Implementing Platform Security with UEFI

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Agenda

• UEFI Updates
• Security Feature of Intel® UDK2010 SR1 Release
• Secure Boot Factory Tools
• Secure Firmware Updates
• Summary

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Agenda

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UEFI Updates

• UEFI Specification
  – Version 2.3.1, Errata A published on Sept. 7, 2011
  – Clarifications from version 2.3.1
  – Additional ECRs are work in progress

• UEFI SCT
  – Published a UEFI Winter 2012 Plugfest Release in Feb, 2012
    ▪ Version 2.3.1 compliance test preview
  – Investigating coverage for 2.3.1 Errata A

• Be Ready for Windows* 8
  – UEFI 2.3.1 support
  – UEFI drivers and applications
  – Secure boot (sign the executables)
  – Seamless boot, hybrid boot, fast boot
  – IPv6 and IPv4 network stack
  – UEFI Spring 2012 Plugfest in Taipei (May 8-10)

• PI Specification
  – Version 1.2 Errata C published in October 2011

2012 marks the ubiquitous adoption of UEFI on PCs
Intel® UDK2010 SR1 Key features

- UEFI 2.3.1 Secure Boot
- TCG Physical Presence v1.2 rev 1.0 support
- User Identification (UID) per UEFI 2.3.1a
- iSCSI over IPv6
- Networking Improvements - DHCP4/DHCP6 API & IPV6 identification
- Opal/eDrive SATA devices support per UEFI 2.3.1a
- USB 3.0 Controller support (XHCI)
- UEFI 2.3.1 Internal Forms Representation (IFR) support
- Modular and Faster Build Process
- Fast Boot support (asynchronous Block I/O)
HP Experience on Intel® UDK2010 SR1

• Advantages
  – Support for many of the new UEFI and Windows* 8 features
    ▪ UEFI 2.3.1 support
    ▪ Support for Windows 8 features
      ➢ Secure Boot
      ➢ Seamless Boot
    ▪ Support for IPv6 and IPv4 network stacks
      ➢ IPSec is implemented
  – Most of the code is ready-to-go and doesn’t require changes

Intel® UDK2010 SR1 provides a valuable reference implementation for the industry
Agenda

• UEFI Updates
• **Security Feature of Intel® UDK2010 SR1 Release**
  • Secure Boot Factory Tools
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Intel® UDK2010 SR1 Security Features

• UEFI Secure Boot
  – UEFI variable support for UEFI Secure Boot as defined by UEFI 2.3.1a (EFI_VARIABLE_TIME_BASED_AUTHENTICATED_WRITE_ACCESS attribute with EFI_VARIABLE_AUTHENTICATION_2 and EFI_VARIABLE_AUTHENTICATION support)
  – DXE Image Verification library to support UEFI Secure Boot (UEFI 2.3.1a)
  – PK x509 Certificate Support
  – Support EFI_VARIABLE_AUTHENTICATION_2 for PK variable format (UEFI 2.3.1a)
  – Add enable/disable mechanism for UEFI Secure Boot

• TCG Trusted Boot
  – TCG EFI Platform Specification
Intel® UDK2010 SR1 Other Features

- User Identity (UID) Support (UEFI 2.3.1a)
- Secure Storage Protocol
  - Enable Opal/eDrive SATA devices using the EFI_STORAGE_SECURITY_COMMAND_PROTOCOL, ATA-8 Trusted Send/Receive and IEEE1667 Silo (UEFI 2.3.1a)
- Networking Improvements
  - Errata related to Netboot6-DUID
  - Provide more DHCP4 & DHCP6 API support
  - iSCSI (ip6) open source implementation for IPv6
- Support ATA Asynchronous Block Io (UEFI 2.3.1a)
- USB 3.0 Controller Support (XHCI)
- Update Internal Forms Representation (IFR) implementation to match UEFI 2.3.1 Specification
UEFI Secure Boot vs TCG Trusted Boot

- UEFI authenticate OS loader (pub key and policy)
- Check signature of before loading

• UEFI Secure boot will stop platform boot if signature not valid (OEM to provide remediation capability)
• UEFI will require remediation mechanisms if boot fails

TPM/TCM will measure OS loader into PCR (Platform Configuration Register)

- TCG Trusted boot will never fail
- Up to other SW to make security decision using attestation
UEFI Secure Boot Component:

- **UEFI Driver Signing**: The system provider may decide to authenticate either the origin of the executable or its integrity.

- **Authenticated UEFI Variable**: It provides a way to protect the critical variable being modified by malicious software.

- **Firmware/OS Key**: We can create a trust relationship between the platform owner, the platform firmware, and an operating system.
UEFI Driver Signing

- **Why?** – Origin & Integrity
- **How?** – Authenticode PE

Diagram:
- PE Image
  - PE Header
    - Certificate Directory
  - Section 1
  - ... (continued)
  - Section N
    - Type
    - Attribute Certificate Table

PKCS#7 + Authenticode Ext
- ContentInfo
  - PE file hash
- Certificate
  - X.509 Certificate
- SignInfo
  - Signed hash of ContentInfo
**UEFI Authenticated Variable**

- **Why?** – Integrity (no confidentiality)
- **How?** – Time Based

Authenticated Variable

**PKCS#7**
- ContentInfo
  - N/A
- Certificate
  - X.509 Certificate
- SignInfo
  - Signed hash of VariableName + VariableGuid + Attributes + TimeStamp + DataContent

**Input Variable Data**
- Authentication
  - Time Stamp
  - Type
- Certificate
- Data Content
Firmware/OS Key

- **Why?** – How can firmware know if certificate is valid?
- **How?** – Firmware/OS Key

(Signature Database)
Put Them Altogether: UEFI Secure Boot

1. Enroll $PK_{pub}$
2. Delete $PK_{pub}$
3. Platform-Specific $PK_{pub}$ Clear
Put Them Altogether: UEFI Secure Boot

1. Enroll

Authenticated Variable
- PK
- KEK

2A. Signed Image Discover
- Certificate + SignInfo

2B. Signature Verification

2C. Signed Image Load
- Certificate + SignInfo

PEI FV

Variable

DXE FV

Image Verify

OpRom.efi

OsLoader.efi
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UEFI 2.3.1 Secure Boot Begins at the Factory

1 Pre-Production
Certificate Generating Station @ OEM

2 Production
Initial Security Load

3 Protected User
Every New System receives Initial Security Database

OEM is Responsible for Initializing Secure Boot
UEFI Secure Boot Database Review

If Signed by key in db, driver or loader can Run!

If Signed by key in dbx, driver/loader forbidden!
Public vs. Private Keys

- A pair of keys, one public, one private, are created
- Private keys stay secure at Partner or in the OEM’s Security Office
- Private keys are used to ‘sign’ objects
- Only Public keys loaded into the Platform
- Public keys are used to check signatures

Private Keys Must be Stored Securely!
Who “Owns” The System Security Keys?

• **PK** – Key pair is created by Platform Manufacturer
  Typically one PK pair used for a model or model Line

• **KEK** – Key supplied by OS Partner,
  Optional: Include 2\textsuperscript{nd} key created by OEM

• **db** – OS Partner supplies Key,
  CA Partner supplies Key,
  Optional: OEM App Signing Key

**Signature Tests using db Keys Block Rogue S/W!**
OEM Administration

• Keys are installed for testing with target OS
• Keys are installed in the factory before shipping

• Preparation Tasks
  1. Gather public keys from partners
  2. Generate PK for model
  3. Make a package of initial key load
  4. Occasional maintenance of forbidden list

• Repetitive Tasks
  1. Factory will boot and install the initial key load

Careful Preparation Delivers Successful Launch
Major Components of the Tool Set

Security Team Office

- Partner keys
- Key Management Tool
- OEM Keys

Factory

- DB Install Image
- Keys
- Key Installer

Diagram showing the integration of these components.
Key Generator and Management Tool

• InsydeH2O* Key Manager imports:
  - Partner’s KEKpub
  - Public signing keys for db (example Microsoft Signing Authority, Windows Signing key, OEM signing authority)
  - Current Revoked keys or hash list for dbx

Key Manager Organizes Database Prep
Key Generator and Management Tool

- Use Key Manager to Create:
  - PKpriv and Pkpub for model line
  - KEKpriv and KEKpub for OEM
  - OEM App Signing key

**Key Manager Creates OEM Required Keys**
Insysde Factory Install Image File

(1) Key Installer
   - Runs in WIN8 or WINPE
   - Checks it’s own integrity
   - Installs the Secure Keys

(2) Initial Database Image
   - PK – System Master Key
   - KEK – OEM and Partner Management Keys
   - db – Industry Recognized Driver/app signing Keys
   - dbx – Revoked signing keys

Single Signed Installer File Prevents Factory Tampering
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Secure Field Update to Firmware Store

- Field Firmware Update must support all elements of NIST 800-147 & Windows* 8 client recommendations
  - Any update to the firmware flash store but be signed by creator
  - Firmware must check signature of the update
  - Firmware updates are signed by another key – not PK
  - Policy must remain in effect even if Secure Boot Database is cleared by user

All Firmware Updates Must be Signed at Factory
Signing Firmware Update Files:

- InsydeH2O* Update Tool
- Sys Firmware Update Image
- Signed capsule file ready for Download Site
- Certificate Store (OEM Private)

*InsydeH2O* Secure Update Meets Industry Requirements
DEMO!
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Summary

• 2012 is the year for ubiquitous UEFI adoption
• With UEFI 2.3.1, the boot experience is fast, secure and beautiful leading to higher customer satisfaction and opportunity for product differentiation.
• Intel® UDK2010 SR1 is a good reference, especially for security features
• With the benefits of secure boot come new responsibilities for OEMs in management of security database.
• Modern standards require secure firmware updates
Call To Action

System OEMs and their partners need to plan the switch to UEFI 2.3.1 Secure Boot:

1. Use learning resources including Intel® UDK2010 SR1
2. Develop procedures and assign clear responsibilities for security tasks
3. Work with IBV for firmware implementation and new factory tools
# Related Sessions

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<td>GVCS001</td>
<td>Leveraging the Full Processing Power of Next Generation Intel® core Microarchitecture, Code Name Ivy Bridge</td>
<td>Wed</td>
<td>11:00</td>
<td>306B</td>
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<td>GVCC001</td>
<td>Poster Chat: Tools for Tuning Graphics and Heterogeneous Computing Applications for the Next Generation Intel® Processor Graphics</td>
<td>Wed</td>
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## Platform Technologies and Analysis Sessions

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<td>PTAC001</td>
<td>Poster Chat: UEFI Application Development using Standard Libraries and Python*</td>
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<td>PTAS001</td>
<td>System Behavior and Performance Prediction using System Modeling and Simulation Tools</td>
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<td>PTAS002</td>
<td>Shift Left! Leverage Full System Simulation to Reduce Your Time To Market</td>
<td>Wed</td>
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<td>Advanced UEFI Development Environment for Embedded Platforms</td>
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<td>Implementing Platform Security with UEFI</td>
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<td>Platform Optimization Using Open Computing Language (OpenCL*) Tool</td>
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Software and Services Group Pavilion - Platform Technologies: UEFI, Analysis Tools, and Simulation Booth Number 16

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