Building A UEFI Security Test Strategy

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insyde®

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Agenda

- Introduction
- Why Security Testing?
- Areas to test
- Available Test Sources
- Next Steps
- Q & A

Introduction

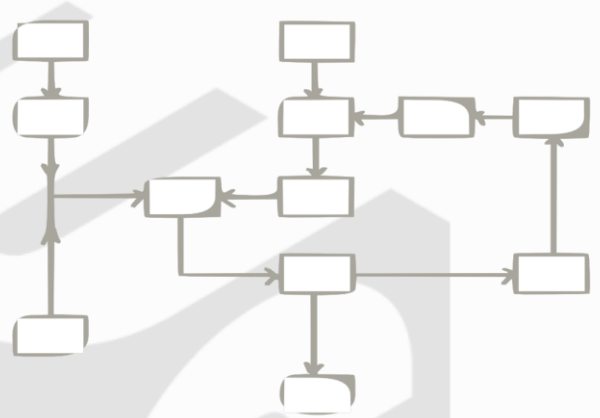
UEFI is everywhere

- Tablets, PCs, Servers, Industrial Controllers
- Booting in UEFI Mode
- UEFI Secure Boot since 2.3.1c and Windows 8.0
    - Trying to protect the layers before the OSs
- UEFI interfaces are exposed, no BIOS hiding in the CSM

Security Researchers

- UEFI provides well defined interfaces to the OSs
- All Modern Windows 8 systems have common UEFI specs
- Security Researchers have a good starting point at TianoCore.ORG

Why Security Testing?



Systems are very complex

A single bit in a register can allow attacks

- If BIOS_Control bit 0 = 1, BIOS is writable
- If BIOS is writable, a hacker can insert code
- If the hacker is skilled, the code can do anything

This example can turn a system into a Brick!

OEM Warranty issue!

Areas to Test

Interfaces to the OS

Network interfaces

Interfaces to SMM / security co-processors

External port interfaces

- Keyboards!, Mice!, USB ports, PCIe slots

ROM storage device registers

SMI Protection Control registers

Device update is critical

Some testing after machine is ready to ship

Available Test Sources

Silicon Vendors

- Open source tools
- NDA / Confidential tools

MITRE's Copernicus

BIOS Vendor tests

Hacking Tools

Intel Tools

Intel CHIPSEC tool – (github.com/chipsec/chipsec)

- Open source "engine"
- Open source test scripts
- NDA Test scripts

Intel SelfTest (NDA)

Intel BITS - (downloadcenter.intel.com/Detail_Desc.aspx?DwnldID=19763)

Most Intel tools identify Failures !!

CHIPSEC

A framework for analyzing security of PC platforms including hardware, system firmware and platform component configuration.

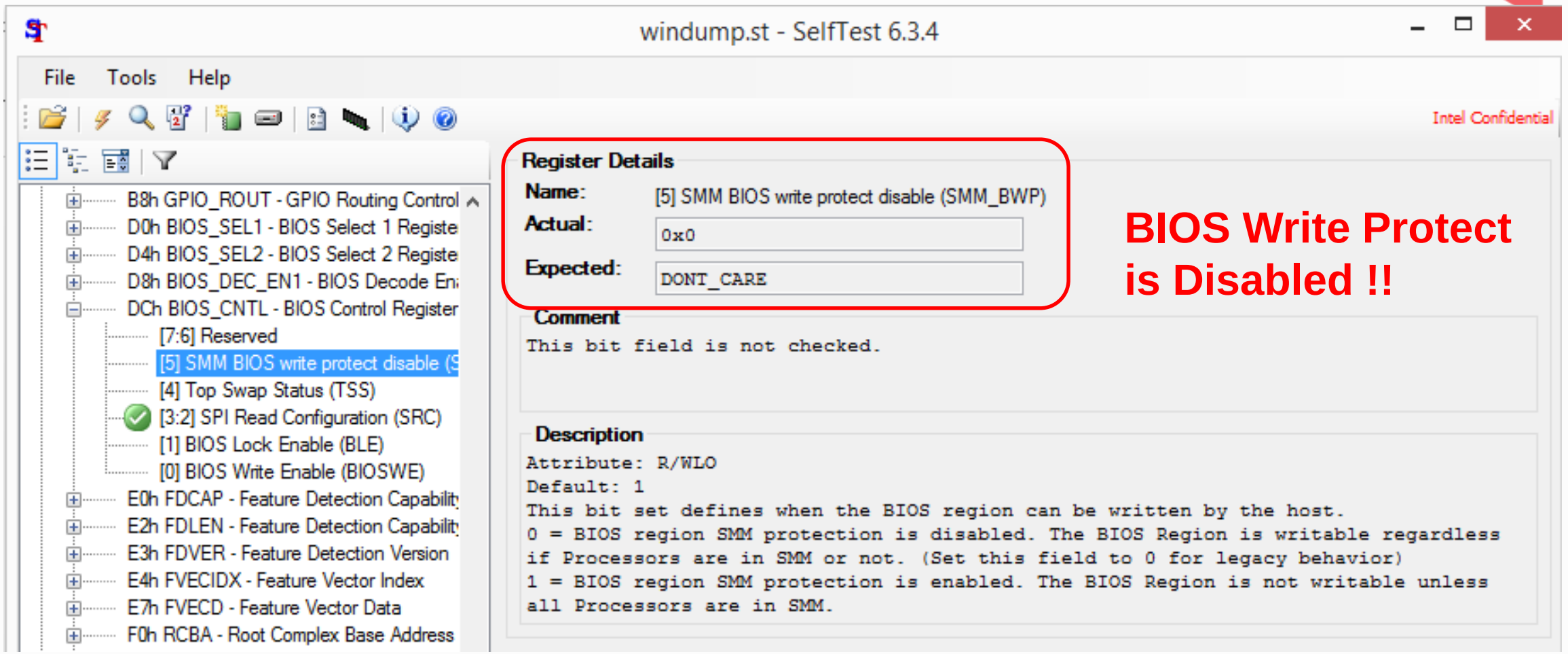
Allows creating security test suites, security assessment tools for low level components and interfaces.

```
[x][ ================================================================
[x][ Module: SMI Events Configuration
[x][ ================================================================
[-] SMM BIOS region write protection has not been enabled (SMM_BWP is not used)

[*] PMBASE (ACPI I/O Base) = 0x0400
[*] SMI_EN (SMI Control and Enable) register [I/O port 0x430] = 0x00022033
    [13] TCO_EN (TCO Enable)             = 1
    [00] GBL_SMI_EN (Global SMI Enable) = 1
[+] All required SMI events are enabled
[*] TCOBASE (TCO I/O Base) = 0x0460
[*] TCO1_CNT (TCO1 Control) register [I/O port 0x468] = 0x0A00
    [12] TCO_LOCK = 0
[-] TCO SMI event configuration is not locked. TCO SMI events can be disabled
[*] GEN_PMCON_1 (General PM Config 1) register [BDF 0:31:0 + 0xA0] = 0x0E18
    [04] SMI_LOCK = 1
[+] SMI events global configuration is locked
[-] FAILED: Not all required SMI sources are enabled and locked!
```

BIOS Region Write Protection not enabled !!

Intel's SelfTest



MITRE's Copernicus

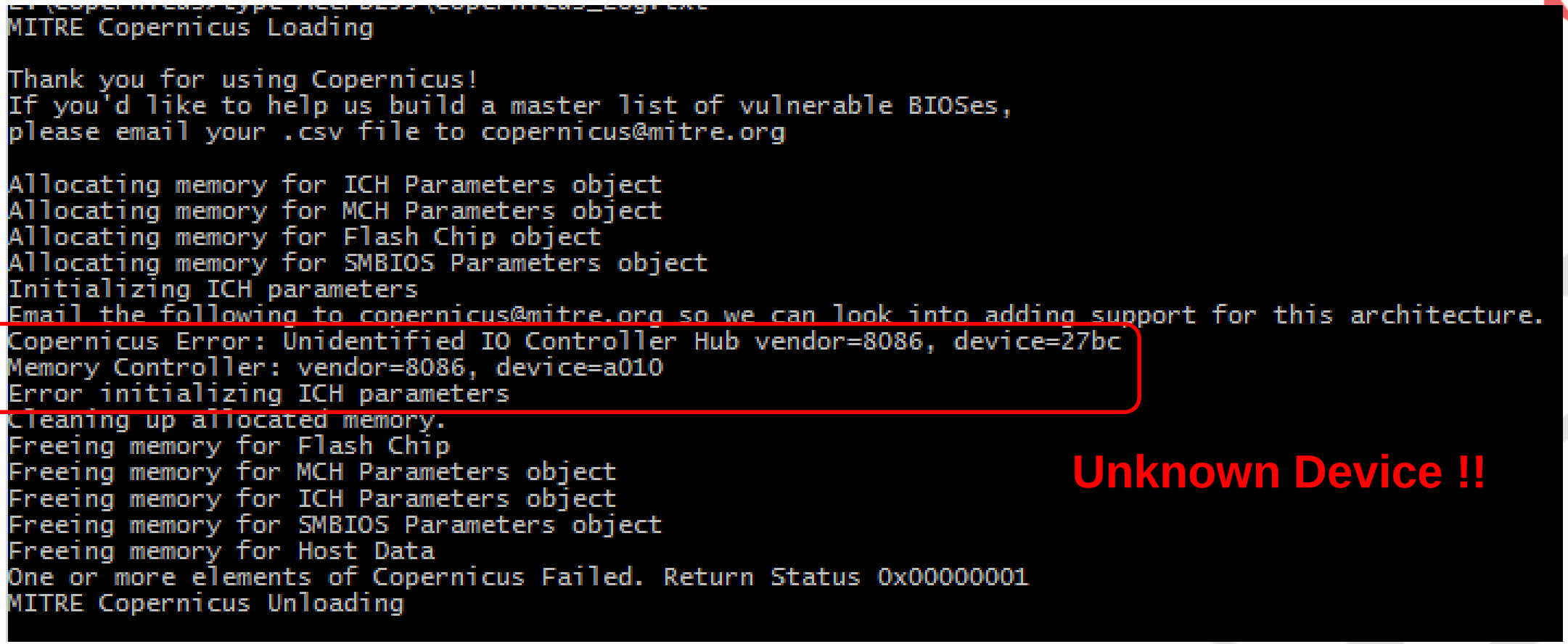
"[The BIOS] is a great place to persist indefinitely without fear of detection" – MITRE *Copernicus_July-2013.pptx*

BIOS Access Control checking

- Run collection tool
- Run Python analysis tools
- Review results

Failures are not identified !!

MITRE's Copernicus Log – limited chipsets



Unknown Device !!

MITRE's Copernicus – Error?

```
E:\Copernicus>c:python protections.py per-version -id -o output.csv StrawberryMountain
COUNT BIOS_VENDOR PRODUCT_NAME BIOS_VERSION SMRAM_UNLOCKED BIOS_UNLOCKED
1                                           0              1

1 CSV files successfully processed
0 out of 1 (0.0%) unlocked SMRAM
1 out of 1 (100.0%) unlocked BIOS
0 out of 1 (0.0%) SMI_LOCK not set
1 out of 1 (100.0%) PR write protection used
0 out of 1 (0.0%) SMM_BWP used when supported
0 out of 1 (0.0%) vulnerable to CERT VU#255726
0 out of 1 (0.0%) vulnerable to CERT VU#912156
0 out of 1 (0.0%) vulnerable to CERT VU#552286
```

Failing BIOS - Unlocked !!
YES it is a failure !!

Some of Insyde's test tools

Private Interface Tester

- Tests SMI input parameters – buffers
- InsydeSecurityTestToolX64.efi
- InsydeSecurityTestToolIA32.efi

Insyde Toolbox - H2OITB

- Around 20 separate tests
- Variables, CMOS, variable reclaim testing

** in development

Private Interface Tester

```
Insyde Security Test Tool V1.0
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Reserved.

Function 54h test....[Pass]
Function 55h test....[Pass]
Function 56h test....[Pass]
Function 57h test....[Pass]
Function 58h test....[Pass]
Function 59h test....[Pass]
Function 5Ah test....[Pass]
Function 5Bh test....[Failed]
```

The range of input buffer memory can overlap SMRAM.

Insyde Toolbox examples

- **Variable reclaimation check [count]**
  If variable size is not full, continue to write variables to cause reclaim on next boot

- **Variable rebuild check [count]**
  Erase all variables and FV header with fill data 0xFF or 0x00

- **Variable boundary check [count]**
  Write variables and try to overfill the space
  Write variables and try to exactly fill the space

- **Variable usage [count]**
  Check available space to check if BIOS updated any variables

- **Dump Variables to a file**

- **Perform malicious change to variables**

- **Partially erase variables**

Hacker tools

UEFITool - UEFI firmware image viewer and editor
https://github.com/LongSoft/UEFITool

Universal-IFR-Extractor - extract IFR from UEFI modules
https://github.com/donovan6000/Universal-IFR-Extractor

HxD - Hex Editor and Disk Editor
http://mh-nexus.de/en/hxd/

Binwalk - Firmware Analysis Tool
https://github.com/devttys0/binwalk

Search for signatures inside binary files
http://freecode.com/projects/signsrch

firmware-mod-kit - tools for easy deconstruction and reconstruction of firmware images
https://code.google.com/p/firmware-mod-kit/

Next Steps

Decide how much testing is required

Test in multiple project phases

- Design phase = What will you test?
- Development phase = Is everything ready to lock down?
- Manufacturing phase = Is the system ready to ship?

Don't ship with back doors! Perform final locks!

Expect future attacks, prepare for field updates

Contact Kevin Davis or Alan Lo for demos

Insyde Suites #902 & #904

Building A UEFI Security Test Strategy

Demo

More reading …

- Intel CHIPSEC
  https://github.com/chipsec/chipsec
- MITRE Copernicus tool
  http://www.mitre.org/capabilities/cybersecurity/overview/cybersecurity-blog/copernicus-question-your-assumptions-about
- Signed BIOS Attack
  http://www.ekoparty.org/archive/2013/charlas/Kallenberg/DefeatingSignedBios-EkoParty_2013_v1.pptx
- BIOS Attack Summary
  https://www.defcon.org/images/defcon-22/dc-22-presentations/Bulygin-Bazhaniul-Furtak-Loucaides/DEFCON-22-Bulygin-Bazhaniul-Furtak-Loucaides-Summary-of-attacks-against-BIOS-UPDATED.pdf
- NIST BIOS Protection Guidelines (SP 800-147 and SP 800-147B)
  http://csrc.nist.gov/publications/nistpubs/800-147/NIST-SP800-147-April2011.pdf
  http://csrc.nist.gov/publications/drafts/800-147b/draft-sp800-147b_july2012.pdf
- IAD BIOS Update Protection Profile
  https://www.niap-ccevs.org/pp/pp_bios_v1.0.pdf
- Windows Hardware Certification Requirements
  http://download.microsoft.com/download/A/D/F/ADF5BEDE-C0FB-4CC0-A3E1-B38093F50BA1/windows8-hardware-cert-requirements-system.pdf
- UEFI Forum sub-teams: USST (UEFI Security) and PSST (PI Security)

For more information on the Unified EFI Forum and UEFI Specifications, visit http://www.uefi.org

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