Unified Extensible Firmware Interface (UEFI): Best Platform Security Practices

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EFIS003
Agenda

• Background & Motivation

• Best Practices on Platform Security
  – Trusted Computing Elements
  – UEFI Security Overview
  – Hardware Rules
  – UEFI PI & Firmware Practices

• UID & Byosoft Practices on PBA
Background & Motivation

• Security is not only OS things: researchers have started to look for vulnerabilities in layers above, as well as underneath the OS.

• Real World: SMM configuration bugs, exploitable memory overflows, firmware downgrades triggered by malware, ...

• Challenges
  – Firmware is an interesting attack target: Early execution, Privileges, Asset Data, SMM, etc
  – Malicious software running underneath the OS is quite powerful: Difficult to detect; Cannot be eliminated by OS reboot or re-install; Information Leak; Identify Theft; ...

• Should consider more security things on Platform & Firmware now!
Platform Security – The Problem Statement

- Protection Against Malicious Code
  - Worms, Virus, Rootkit, Bootkit
- Business Process Compliance
  - Regulatory requirements from EU Privacy, SarbOx, Basel II, HIPAA, GLB etc.
- Internal/External Access and Data Protection
  - Secure provisioning of Infrastructure/Users
  - Managing access/identity across disparate applications

Security isn’t hype, but real market need
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Goals / Guidelines

• Potential Threats
  ✓ Spoofing
  ✓ Tampering
  ✓ Repudiation
  ✓ Information Disclosure
  ✓ Denial of Service
  ✓ Elevation of Privilege

• Platform and UEFI PI-focused summary of **rules** and **practices**
  ✓ Integrity Protection
  ✓ Data Protection
  ✓ Verification
  ✓ Platform Availability

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**Hardware and Firmware are the Roots of Trust**
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Trusted Computing & Measured Boot

- The hardware root of trust includes
  - TPM
  - Flash
  - Binding of above into system

- Measured Boot
  - Provide an end-to-end solution for the customer to be TCG conformant
  - Recording the platform state of the machine into a PCR
  - Boot Flow

- S-CRTM
  - Core Root of Trust for Measurement
  - Detects physical presence and initiates measurements for Rest of firmware bootstrap
UEFI Measurement & OS Usage

Standardized way to measure and report
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UEFI Driver Signing

- Expand the types of signatures recognized by UEFI
  - EFI_CERT
  - Authenticode
- Core firmware verification of publisher identity and image integrity of all UEFI extensions
- Security / Trust Policy Configuration to identifies a small set of trusted root certification authorities
- Enable installation and verification of boot applications used to boot any operating system the customer selects for the platform

<table>
<thead>
<tr>
<th>MS-DOS* Header</th>
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<tbody>
<tr>
<td>PE Header Offset</td>
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<tr>
<td>PE Header</td>
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<tr>
<td>Sections Directory</td>
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<tr>
<td>Section #1</td>
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<td>Section #2</td>
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<td>Section #n</td>
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<tr>
<td>Debug Information</td>
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<tr>
<td>Certificate #1</td>
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<tr>
<td>Certificate #2</td>
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<tr>
<td>Certificate #n</td>
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</tbody>
</table>

Embed signatures within executable
UEFI User Identification

- Standard framework for user-authentication devices such as smart-cards, smart-tokens & fingerprint sensors
- Uses UEFI HII to display information to the user
- Introduces optional policy controls for connecting to devices, loading images and accessing setup pages
UEFI Authenticated Variable

- Variable is “valuable” information for platform
- Write-protected Variable service, based on asymmetric key technology
- Pre-defined variables for platform mode switching & key exchange between Firmware and OS
UEFI IPsec (Pre-deployed SA)

IPsecConfig

TCP6 driver

UDP6 driver

IP6 Driver

ND | MLD

ICMPV6

AH/ESP

IPsecDB

SPD,SAD

Update SPD/SAD DB

Inbound Packet

MNP

Find SA, and Encapsulate AH/ESP header per SA info

Find SA, and process AH/ESP Header

Outbound packet

Call SetData()
- Add an SPD entry (for TRAFFIC1, Manual SA)
- Add required manual SA for this SPD entry

UEFI Security Continues to Evolve
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Hardware Best Practices

- CRTM Flash Protection
  - Locking must not be controlled by any un-trusted programmable entities
  - Once locked within CRTM code, it must not be un-lockable without going through a system reset
- Physical Presence
  - Physical Presence (PP) hardware must not be changeable by any un-trusted programmable entity
- Reset
  - TPM must get reset for any type of platform reset
  - No path available to manipulate reset vector in the system

Hardware is a key part of root of trust
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What About Firmware Practices?

UEFI PI Overview

- UEFI 2.3 (published) specifies how firmware boots the OS loader
- UEFI’s Platform Initialization Architecture specifies how modules initializing SI and the platform interact and provides common services for those modules
- PI DXE is the preferred UEFI Implementation
- PEIMs and DXE drivers to implement CRTM, SRTM, Update, other security features

**Design Intent**
- The PI phase is under control of the Platform Manufacturer (PM)
- Updates to PI phase should occur under PM authorization (PM_AUTH)
- PI phase can be decomposed into compartments
  - SEC
  - PEI
  - DXE
  - DXE SMM

Methods of building PI impacts trust
UEFI PI Best Practices

- **Hardware mis-Configuration:**
  - Appropriate set locks and other hardware configuration should be set by the PM-only PI code prior to running 3rd party code, such as UEFI drivers or operating system loaders

- **Callouts**
  - Don’t call out from PM_AUTH PI code to non-PM_AUTH code
  - Measure any code before loading

- **Interface Correctness**
  - Pass compliance tests
  - Check & validate input, especially from non-PI PM_AUTH into PI code

- **Flash Protection and Update Security**
  - Appropriate update of PI and CRTM – either immutable or cryptographic update

- **Denial of Service**
  - Platform recovery/update strategy

Firmware completes the platform trust solution
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UEFI User Identification

Authentication over platform & identifier
- User authentication prior to the OS loading
- Better resource control - identifier-based platform
- SSO vision
- Independent of OS and applications (push authentication into pre-boot environment)

Concepts:
- User profile
- Single-factor/Multi-factor
- Enroll
- Credential
  - What you know (Password)
  - What you have (Smart Card)
  - What you are (Fingerprint)
Components in UEFI UID

- User Identity Manager
  - User Information
  - User Identification Policy
  - User Privileges
- Credential Provider
  - Fingerprint sensor
  - Smart Card
  - Password
  - Network Authentication
- Access Control
  - Access Policy
Credential Provider Driver

- Follow the UEFI Driver Model

  ![Diagram]

  - Install EFI_USER_CREDENTIAL_PROTOCOL
  - Install user-interface forms using HII Database Protocol
  - Install EFI HII Configuration Access Protocol

- UEFI Spec does not explicitly support passing credential info to OS. The EFI System Configuration Table is a place to store the encrypt credential info to an OS-present driver or app.
Security Considerations

The drivers which be loaded from unprotected location should be verified.
Byosoft UID Practice

- Fingerprint and USB smart card implementation using two protocols
Byosoft UID Extension: Multi-User/OS

UID is the foundation of many security functions, such as Multi-User/OS

- Separate storage space for individual
- Boot different OS from each space
- Feature:
  * One machine can be used by different users
  * Combines with the UID, provides more functions
Byosoft UID Extension: Pre-boot Data Protection

• One access control mechanism for preserving confidentiality

• Two methods:
  * Pure software
  * Using 3rd party hardware (TPM or other) to improve the secure level

• Features:
  * Be independent of OS
  * Binds secret data with platform
  * Simple to deploy

UID is the naturally KEY for Cryptology algorithms
Byosoft Platform Security Practices

<table>
<thead>
<tr>
<th>Function</th>
<th>UID</th>
<th>Multi-user/OS</th>
<th>Data protect</th>
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<td>Trusted platform</td>
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<td>Driver/App</td>
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<td>Boot Policy Driver</td>
<td>GUI Driver</td>
<td>TCG Protocol/Platform Driver</td>
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<td>TPM Service Driver</td>
<td>Crypt Service Driver</td>
<td>I/O Device Driver</td>
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<td>Lib</td>
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<td></td>
<td>Crypt Lib</td>
<td>GUI Lib</td>
<td>EDK Lib</td>
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Firmware completes the platform trust solution
Summary

• Security problems in the industry are real
• Trust and a security architecture can address some needs, especially hardware and firmware
• Follow best practices on hardware and firmware configuration and implementation
• UEFI and hardware security evolution
Next Steps – Security Requirements

• Use the trusted device
• Follow best practices on hardware and firmware
• Get involved in UEFI and Trusted Computing forums
• Download the Security white paper: http://download.intel.com/technology/efi/SF09_EFIS001_UEFI_PI_TCG_White_Paper.pdf
Additional resources on UEFI:

- Other UEFI Sessions – Next slide
- More web based info:
  - Specifications and Implementation sites:
  - Security Whitepaper:
    http://download.intel.com/technology/efi/SF09_EFIS001_UEFI_PI_TCG_White_Paper.pdf
  - UEFI Plugfest Event at Intel in Dupont Washington, June 22-25, 2010 www.uefi.org or email: laurie.jarlstrom@intel.com
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### April 14

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<th>Description</th>
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<td>S001</td>
<td>Intel, IBM, HP</td>
<td>Using the Latest EFI Development Kit (EDK II) for UEFI Advanced Development and Innovation</td>
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<td>Notebook Advancements for Unified Extensible Firmware Interface (UEFI) for Pre-boot Productivity</td>
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<td>Intel, Microsoft, Insyde</td>
<td>UEFI Fast Boot for Microsoft* Windows* 7 : Fast Boot Without Compromising your BIOS</td>
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<td>UEFI Firmware Solutions for Enterprise Servers: A Case Study in 8-way Processor Support</td>
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