Security and confidential computing

axel simon
office of the CTO

enarx.io

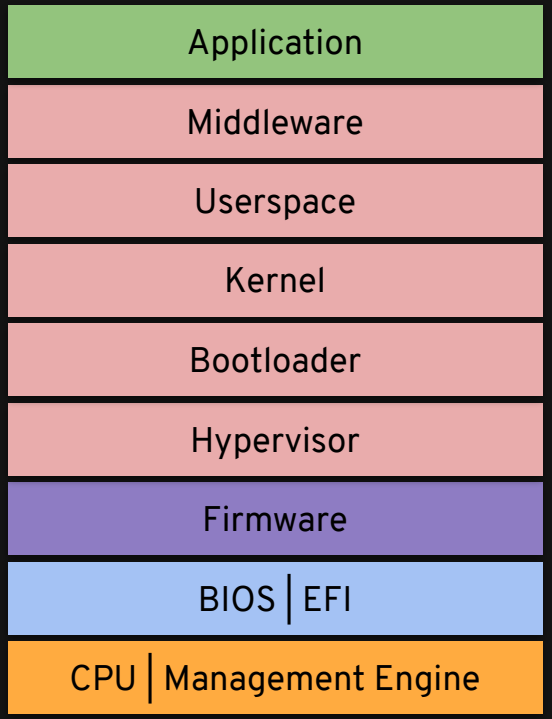
Red Hat

The Problem

The Need for Confidentiality and Integrity

- Banking & Finance
- Government & Public Sector
- Telco
- IoT
- HIPAA
- GDPR
- Sensitive enterprise functions
- Defense
- Human Rights NGOs
- ...

Virtualization Stack



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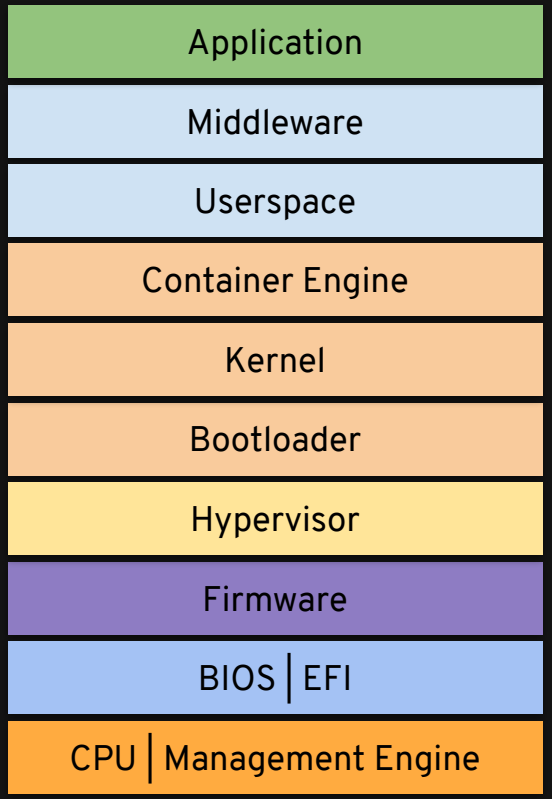
Container Stack



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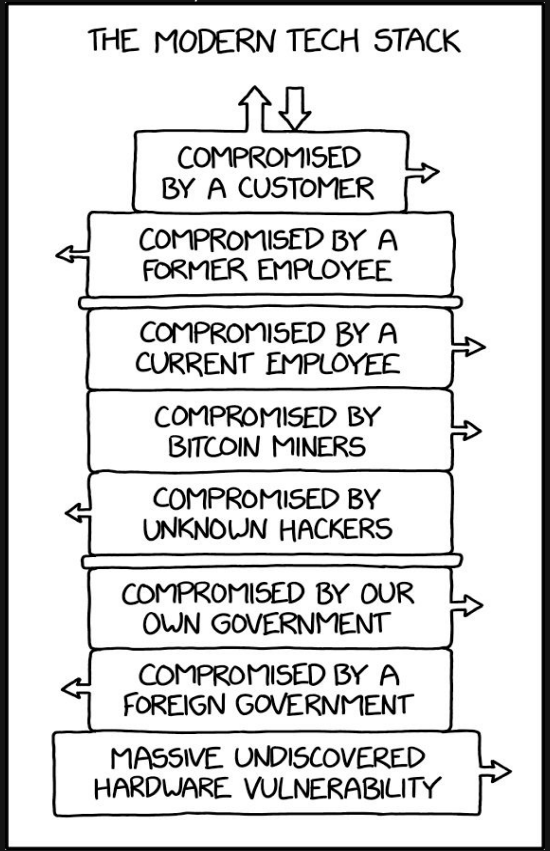
Virtualization Stack

as seen by xkcd (xkcd.com/2166)



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Trusted Execution Environments

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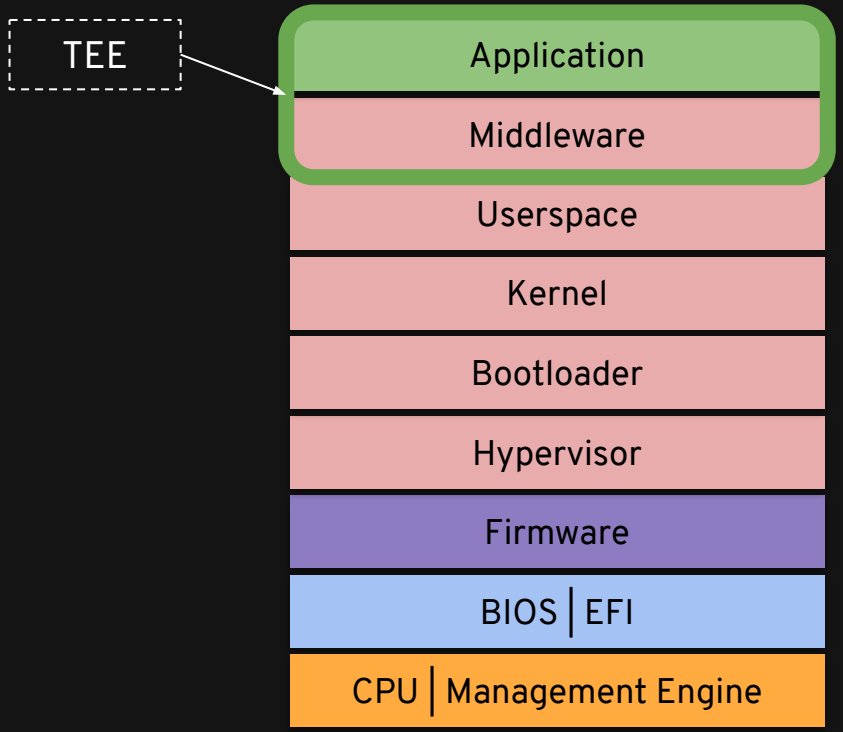
What's a TEE?



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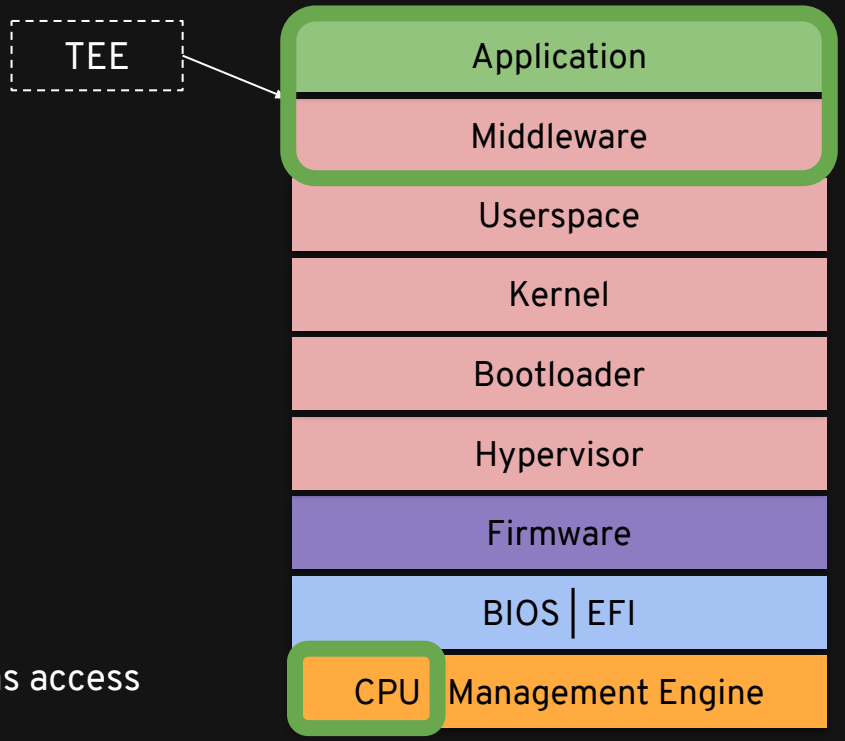

Only the CPU has access

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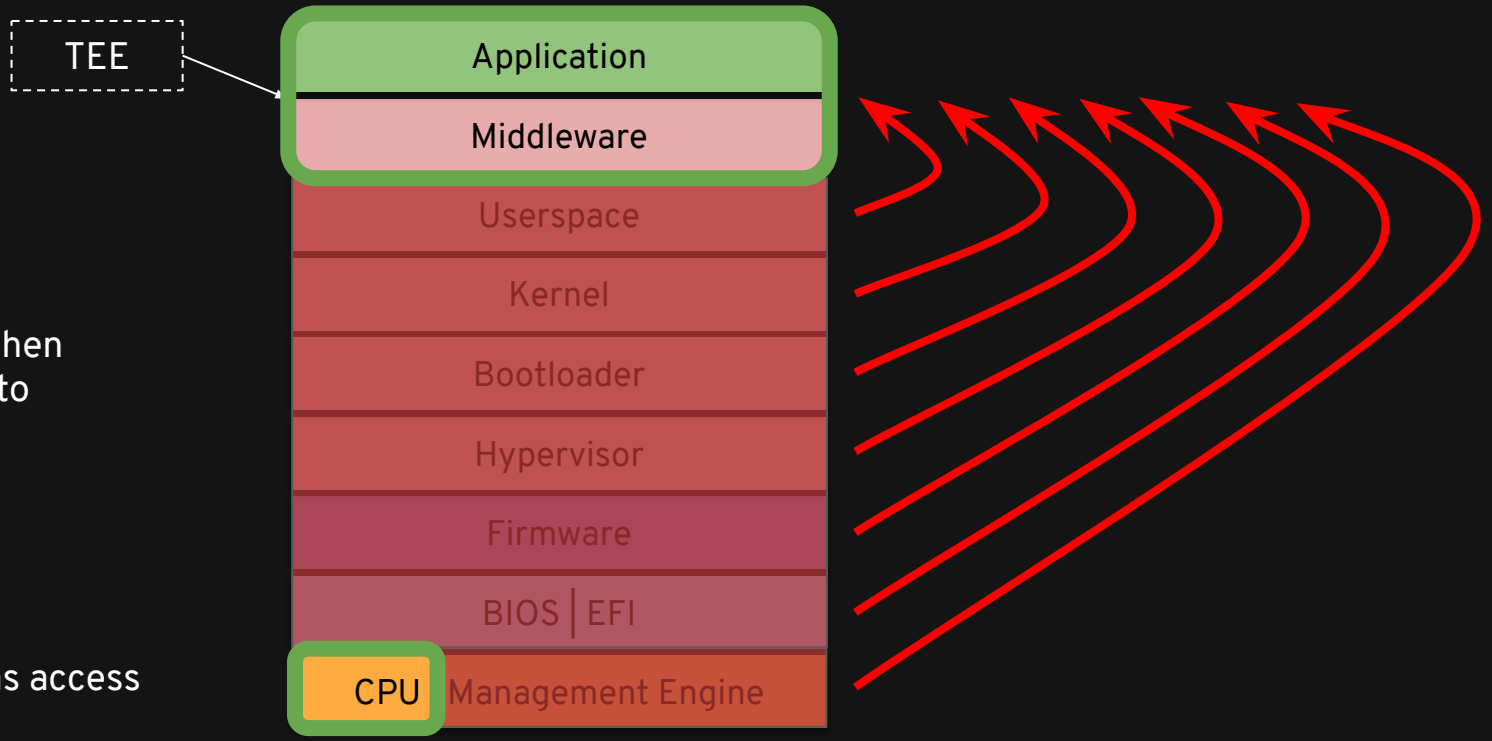

What happens when other layers try to access?

Only the CPU has access

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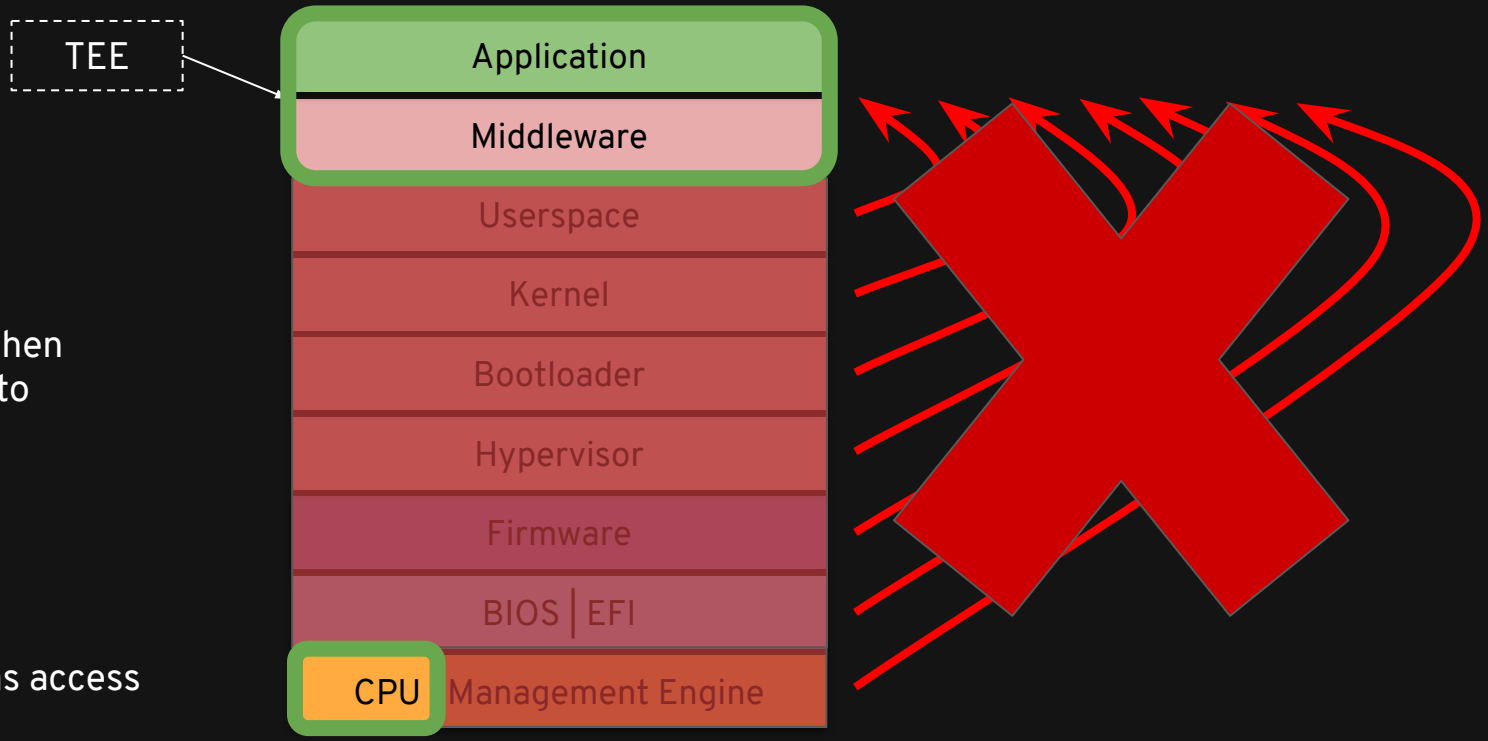

What happens when other layers try to access?

Blocked by CPU

Only the CPU has access

Trusted Execution Environments

TEE is a protected area within the host, for execution of sensitive workloads

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- Memory Confidentiality
- Integrity Protection
- General compute
- HWRNG

Trusted Execution Environments

Q. “But how do I know that it’s a valid TEE?”

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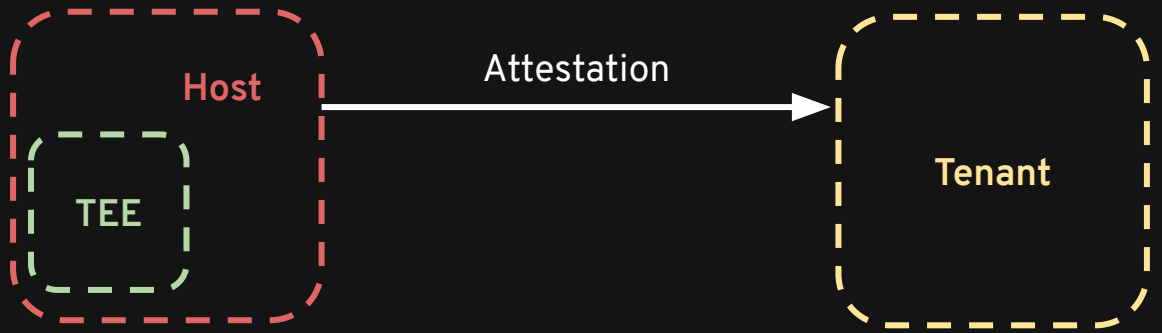
Trusted Execution Summary



Q. “But how do I know that it’s a valid TEE?”
A. Attestation

TEE provides:

- Memory Confidentiality
- Integrity Protection
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Trusted Execution Summary

Attestation includes:

- Diffie-Hellman Public Key
- Hardware Root of Trust
- TEE Measurement

TEE provides:

- Memory Confidentiality
- Integrity Protection
- General compute
- HWRNG

Trusted Execution Models

Process-Based

- Intel SGX (not upstream)
- RISC-V Sanctum (no hardware)

VM-Based

- AMD SEV
- IBM PEF (no hardware)
- Intel MKTME (no attestation[1])

Not a TEE: TrustZone, TPM

1. Attestation is discussed here: https://patents.google.com/patent/US20190042463A1/en?oq=20190042463

Trusted Execution: Process-Based

PROS

- Access to system APIs from Keep

CONS

- Unfiltered system API calls from Keep
- Application redesign required
- Untested security boundary
- Fantastic for malware
- Lock-in

Trusted Execution: Virtual Machine-Based

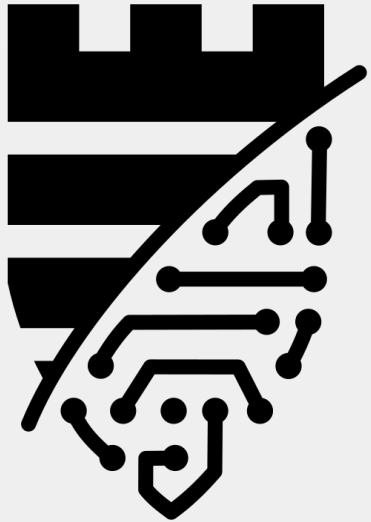
PROS

- Strengthening of existing boundary
- Run application on existing stacks
- Bidirectional isolation
- Limits malware

CONS

- Hardware emulation
- Heavy weight for microservices
- CPU architecture lock-in
- Duplicated kernel pages
- Host-provided BIOS

Introducing Enarx



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The Enarx 5-bullet overview

- Uses TEEs (SGX, SEV, etc.) for confidential workloads

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- Uses TEEs (SGX, SEV, etc.) for confidential workloads
- Easy development and deployment using Wasm
- Strong security design principles
- Cloud-native → Openshift, kubernetes
- Open source: *project*, not production-ready (yet)

CONFIDENTIAL COMPUTING
CONSORTIUM

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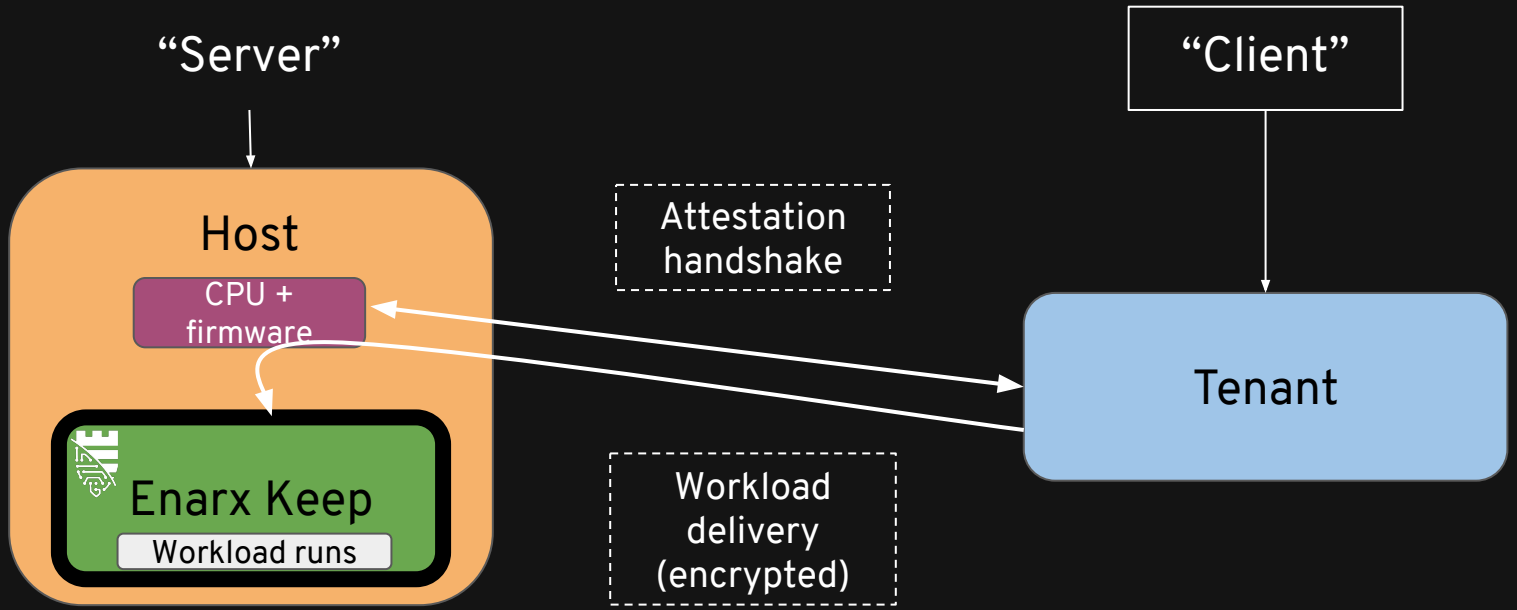
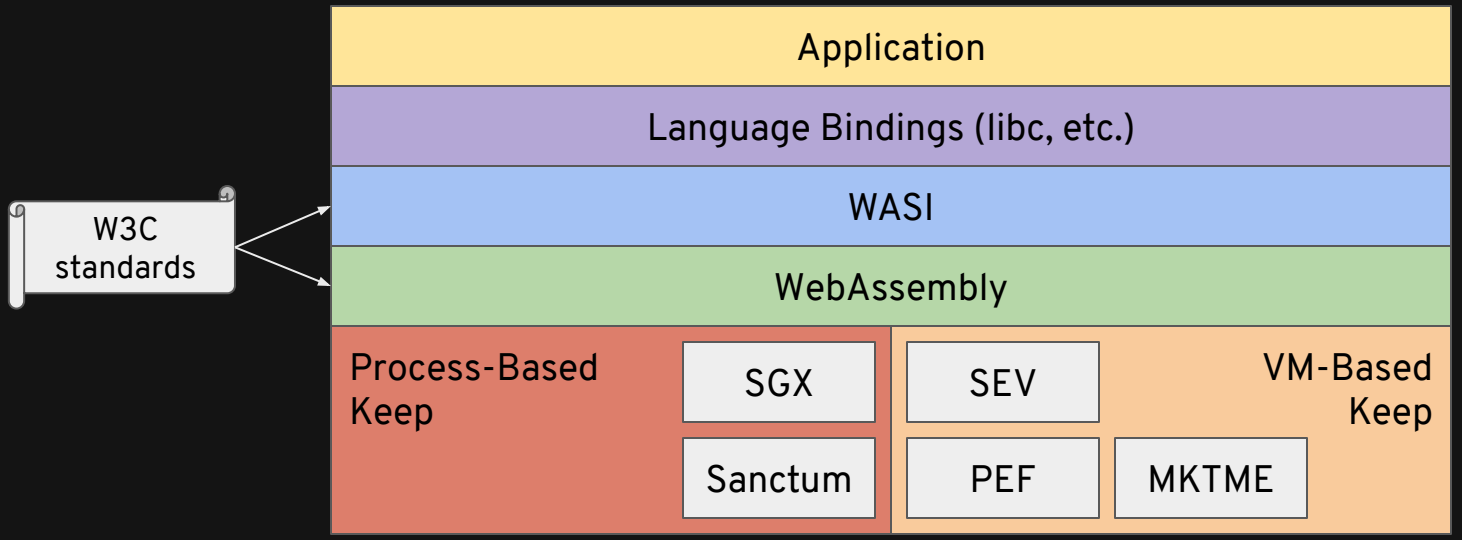
Where do we want to be?

What's the full picture?



Enarx Architecture



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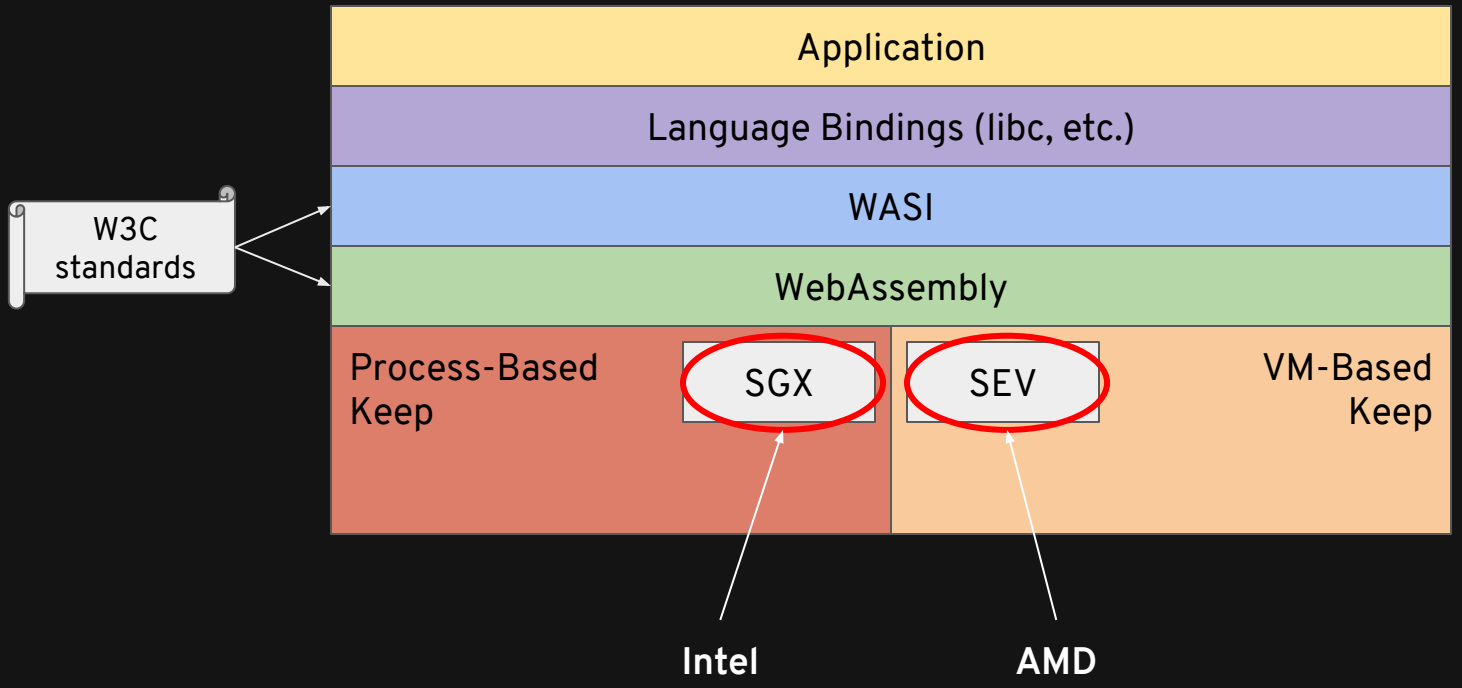
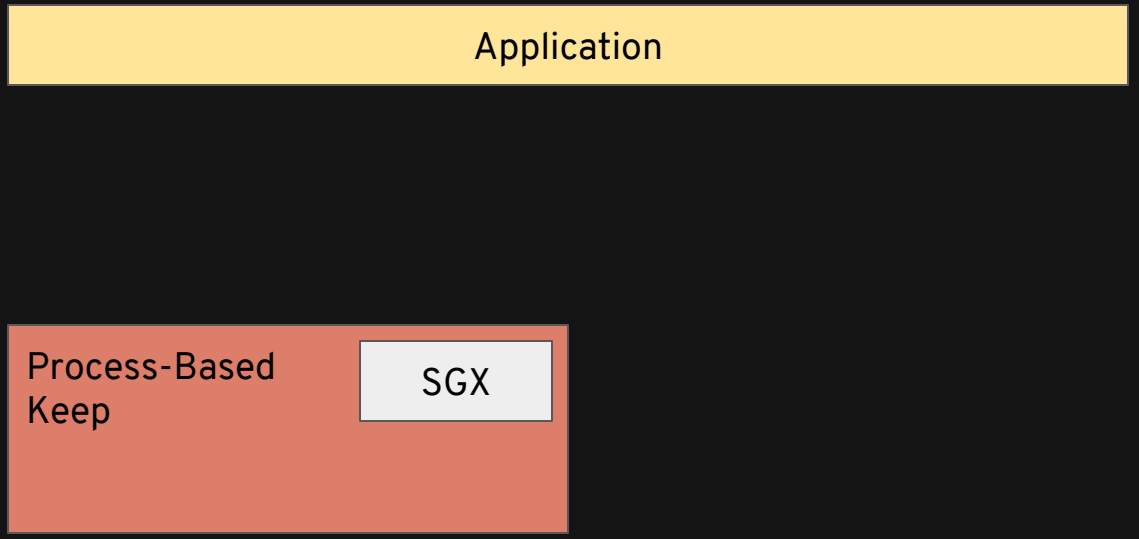


Breaking things down with SGX



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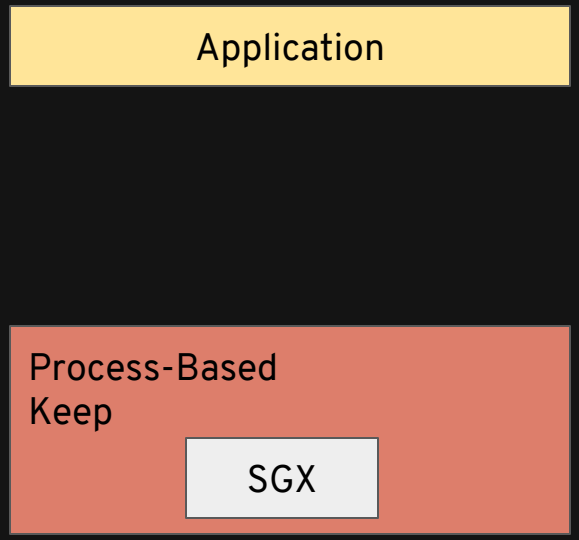

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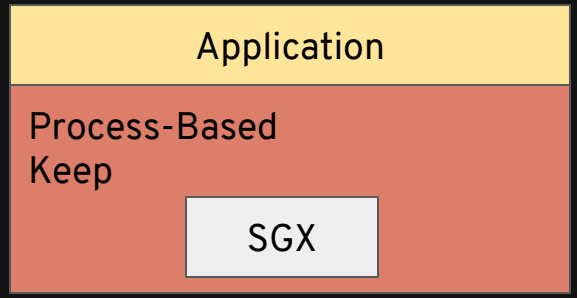
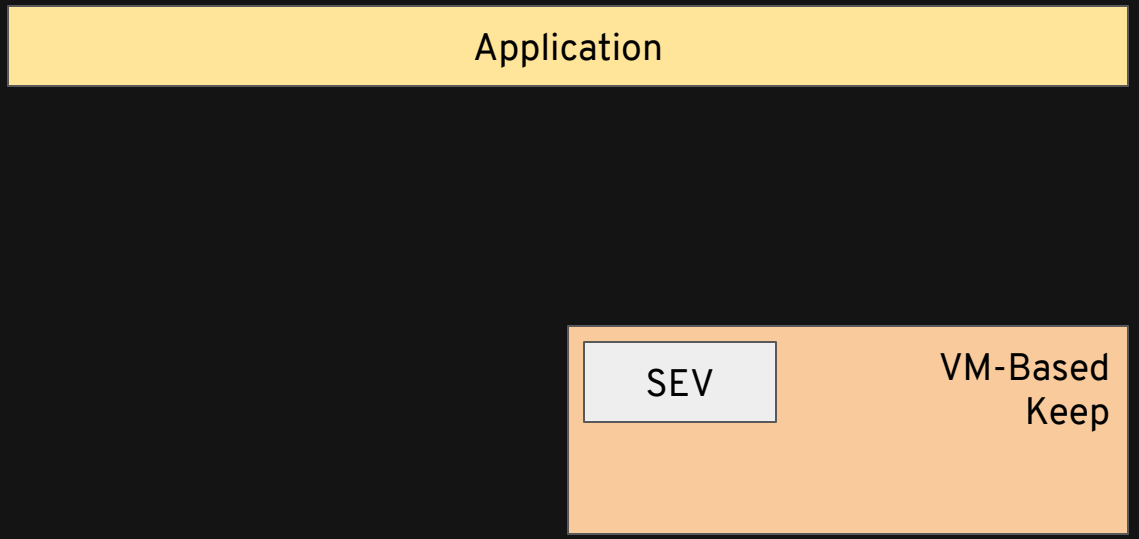


SGX demo

Breaking things down with SEV



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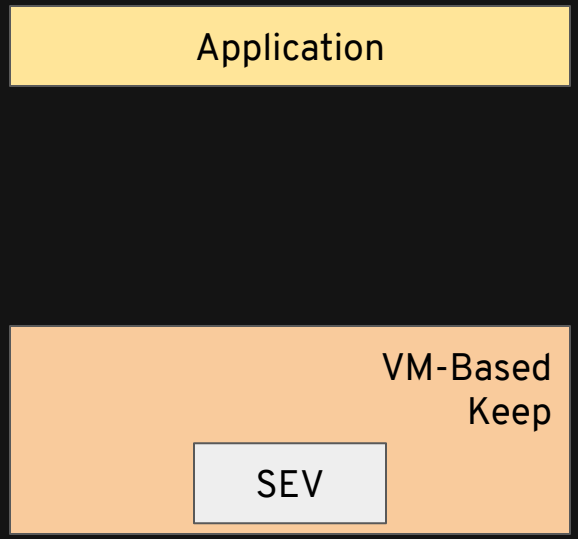
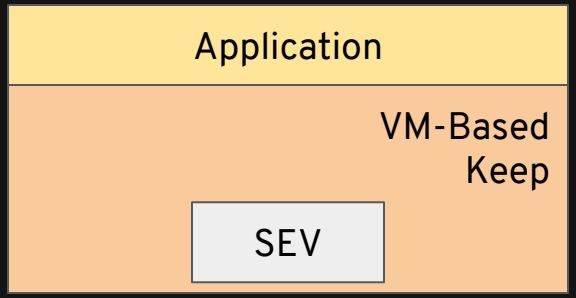
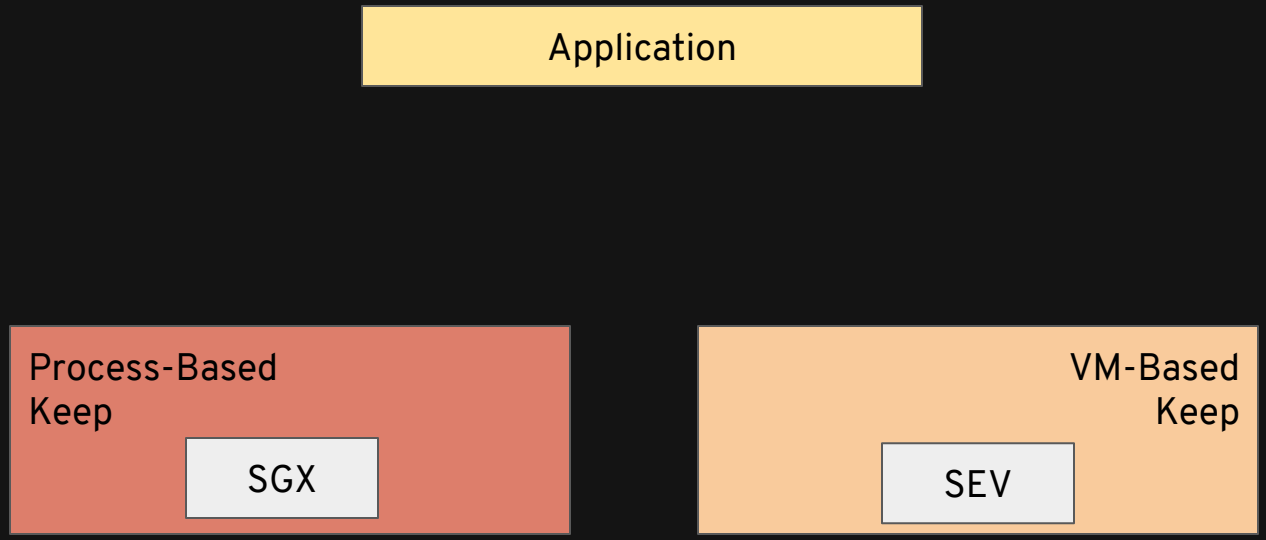


Breaking things down with SEV



SEV demo

Where we'd like to be



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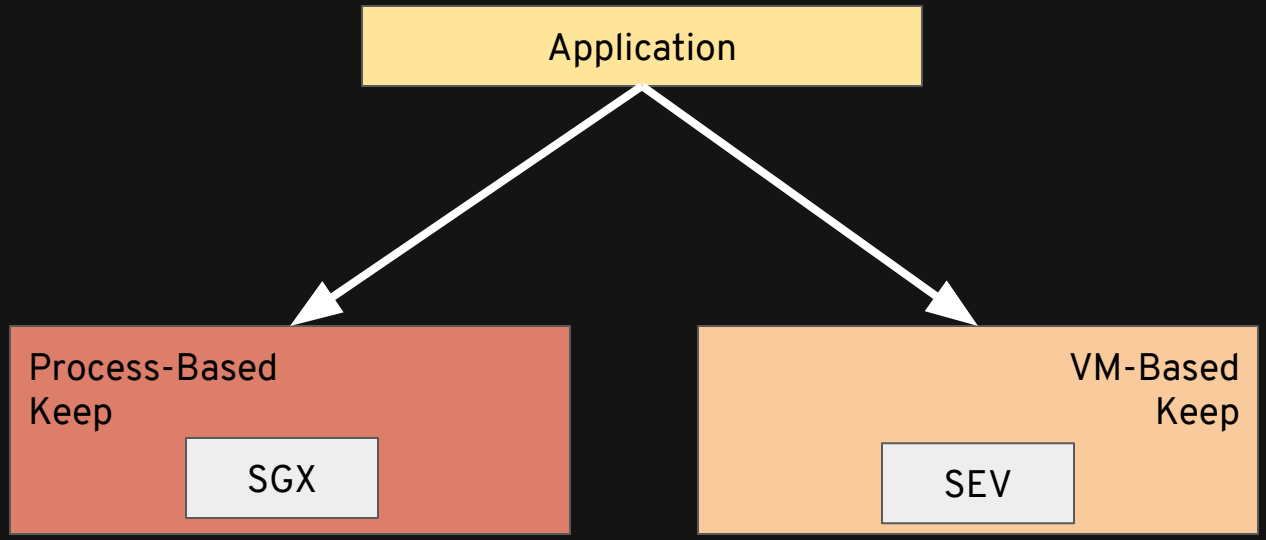

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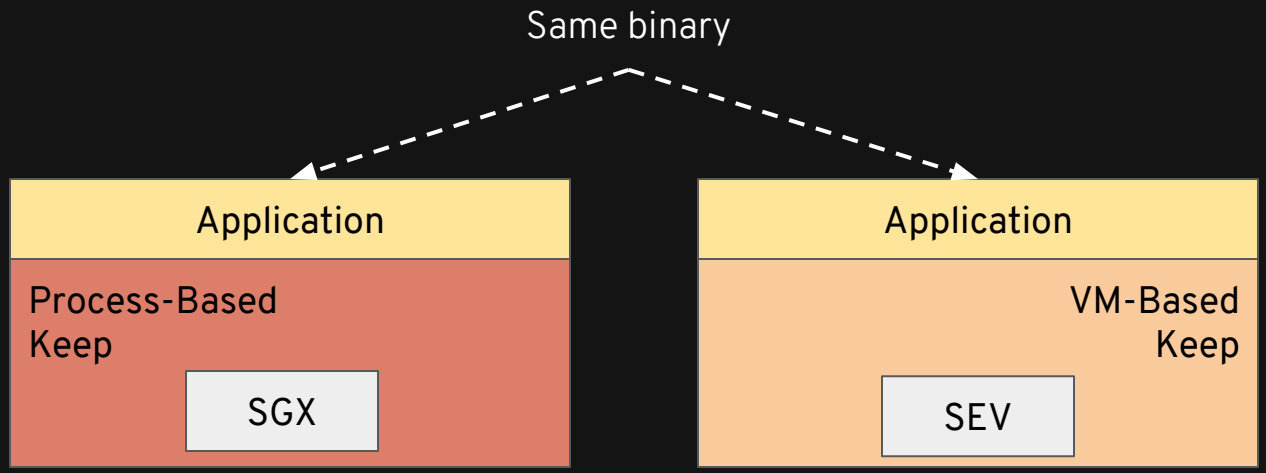
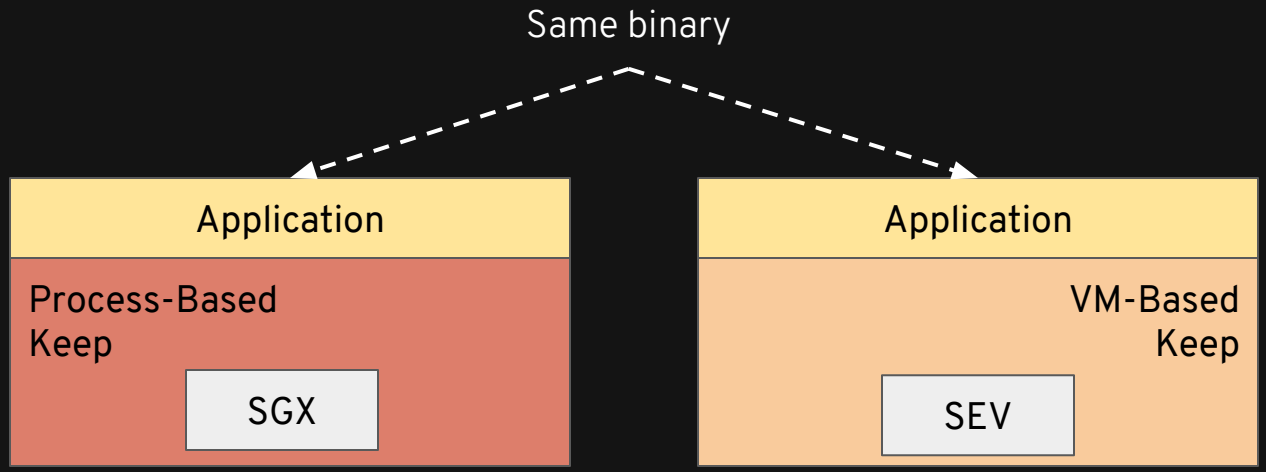


Where ~~I'd like~~ to be

Where we are



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```
[nathaniel@localhost enarx]$ cat ~/test.c
#include <stdio.h>

int
main(int argc, char *argv[])
{
    printf("Good morning, that's a nice tnetennba!\n");
    return 0;
}
[nathaniel@localhost enarx]$ musl-gcc -fPIE -static-pie -o ~/test ~/test.c
[nathaniel@localhost enarx]$ file ~/test
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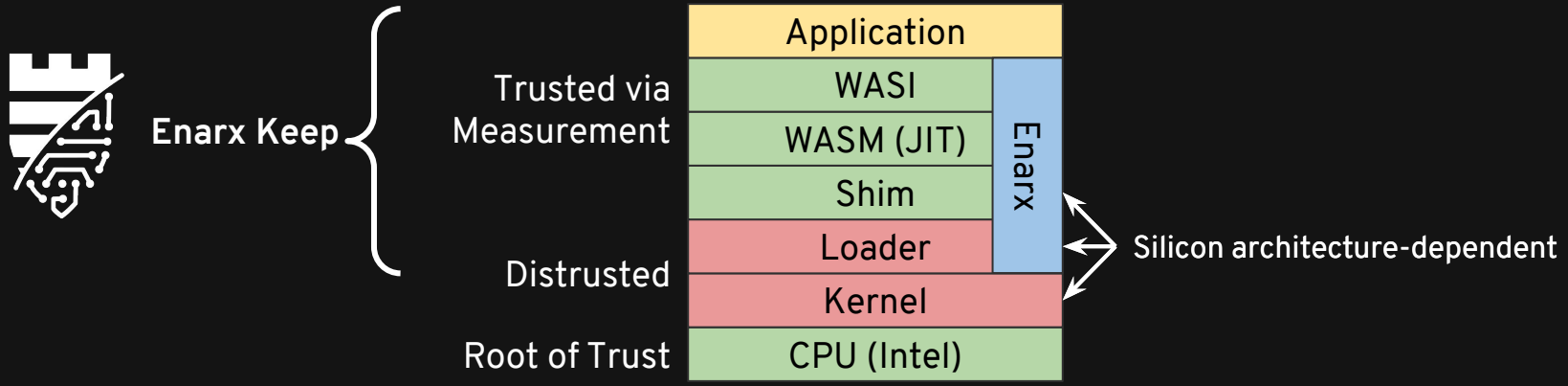
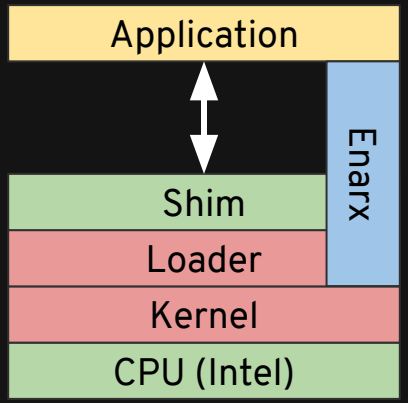
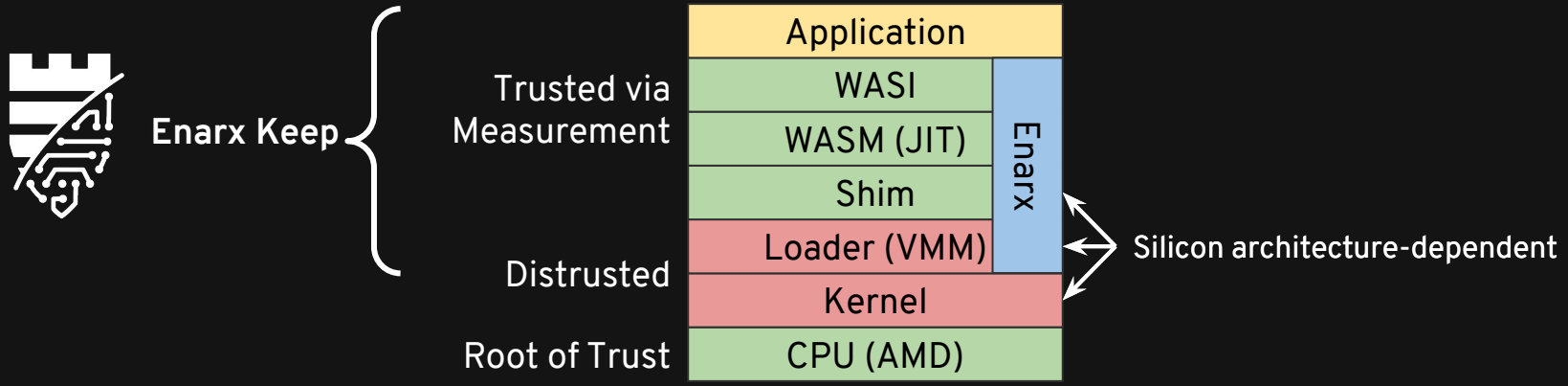
Layers - process-based Keep



Layers (now) - process-based Keep



Layers - VM-based Keep



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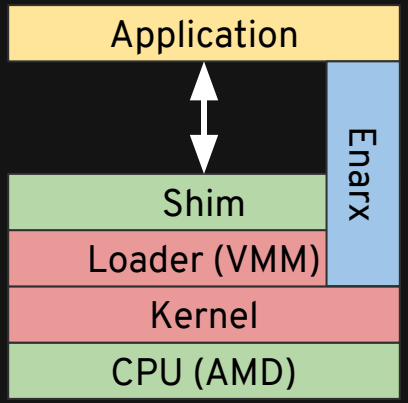

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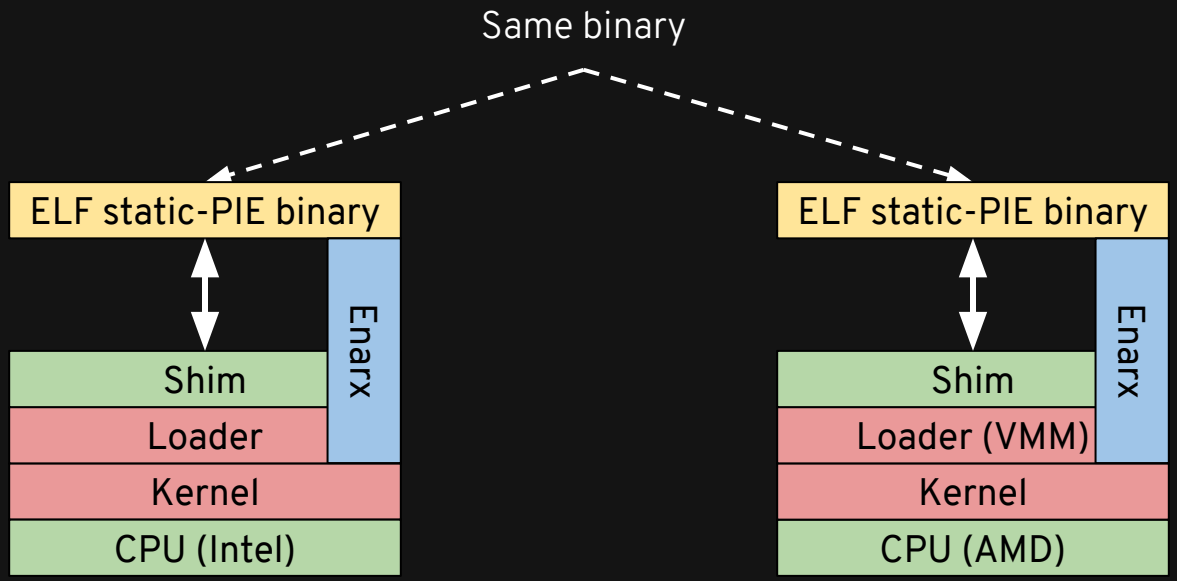
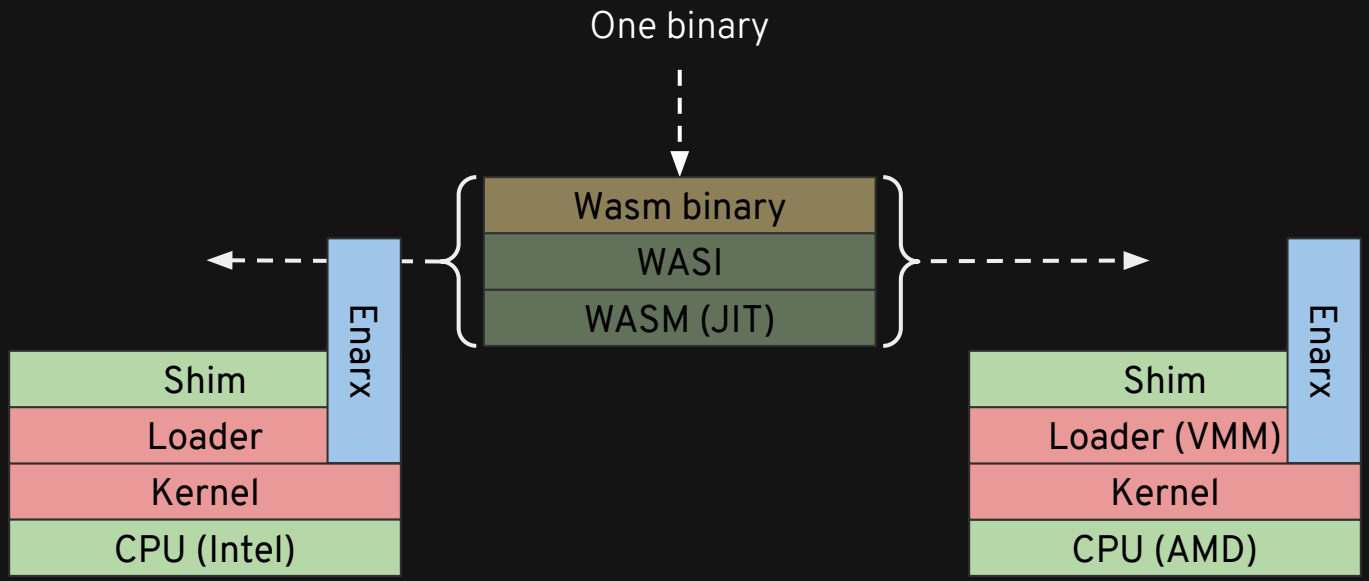


Where we'd like to be *next*



We are an open project

• Code	✓ GitHub	
• Wiki	✓ GitHub	
• Design	✓ GitHub	
• Issues & PRs	✓ GitHub	
• Chat	✓ Rocket.Chat	(Thank you!)
• CI/CD resources	✓ Packet.io	(Thank you!)
• Stand-ups	✓ Open to all	
• Diversity	✓ Contributor Covenant CofC	

We Need Your Help!

Website: https://enarx.io

Code: https://github.com/enarx

License: Apache 2.0

Language: Rust

Daily stand-ups open to all! Check the website wiki for details.

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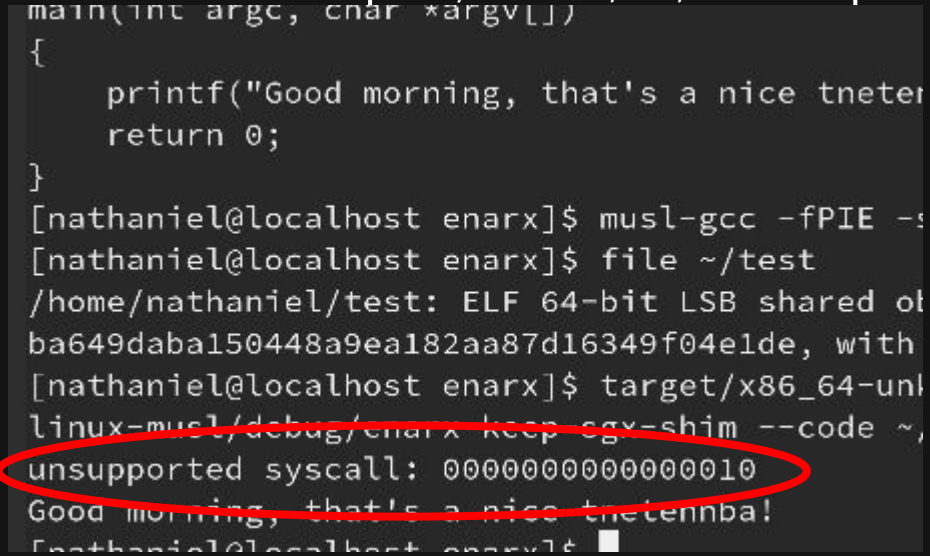

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Questions?

https://enarx.io

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