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Risks to UEFI firmware:
Due to growing attack surfaces

Spring 2019 UEFI Seminar and Plugfest

April 8th - 12th, 2019

Presented by Dick Wilkins (Phoenix Technologies Ltd.)

Legal Stuff

Agenda

- Firmware is a target
- Spec extensions provide new attack surfaces
- OEM features add even more
- Examples of risky implementations
- Mitigation recommendations
- Suggestions for working groups
- Questions?

Firmware as a target

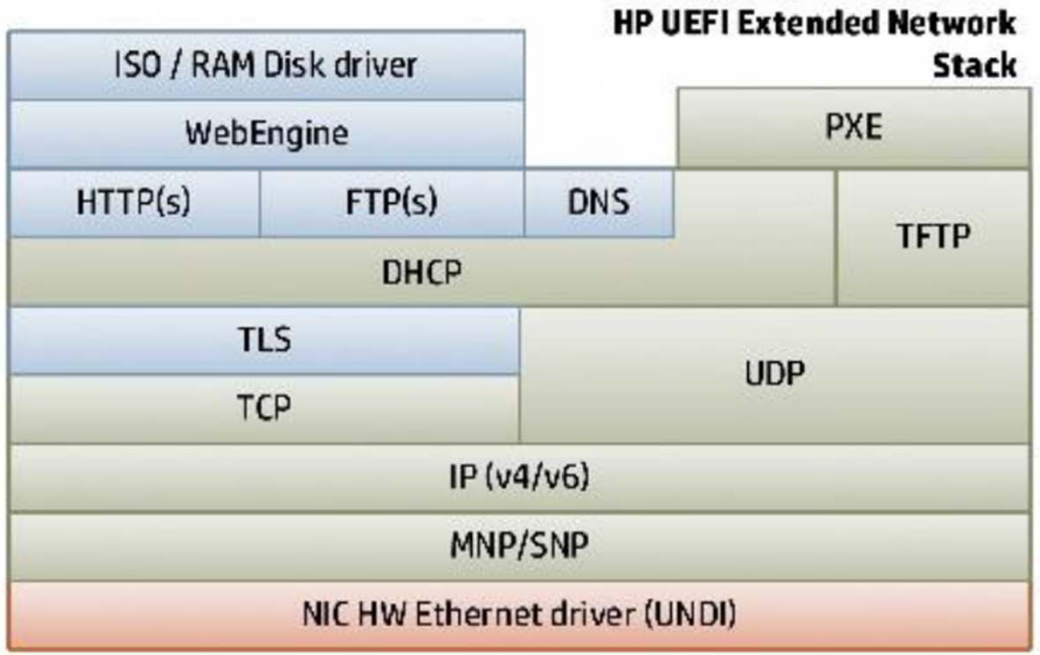
- As OSes and apps are hardened, the bad actors move to platform firmware
- If firmware is compromised, nothing that runs later is safe
  - Malware can spoof an OS, Virtual Machines, Anti-virus, etc. Any code that runs later
  - It can be persistent, runs boot after boot
  - Wiping the system and reinstalling software may not clear it

UEFI features add attack surfaces

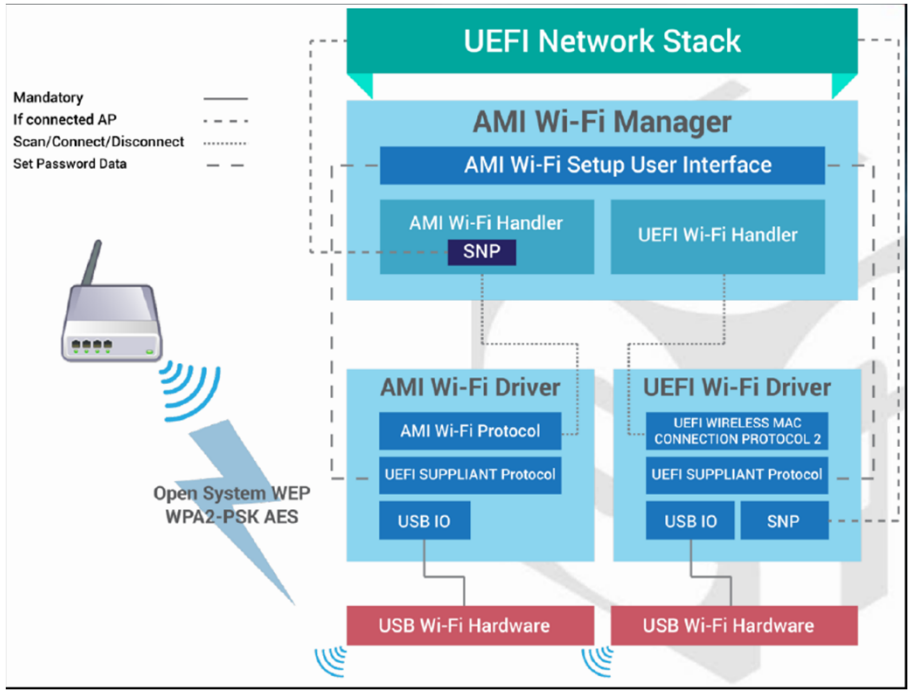
- In the past several years, UEFI Forum has added network support to the spec
  - SNP, PXE, BIS, HTTP(S) Boot, TCP/IP, UDP, IPSec, FTP, TLS, ARP, DHCP, MTFTP
  - Users have also added SNMP and others
- Some have added NTFS filesystem support to firmware

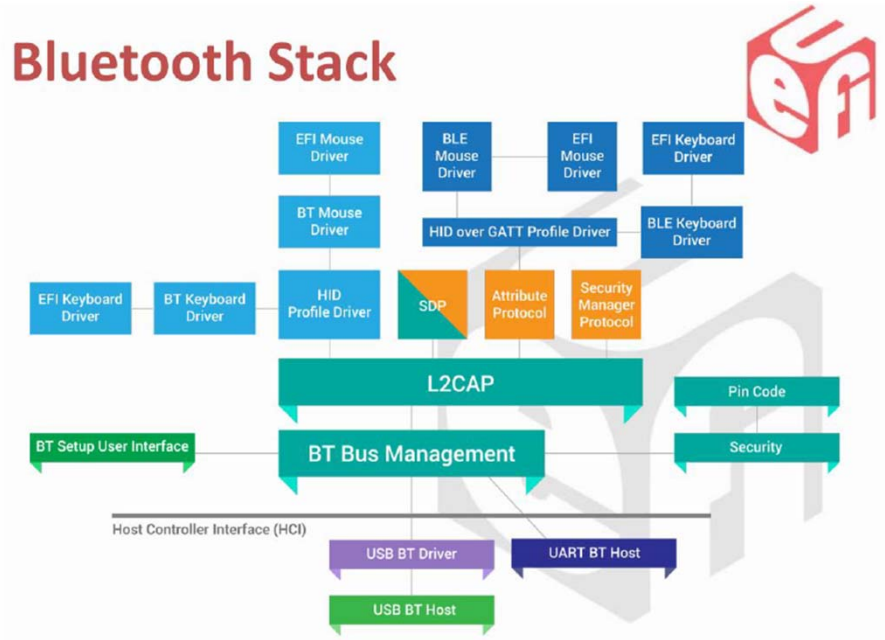
An example

HP UEFI extended Network Stack



More examples





Why are these features necessary?

- While not fundamentally needed to "boot the box", they enable:
  - Remote management
  - Network boot
  - Failure recovery
  - Other value-add features

So, what are the risks?

- Eclypsium Inc. (https://www.eclypsium.com/) has delivered Blackhat/Defcon presentations on the dangers of these attack surfaces
- Network connectivity allows for exploits that don't require physical access to a system
- These examples have been presented in public so the "bad actors" out there are aware of them
  - Many implementations have lots of ports open
  - Some are known to be vulnerable to attack
  - Are they really needed?

Remote management

- Many server type systems have allowed for a remote management interface in the pre-boot environment
- This approach to remote management is moving outside the server space
- This may be via a BMC and private network or other mechanism
- This management interface is particularly dangerous as it allows low-level control of:
  - Loading firmware, UEFI drivers, OSes, device drivers, etc.
  - Software/firmware (mis)configuration for evil or denial of service
  - Remote management may not be visible to end users and may happen when the system appears to be off
- Many ports are open for remote management
  - Are they really needed?

BMCs are particularly vulnerable

- Some BMCs have been shown to be very insecure
  - The IPMI protocol specification has known vulnerabilities (https://www.us-cert.gov/ncas/alerts/TA13-207A)
  - Vulnerabilities that may allow unauthorized and persistent remote access
- They depend on being on a private, air-gapped, network for access security
- It is common for them to use older processor designs and ancient software
- They do not securely boot themselves
- Their firmware is rarely updated
- They can be used by a malevolent host OS/app to compromise the private management network
  - Ref: Blackhat presentation: The Incredible Lightness of BMCs
  - https://blog.rapid7.com/2013/07/02/a-penetration-testers-guide-to-ipmi/

SMTP & NTFS at boot time

- The Eclypsium folks displayed a motherboard with a UI to send email in the pre-boot and support for NTFS
- This was in support of the OEM's customer services
- With this capability built in, malicious pre-boot software could attach any file to an email and send it during pre-boot without the OS knowing

Another customer service example

- Another OEM provided an interface to download an EFI app over a network for “hardware diagnostics”
- That app could be run without signature checks, bypassing the secure-boot Chain of Trust
- The EFI app can upload results to a customer provided URL
- It can be set to run once or periodically
- Either the download or upload URL could be “spoofed” to transfer anything

Mitigations

- Make sure your company is following best practices in code development
  - Do targeted code reviews
  - Don't "roll your own" when there is a quality and tested implementation available
  - See earlier Phoenix plugfest presentations for more examples of best practices

Hardware/compiler assisted

- Enable
  - NX data execution protection
  - Stack cookies (stack overrun detection)
  - Heap corruption detection
  - Address space layout randomization

Firmware update

- We, in the UEFI forum, have been discussing the need to update platform firmware regularly
- It is important that OEMs have a path to get security fixes into platforms ASAP
- We cannot wait for end users to download updates
- So lets do it automatically over a network. What could go wrong?

Pull updates

- Multiple vendors have added pre-boot code to get updates
- They can go to default OEM URLs for updates or can be customized
- Many can be customized for check frequency
- They typically exchange XML (or similar) messages containing update availability data

What's wrong with that?

- URLs can be spoofed or replaced
- Any issues with update signature checking can be exploited
- Insecure messages can be altered or replaced directing downloads from anywhere
- Actual testing has shown malformed messages cause firmware hangs (denial of service)
- OEMs have been forced to disable this functionality in hundreds of SKUs (thousands of systems)

An example

- Just two weeks ago the “Motherboard” publication put out an article…

“Hackers Hijacked ASUS Software Updates to Install Backdoors on Thousands of Computers”

> “The Taiwan-based tech giant ASUS is believed to have pushed the malware to hundreds of thousands of customers through its trusted automatic software update tool after attackers compromised the company’s server…”

https://motherboard.vice.com/en_us/article/pan9wn/hackers-hijacked-asus-software-updates-to-install-backdoors-on-thousands-of-computers

Solutions for firmware update

- The UEFI Forum needs to have some serious discussions around how firmware update gets done
- Leaving OEMs on their own with no direction has resulted in some poor and insecure implementations
- Insecure implementations are not good for the community and UEFI reputation
- What do we do?
  - Does the forum specify (direct) an approach?
  - Do we provide example implementation(s) via Tianocore?
  - Do we provide whitepapers that provide clear guidance for secure implementations?
- Phoenix believes the forum should take the lead in helping the membership get this right

Questions?

- Any questions?

Thanks for attending the Spring 2019
UEFI Seminar and Plugfest

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

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