Unifying Confidential Attestation

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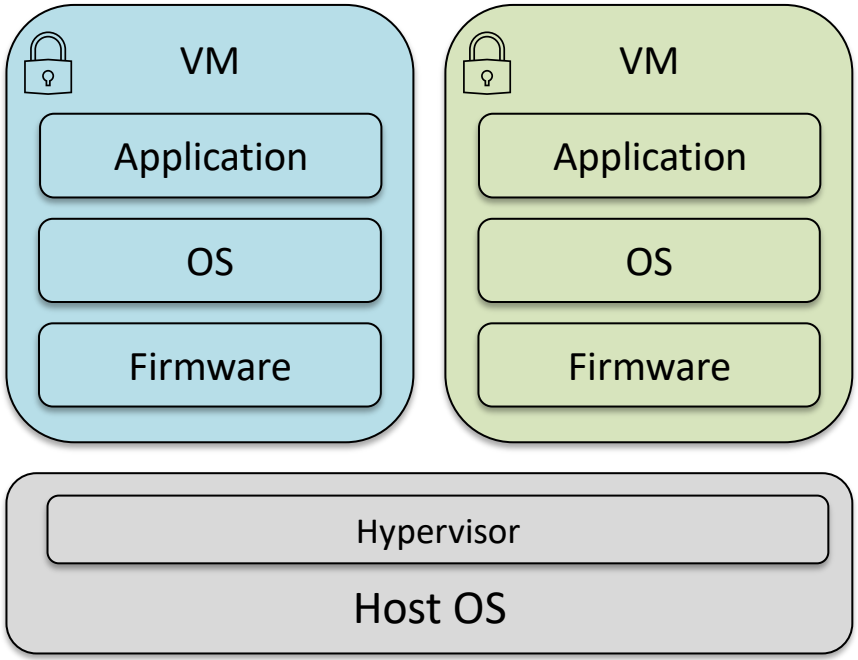
Set the stage

- VM-based Confidential computing
- Untrusted host/hypervisor
- VMs with encrypted memory
- Terms:
  - Guest/Attester
  - Host
  - Owner/Relying Party



What we will cover

- Overview of attestation mechanisms
- Approaches for unification
- Focus on guest

SEV(-ES)

- Pre-attestation driven by the host
- Secure channel established before boot
- Launch measurement covers:
  - Platform information
  - Launch digest (hash of VM firmware and initial vCPUs state)
- Secret injected using secure channel after measurement verification

SEV-SNP

- Driven by the guest
- Signed attestation report covers:
  - Platform information
  - Launch digest (hash of VM firmware and initial vCPUs state)
- VM separated to permission levels (VMPLs)

TDX

- Driven by the guest
- Signed attestation report covers:
  - Platform information
  - VM firmware, initial vCPUs state
  - Can be extended using 4 RTMRs (run-time measurement registers)
- Two phases: get report; then sign it

s390 Secure Execution

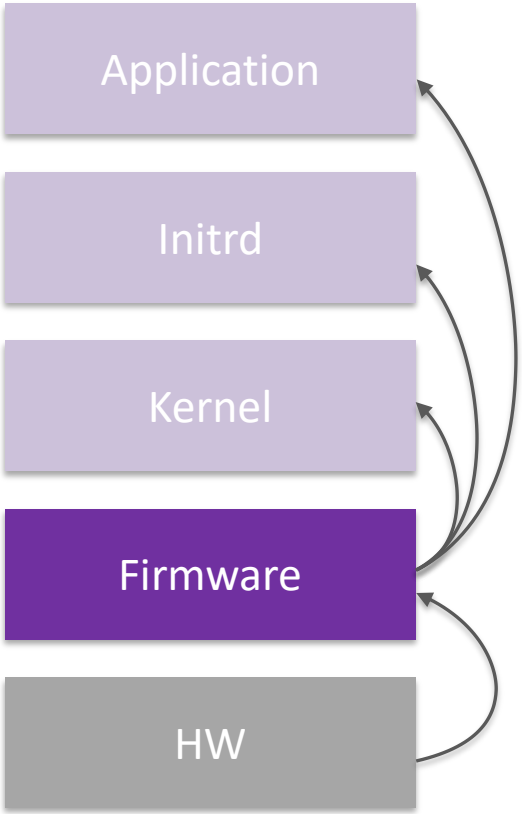
- Driven by the guest
  - Requires encrypted attestation request from owner (guest passes it to ultravisor)
- Signed attestation report covers:
  - Platform information
  - kernel + initrd + kernel command-line
- Optional – guest image is encrypted

Unification

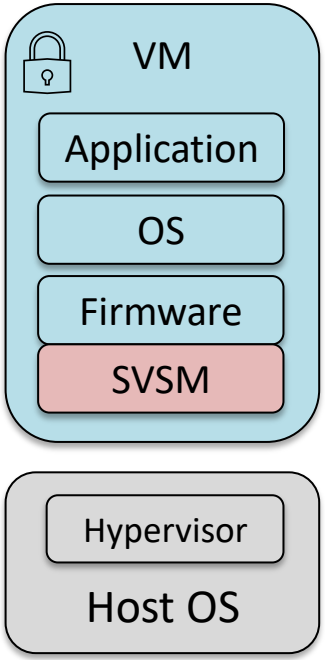
- Measure the entire stack with every TEE
- Let the HW measure part of the stack
- Use software to measure the rest

- Where should we split between HW and SW?

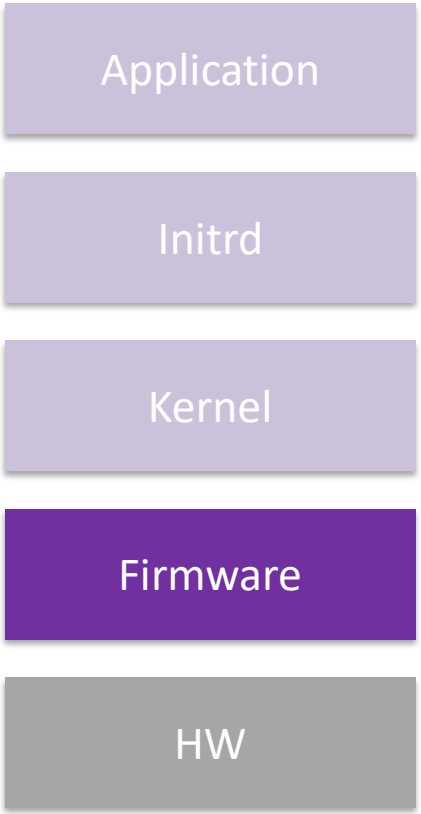
Firmware (1)



- HW measures the firmware
- Firmware measures the rest of the stack by securely emulating a TPM
  - Secure vTPM can't be tampered with by host or guest OS
- Secure vTPM generically exposes attestation to the guest OS and facilitates measurements
- vTPM provides a generic interface across all hardware and requires little to no modification of guests
  - Existing interface with kernel and measurement infrastructure
  - Shared between platforms and deployment types
- Can be implemented as an SVSM with SEV-SNP
  - Memory encryption prevents tampering by host
  - VMPLs prevent tampering by guest OS

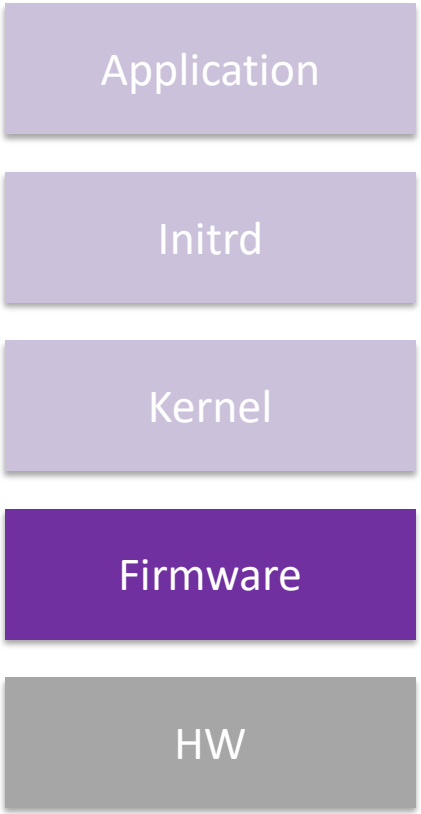


Firmware (2)



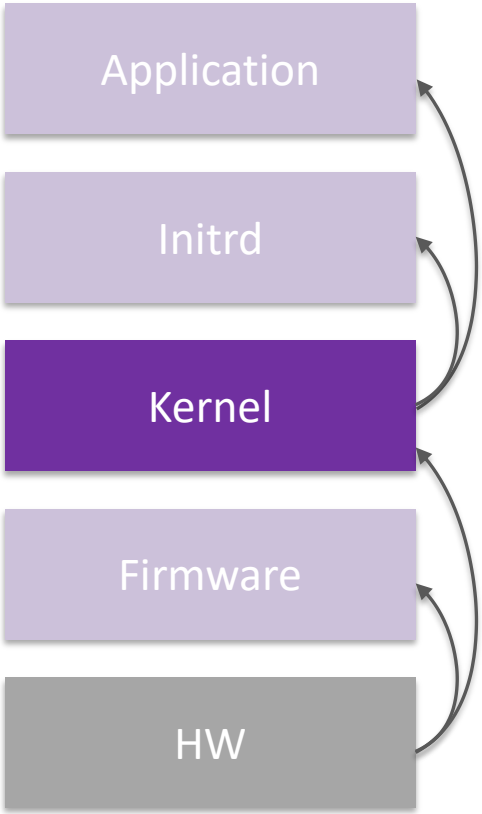
- How do you provision it?
  - Inject identity into vTPM
  - How do we securely manage these TPM identities?
  - TPM is unusable until identity has been provisioned.
- Alternatively, use ephemeral vTPMs, which are manufactured for each guest
  - Include the hash of the public EK in the attestation evidence
  - Verifier of TPM quotes will have to validate evidence

Firmware (3)



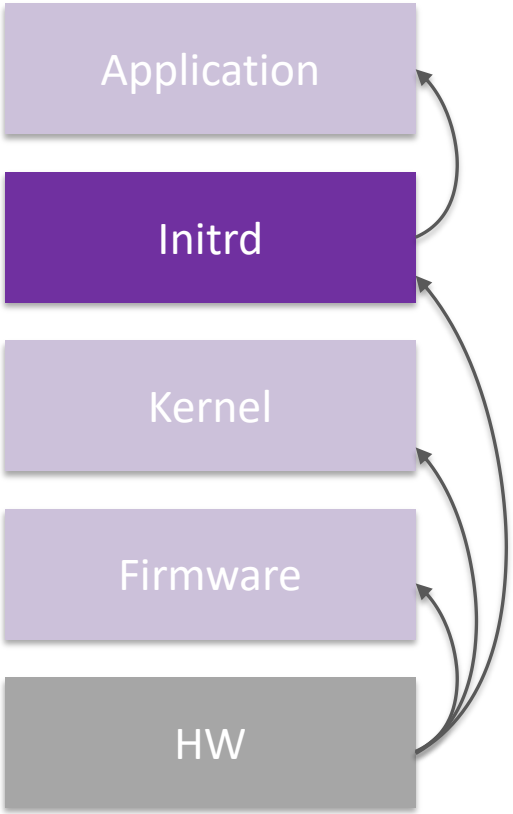
- SVSM/VMPLs only supported with SEV-SNP
- # TDX RTMRs < # TPM PCRs
- If no VMPLs: how can we protect from a malicious kernel?
  - Maybe in another trusted VM
- vTPM is just one option for firmware-based measurement

Kernel



- HW measures firmware and kernel
- Kernel measures the rest
  - Uses software kernel-mode TPM
- There are unification efforts in the kernel for other aspects of confidential computing

Initrd



- HW measures firmware, kernel, and initrd
  - Using measured direct boot (for SEV / SEV-SNP)
  - OVMF extends RTMRs during measured boot (for TDX)
- Attestation Agent in initrd measures the rest
  - Used in Confidential Containers to provide workload secrets/certificates
  - Could also be used for encrypted disks

Initrd

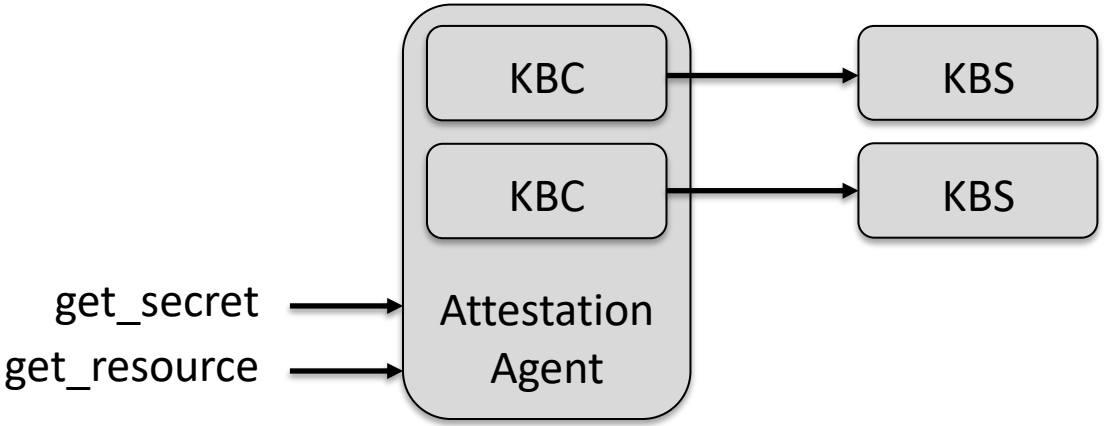
Application

Initrd

Kernel

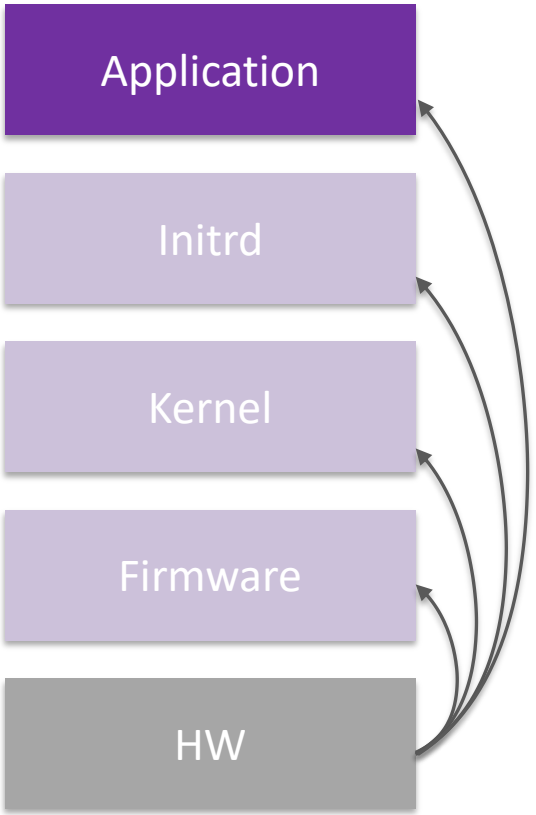
Firmware

HW



- Easier to implement
  - Modular user space process
- Non-standard initrd
  - Distros can add attestation agent

Application



- HW measures the entire stack
- Today, most TEEs don’t measure the whole stack
- HW is less flexible and standardized
- Extending HW measurement to the whole stack can have performance implications

- This is non-unified attestation

Attestation verification

- Verification follows from guest implementation
- Requires validation of hardware measurement
- Might also require validating a software measurement
- HW/SW validation could be split between multiple services

Further research

- Which approach should we take?
  - Are they interoperable?
- Supporting new architectures (ARM-CCA, RISC-V, …)
- Can we standardize future versions of hardware

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