Intel Advanced Technology in the Enterprise: Best Security Practices

Shiva R. Dasari
Senior Software Engineer, IBM

Vincent J. Zimmer
Principal Engineer, Intel

EFIS001
Agenda

• Trusted Computing Elements
  – Problems to solve
  – Firmware and trusted computing
  – OS usage
  – Platform perspective

• Best practices
  – H/W rules
  – PI overview
  – Firmware rules

• Futures
Trusted Computing Elements and Security Features in the platform

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Platform Security – The Problem Statement

- **Protection Against Malicious Code**
  - Worms, patching

- **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*
Dictionary Terminology

- **Trust**
  - An entity can be trusted if it always behaves in the expected manner for the intended purpose

- **Measurement**
  - The process of obtaining the identity of an entity

- **Security**
  - “... maintenance that ensure a state of inviolability from hostile acts or influences”

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*Trust needs an agreed upon lexicon*

1 [www.wikipedia.org](http://www.wikipedia.org)
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Elements of trust

- Reliability
- Safety
- Confidentiality
- Integrity
- Availability

Providing ‘Trust’
Security architecture to deliver trust

Platform Security

Security Architecture

Single layer “security”

SSL, IPsec, etc.

Network
OS
Firmware
Hardware
Drivers
Libraries
Application
GUI
Human User

App 1 App 3 App 2
Roots of trust of security architecture

Hardware and firmware are the roots of trust
What is the heart of Trust

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

- TCG defines TPM’s functionality
  - Protected capabilities
  - Shielded locations

- Not the implementation
  - Vendors are free to differentiate the TPM implementation
  - Must still meet the protected capabilities and shielded locations requirements

Need a hardware root of trust
SRTM\(^1\) for Platform Firmware

Static RTM

RTS / RTR (TPM)

Measurement and execution of Framework/EFI, BIOS, Option ROM, IPL, etc.

Static OS

Firmware use of TPM and Measurements

\(^1\) Static Root of Trust for Management (SRTM)
What is CRTM
- Core root of trust for measurement
- Detects physical presence and initiates measurements for rest of firmware bootstrap

Properties of CRTM
- Immutable, or never changed in the field
- Appropriate cryptographic techniques need to be employed in order to update the CRTM.

For updatable CRTM
- A signed capsule is one implementation path.
- Need manufacturer-approved/secure update process

CRTM is the firmware foundation of trust
UEFI/PI Architecture Boot Flow – Create/Evaluate Integrity List

Measure Into PCR’s

Measure & Create
Measured items in UEFI

Operating system:
- PCR8

EFI OS loader:
- PCR4

EFI boot services:
- PCR0
- Boot Devices
- Protocols + Handlers
- Drivers in System Board Flash

Platform firmware from system board ROM:
- PCR1

Platform hardware:
- PCR5
- EFI System partition
- OS partition
- GPT / partition table

Standardized way to measure and report
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BitLocker™ Drive Encryption
Static Root of Trust Measurement of early boot components

UEFI Firmware
- TPM Init
- EFI Core
- EFI Extensions

Static PreOS
- Boot manager

All Boot Blobs Unlocked
- OS loader
- Start OS

Volume Blob of Target OS unlocked

UEFI Windows* is using SRTM
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Platform Security

IBM System x Servers

- Comprehensive System x portfolio Transition to UEFI based firmware
  - UEFI 2.1 PI 1.0 specification compliant
  - Improved management and configuration capabilities
  - Advanced “Touchless” Compatibility Support Module (CSM)
- Trusted Platform features: TPM enablement, TCG and Core Root of Trust for Measurement support

Blade
- HS22

Rack-mount
- x3650 M2
- x3550 M2
- X3250 M3

Tower
- x3500 M2
- x3400 M2
- x3200 M3
Best Practices on Building Security Features using PI-based Technology

Vincent Zimmer
Principal Engineer, Intel
Background on Best Practices

• Many of these prescriptions covered below are already treated in various TCG documents and design guides.
• The intent of this section is to provide a platform and UEFI PI-focused summary of rules and practices.
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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

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**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
Overall View of Boot Time Line

Power on [ . . Platform initialization . . ] [ . . . . OS boot . . . . ] Shutdown

OEM/PM Extensible

3rd party extensible
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UEFI PI Best Practices

- HW 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
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Futures - UEFI

Driving Signing

- Expands the types of signatures recognized by UEFI
  - SHA-1, SHA-256, RSA2048/SHA-1, RSA2048/SHA-256 & Authenticode
- Standard method for configuring the “known-good” and “known-bad” signature databases.
- Provides standard behavior when execution is denied to provide policy-based updates to the lists.

EFI IPsec Impl (Pre-deployed SA)

- Shell environment
  - Add an SPD entry (for TRAFFIC1, Manual SA)
  - Add required manual SA for this SPD entry
- Call SetData()
- Update SPD/SAD DB
- By child
- Find SA, and Encapsulate AH/ESP header per SA info
- Outbound packet
- Inbound packet
- Find SA, and process AH/ESP header

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 Security continues to evolve
Trust Models: S-RTM & D-RTM

- S-RTM measurement chain starts at reset and includes components from various sources
- D-RTM measurement chain starts with a trusted secure event trigger such as SINIT. D-RTM leads to a smaller TCB, reduced attack surface and thus a more secure system
- MLE provider must make assurances that the MLE maintains the TCB. Smaller TCB simplifies MLE design.

Firmware & Hardware security evolution
Summary

• Security problems in the industry are real
• Trust and a security architecture can address some needs, esp h/w and f/w
• UEFI f/w and TCG hardware for SRTM, BitLocker usage, IBM platforms
• Follow best practices on implementing hardware and firmware
• UEFI and hardware security evolution
Call to action- Security Requirements

• Use the TPM
• Follow best practices on hardware and firmware
• Get involved in UEFI and TCG forums
• Get the white paper
  - [http://download.intel.com/technology/efi/docs/pdfs/SF09_EFIS001_UEFI_PI_TCG_White_Paper.pdf](http://download.intel.com/technology/efi/docs/pdfs/SF09_EFIS001_UEFI_PI_TCG_White_Paper.pdf)
Additional resources on UEFI:

- Other Technical and UEFI Sessions – Next slide
- Visit UEFI Booth #136
- More web based info:
  - Specifications and Implementation sites:
# IDF 2009 UEFI & Other Security Sessions

## ECT# Company Description Time RM D

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