Flash Memory Summit

ECU_102B_1_ Building Security into Your System : Protecting the Platform through Measurement and Attestation

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Abstract

Securing the operational state of components has become an ever increasing topic among the industry. Much of the industry has secured the platforms upon which they operate but the sub components have become the next bastion of enforcing a security model. In this talk, we will cover the attack vectors and counter measures to head off the vulnerabilities in embedded firmware that previously appeared safe. We will discuss recent events, industry initiatives, the notion of trusted firmware and what users should look for in a secure device.

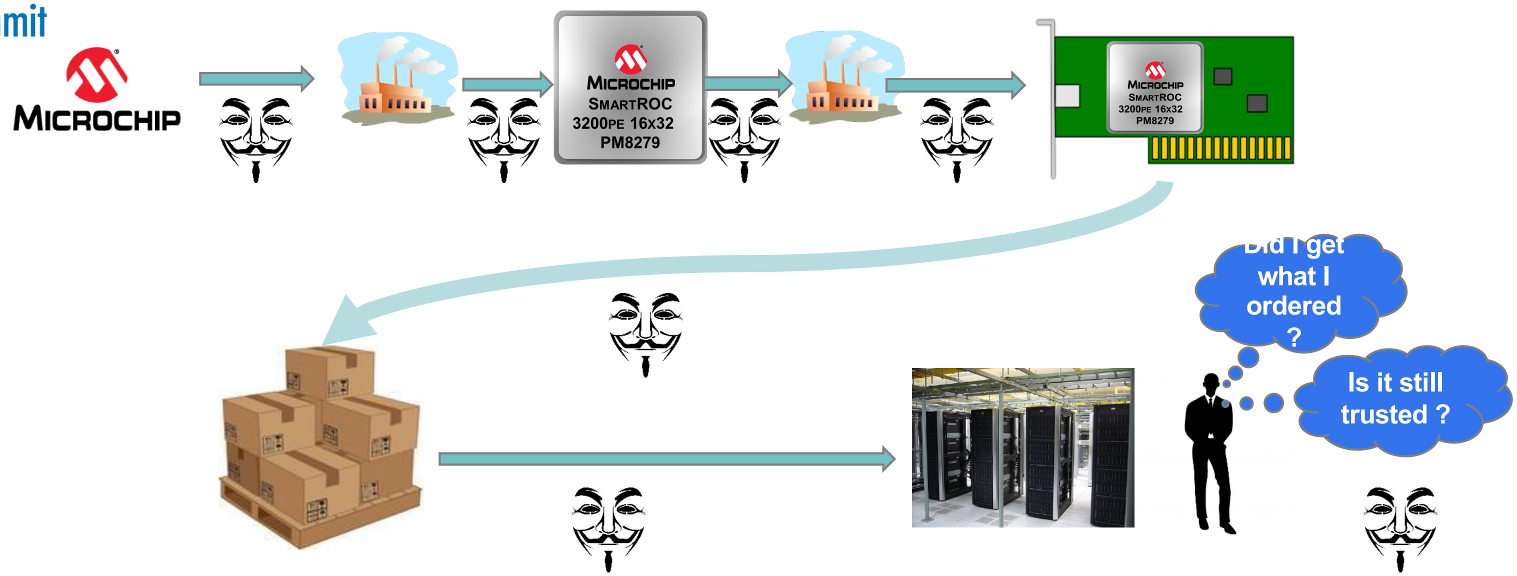
Learning Objectives:

1. Understanding the security landscape and what has ultimately changed in the industry
2. Threat modeling for the new age of protection
3. Understanding how secure trusted firmware translates into solution requirements and product guarantees
4. Learn what attestation measurements are and how they translate into proving to the platform what firmware is actually running

Agenda

- Threat model
- Secure boot for everyone
- Attestation, what happens after Secure Boot
- Reporting via DMTF PCMI Security Protocol

Trusted Platforms - Why the need?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MICROCHIP SMARTROC 3200PE 16x32 PM8279
MICROCHIP SMARTROC 3200PE 16x32 PM8279
Did I get what I ordered ?
Is it still trusted ?

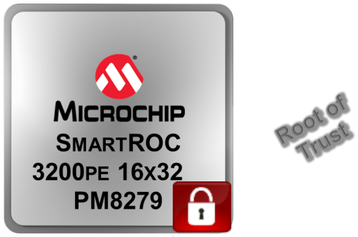
- Various Points of entry
- Where has the product been ?
- Is it really the expected product?
- Was it intercepted in flight ?

- Is it running altered firmware / hardware ?
- Does it contain the intended components ?
- Will it stay that way ?
- Is the product genuine ?

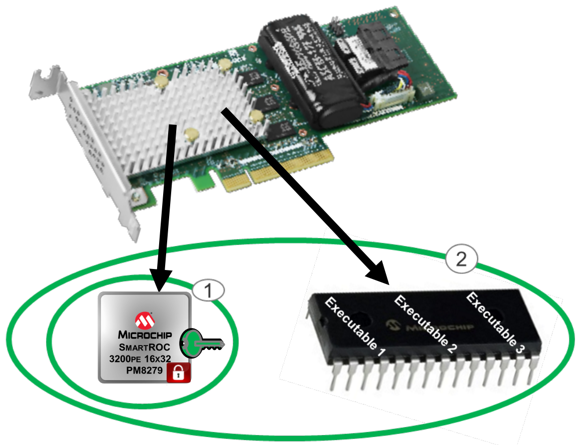
Security Threats Along the Way of Manufacturing & Deploying

What is Secure Boot?

- **Silicon HW Root of Trust**
- Security begins with the Root of Trust contained in the ASIC
  - Embedded Signing Keys
  - Strong Hashing Functions
  - Immutable Authenticating Boot logic in Silicon Boot ROM



- **Board Components enablement and Security**
  - Trust is extended by verifying the authenticity and integrity of FLASH content prior to executing it
  - Digital signatures are supplied with all Firmware and Configuration Binaries
  - Validated with Embedded ASIC signing keys
  - ASIC Calculated Signatures are computed against the stored images and compared with stored signatures.



Embedded
Root Of Trust
In Hardware

Extending Trust to
include All FLASH
Binaries (Blobs)

What is Attestation?

- On demand evidence that the *product* is configured and performing the function intended
- Usually report through a non-mutable mechanism but can be reported by trusted firmware
- A series of measurements taken during boot that reports HW / FW states of a device like a TPM using TCG Dice and Microsoft RIOT methodologies
- Can be used to detect old versions, new versions or rogue versions of FW
- Can also be used to detect the hardware state and authenticity of the part
- May be implemented as a reset of the HW for new measurements or a isolated security processor
- Platform Roots of Trust use attestation to continually monitor and validate system components

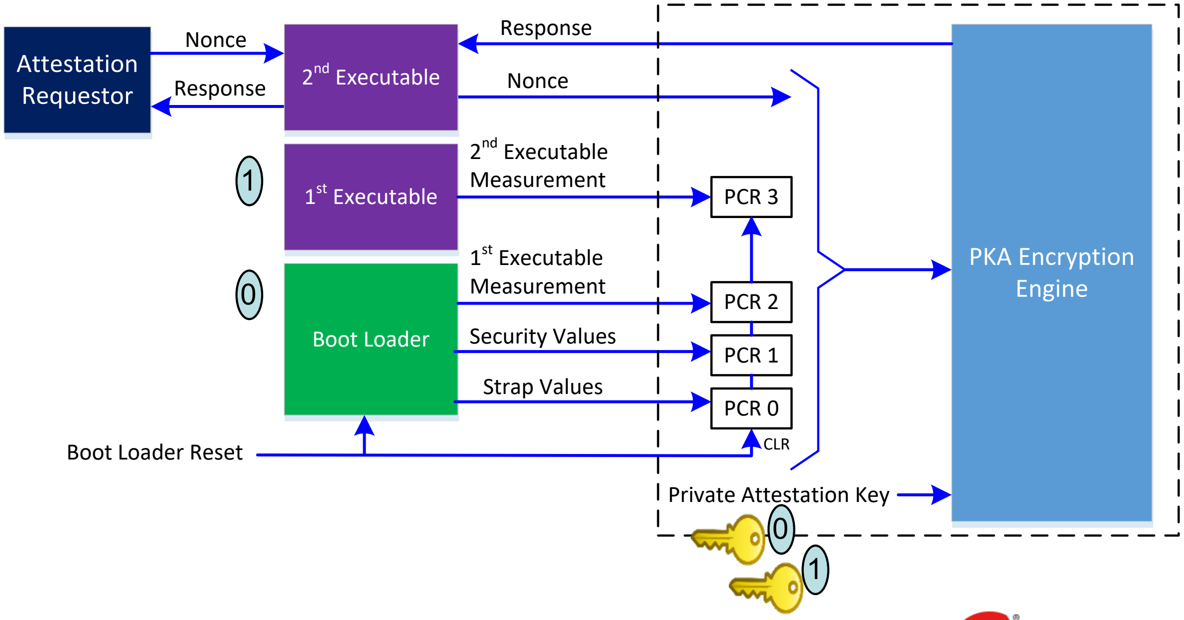
Attestation : Example Flow

Public Attestation Keys

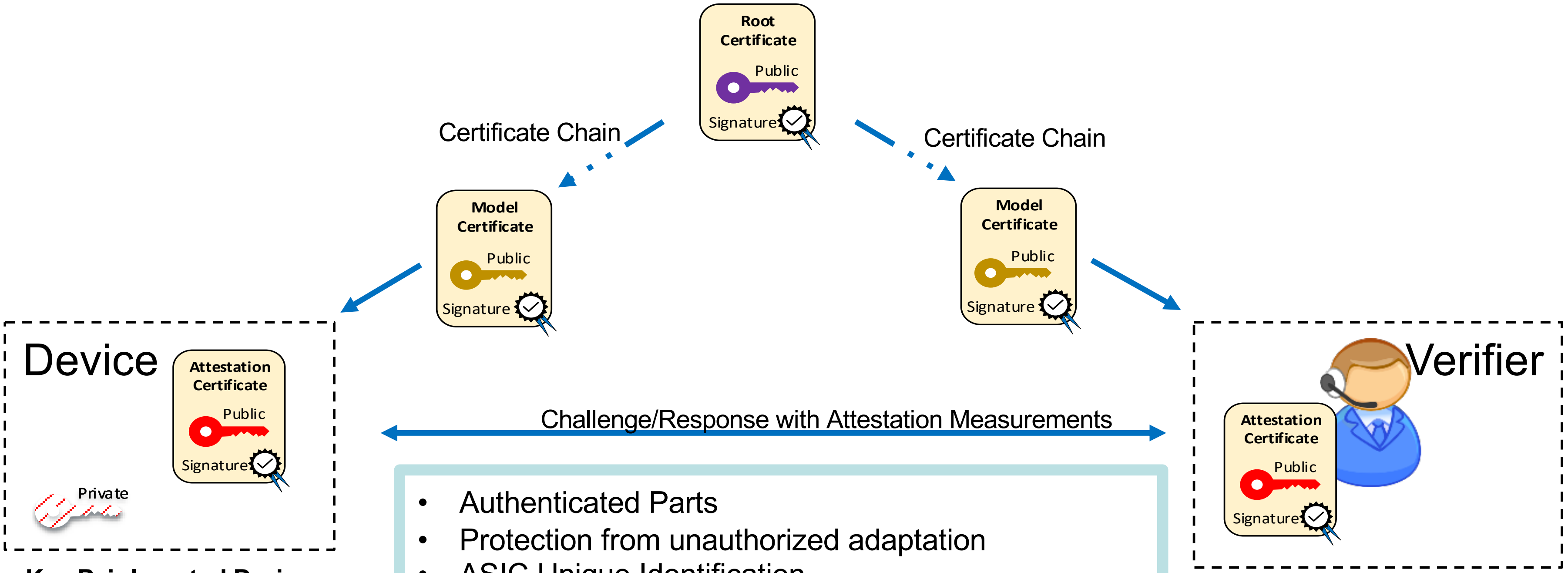
Response

Passes Measurement Valid State

Fails Measurement Take Countermeasures



Manufacturing Identification and Authorization

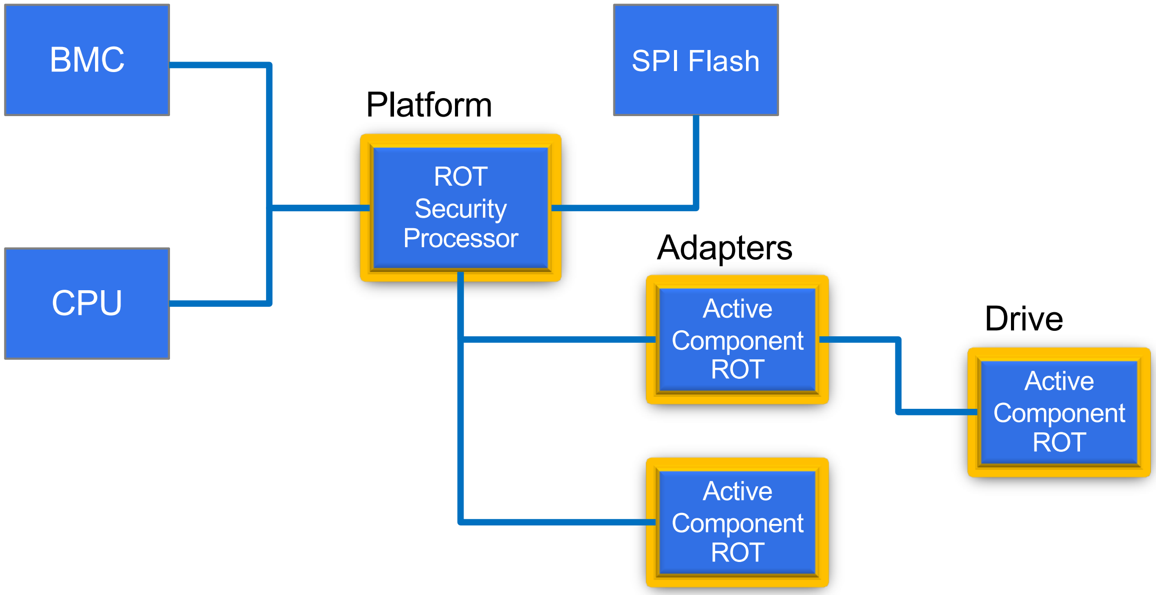


- Authenticated Parts
- Protection from unauthorized adaptation
- ASIC Unique Identification
- ASIC Authorization / Registration to HSM
- Customer Customization with Public Key injection

Key Pair Inserted During Manufacturing

Device Authenticity Verified At Deployment

Who Measures : System of Trust



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Trusted Security Processor with Singular Function for Maintaining Trust

Measurement Reporting via PMCI MCTP

- DMTF is working on a protocol to first authenticate and then exchange a measurement from the components in a system in support of Attestation (RIOT)
- MCTP supports multiple attachment mechanisms (VDM and I2C by example).
- The protocol will allow for the endpoints to negotiate the supported algorithms, security protocol, and bit strengths
- The exchange protocol has reached WIP release state and is ready for feedback

https://www.dmtf.org/content/get-involved-dmtfs-pmci-security-task-force

https://www.dmtf.org/content/pmci-security-architecture-wip-04-03-2019

https://www.dmtf.org/sites/default/files/standards/documents/DSP0274_0.9.0a.pdf

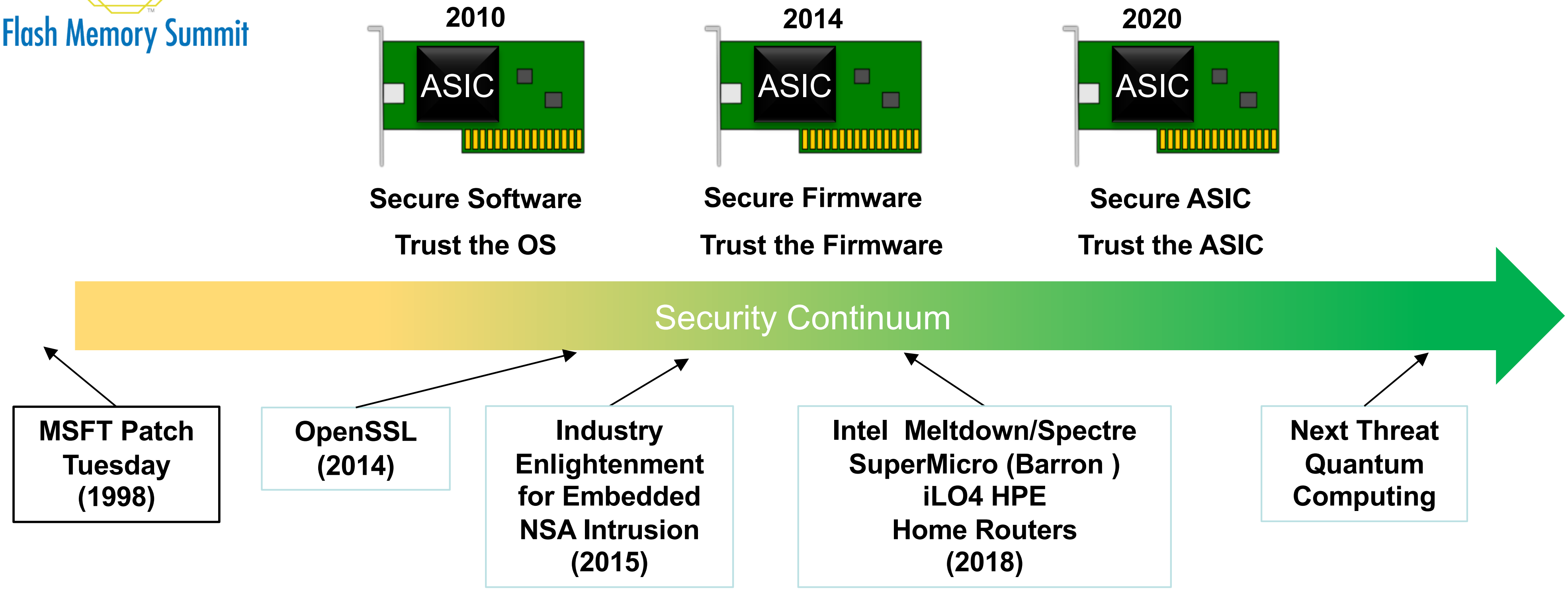
https://www.dmtf.org/sites/default/files/standards/documents/DSP0275_0.9.0a.pdf

Security of Platforms

- Grounded in signed secured firmware validated by unchangeable hardware
- Measured and reported by trusted firmware with unique measurements
- Aggregated in the platform by a discrete component providing coordinated measurement and actions to protect the platform from misuse or attack.
- Microchip provides both embedded security in its ASICs and platforms roots of trust to enable a secure platform.

Thank You

Security is Journey



2010

Secure Software

Trust the OS

2014

Secure Firmware

Trust the Firmware

2020

Secure ASIC

Trust the ASIC

MSFT Patch Tuesday (1998)

OpenSSL (2014)

Industry Enlightenment for Embedded NSA Intrusion (2015)

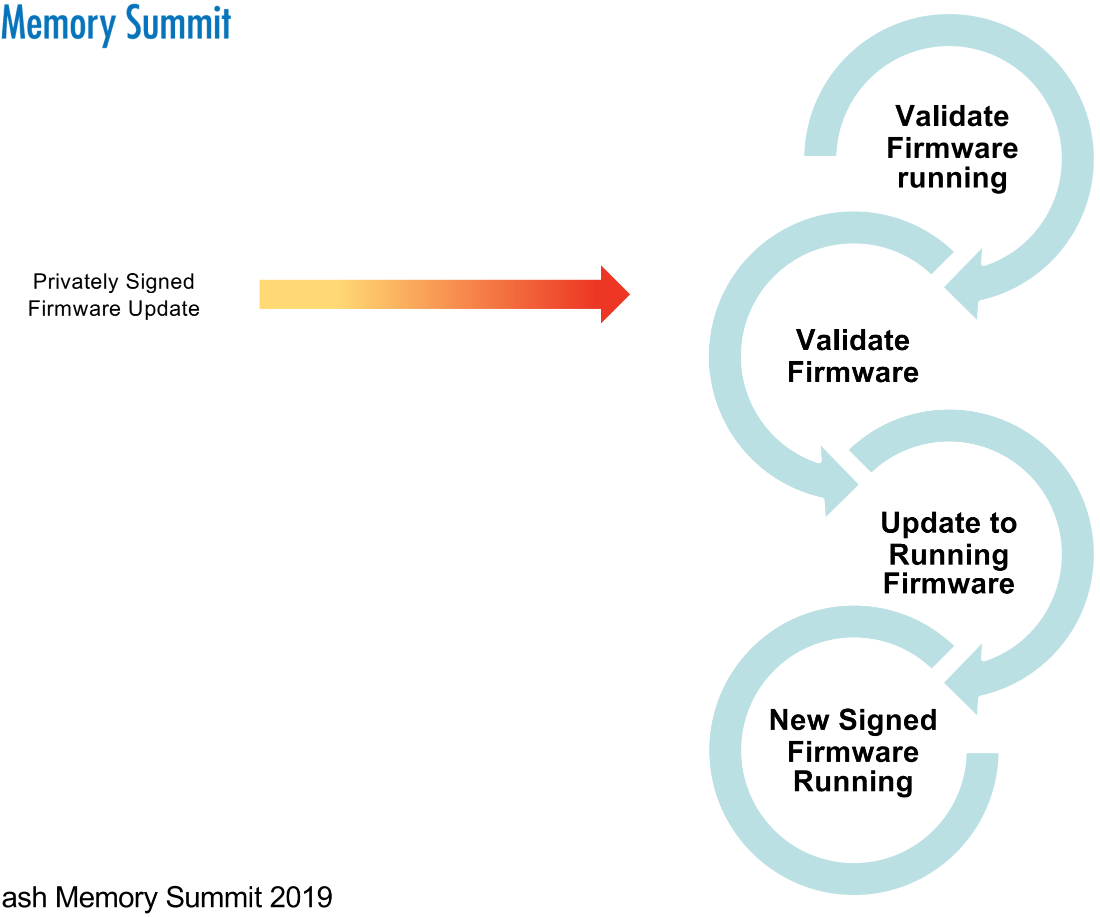
Intel Meltdown/Spectre
SuperMicro (Barron)
iLO4 HPE
Home Routers
(2018)

Next Threat Quantum Computing

Security for Server Components is Becoming Real

https://www.us-cert.gov/ncas/alerts/2018

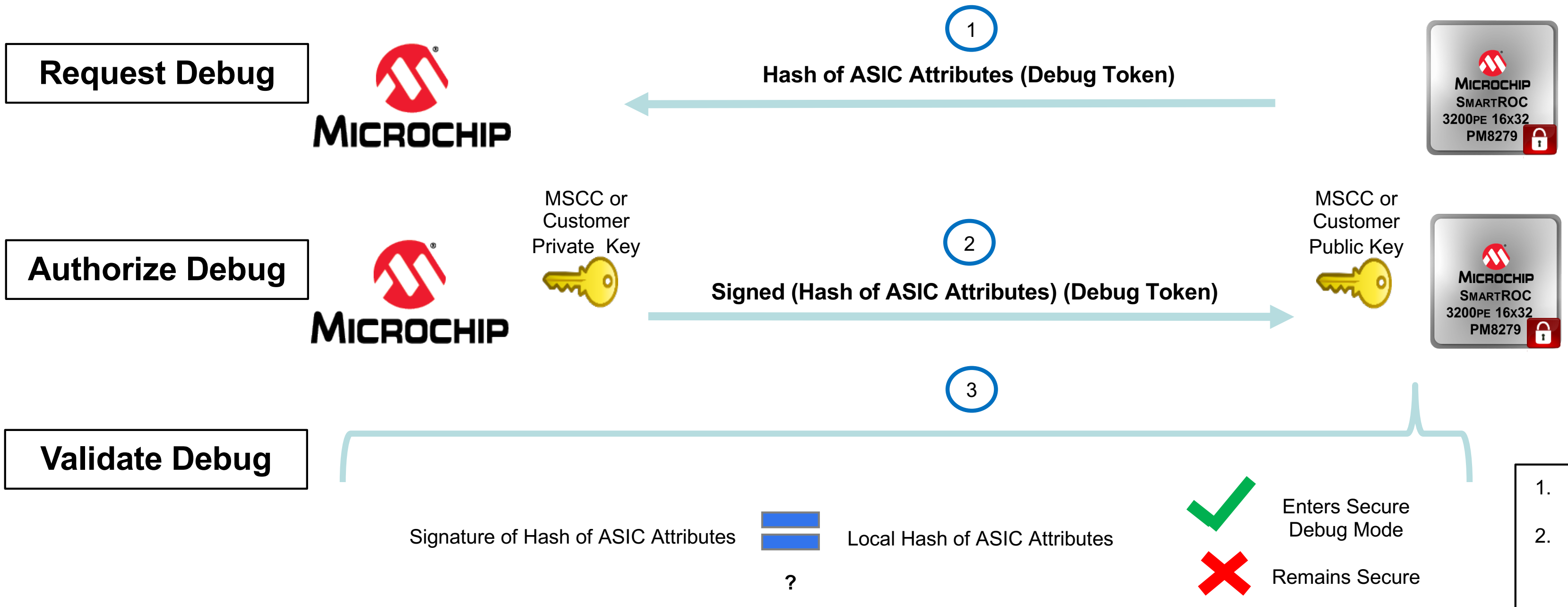
What is Secure FW Update?
Signed MSCC FW Validates Incoming FW Before Update


Privately Signed
Firmware Update
Validate Firmware running
Validate Firmware
Update to Running Firmware
New Signed Firmware Running

Secure Update

1. Adapter ships with signed MSCC FW or signed FW from the solution provider
2. Running Validated Firmware validates incoming images that have been signed by the vendor private key
3. Running Firmware updates the firmware in persistent storage
4. ASIC is reset again to validated new firmware.
5. New Firmware is up and running

What is Secure Debug Mode?



Request Debug

1

Hash of ASIC Attributes (Debug Token)

Authorize Debug

MSCC or Customer Private Key

2

Signed (Hash of ASIC Attributes) (Debug Token)

MSCC or Customer Public Key

Validate Debug

3

Signature of Hash of ASIC Attributes = Local Hash of ASIC Attributes

?

✓ Enters Secure Debug Mode

✗ Remains Secure

1. Unlocks Debug Ports
2. Accepts :
   - Signed Part specific images
   - Signed Production images which forces exiting of Secure Debug Mode.