UEFI Development Kit 2010 (Intel® UDK2010)	Wednesday 11:10	306A

✓ = DONE

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Session Presentations - PDFs

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Q&A

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