RSAConference2020
San Francisco | February 24 – 28 | Moscone Center

HUMAN ELEMENT

SESSION ID: OST-FO2

Running sensitive workloads on untrusted hosts: Project Enarx

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Office of the CTO
Red Hat

The Problem

Who do you trust?

Who do you trust?

- Your Cloud Service Provider?
- Your service provider's sysadmins?
- Your internal servers?
- Your sysadmins?

What do you trust?

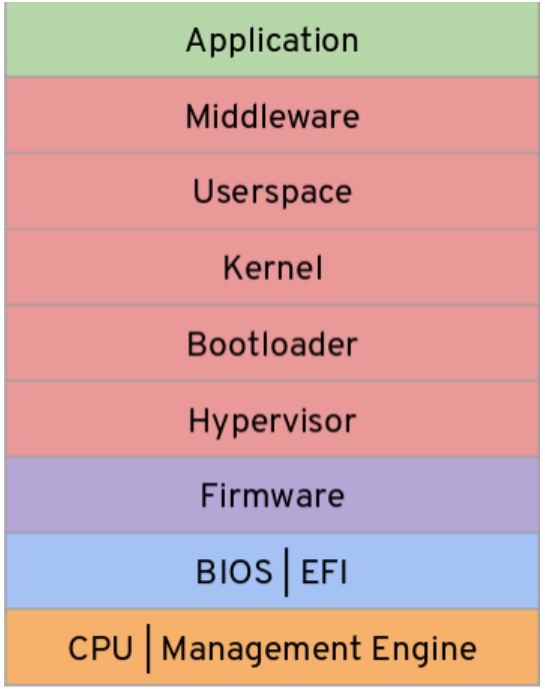
- Your Cloud Service Provider?
- Your service provider's sysadmins?
- Your internal servers?
- Your sysadmins?

- The Operating System?
- The entire software stack?
  - At provisioning
  - After it's been sitting there for months
- All the other workloads?
- All the firmware?
- All the hardware?

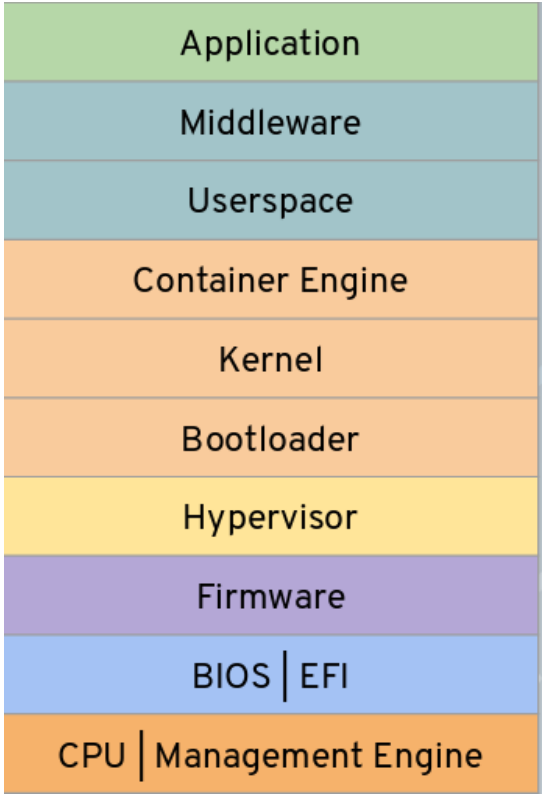
The Need for Confidentiality and Integrity

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

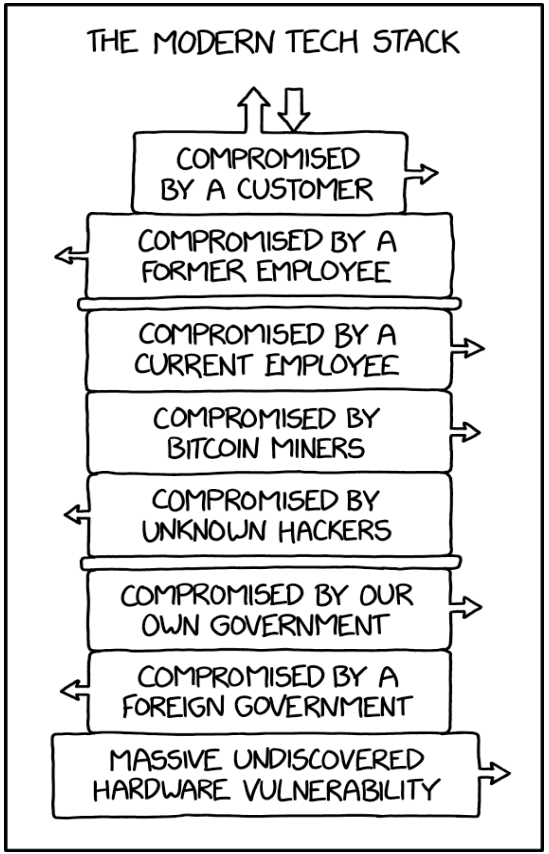
Virtualization Stack



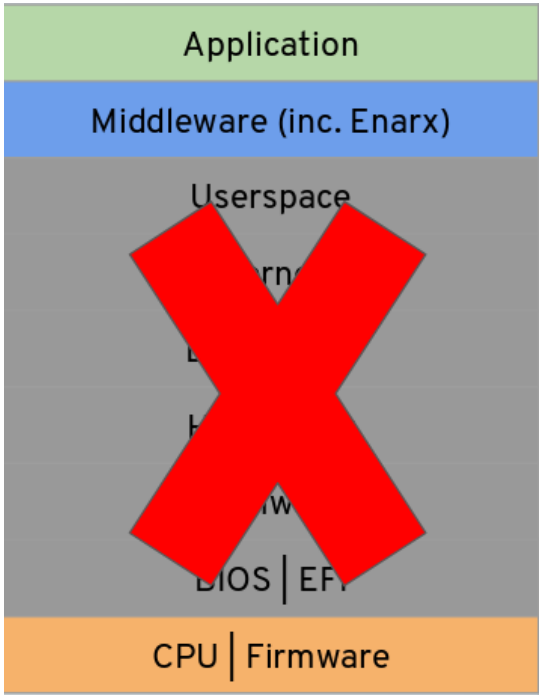
Container Stack



https://xkcd.com/2166/

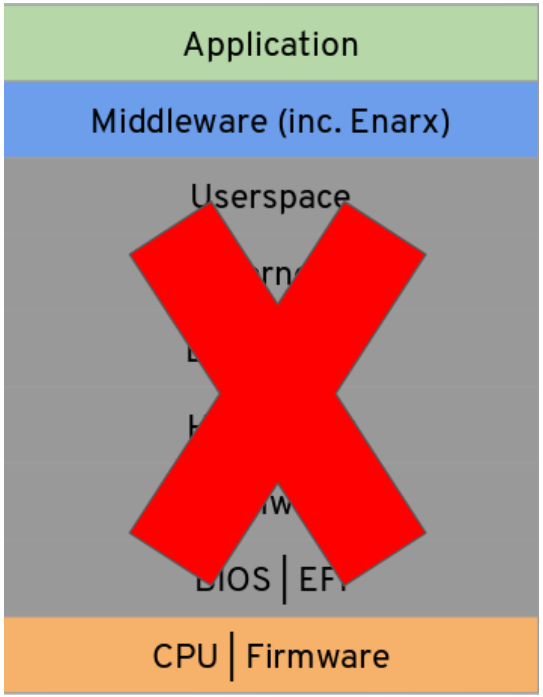


The Plan

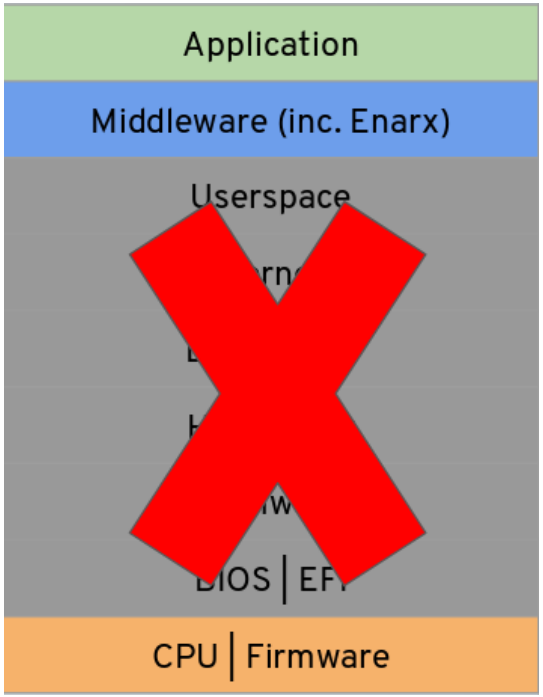


The Principles

Don’t trust the host
Don’t trust the host owner
Don’t trust the host operator
All hardware cryptographically verified
All software audited and cryptographically verified



The Fit

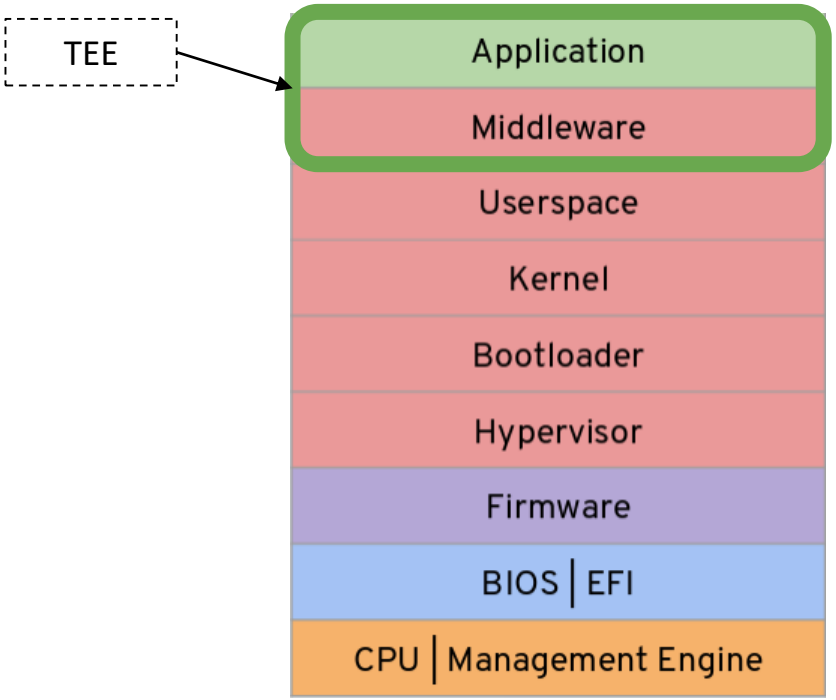


Don’t trust the host
Don’t trust the host owner
Don’t trust the host operator
All hardware cryptographically verified
All software audited and cryptographically verified

Well suited to microservices
Well suited to sensitive data or algorithms
Easy development integration
Simple deployment
Standards based: WebAssembly (WASM)

Trusted Execution Environments

What's a TEE?



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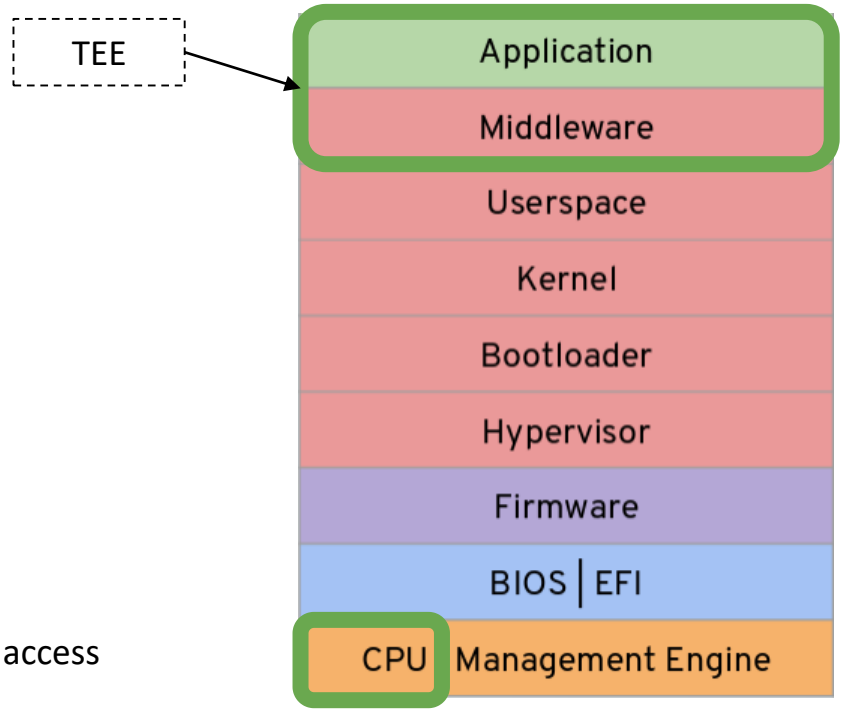
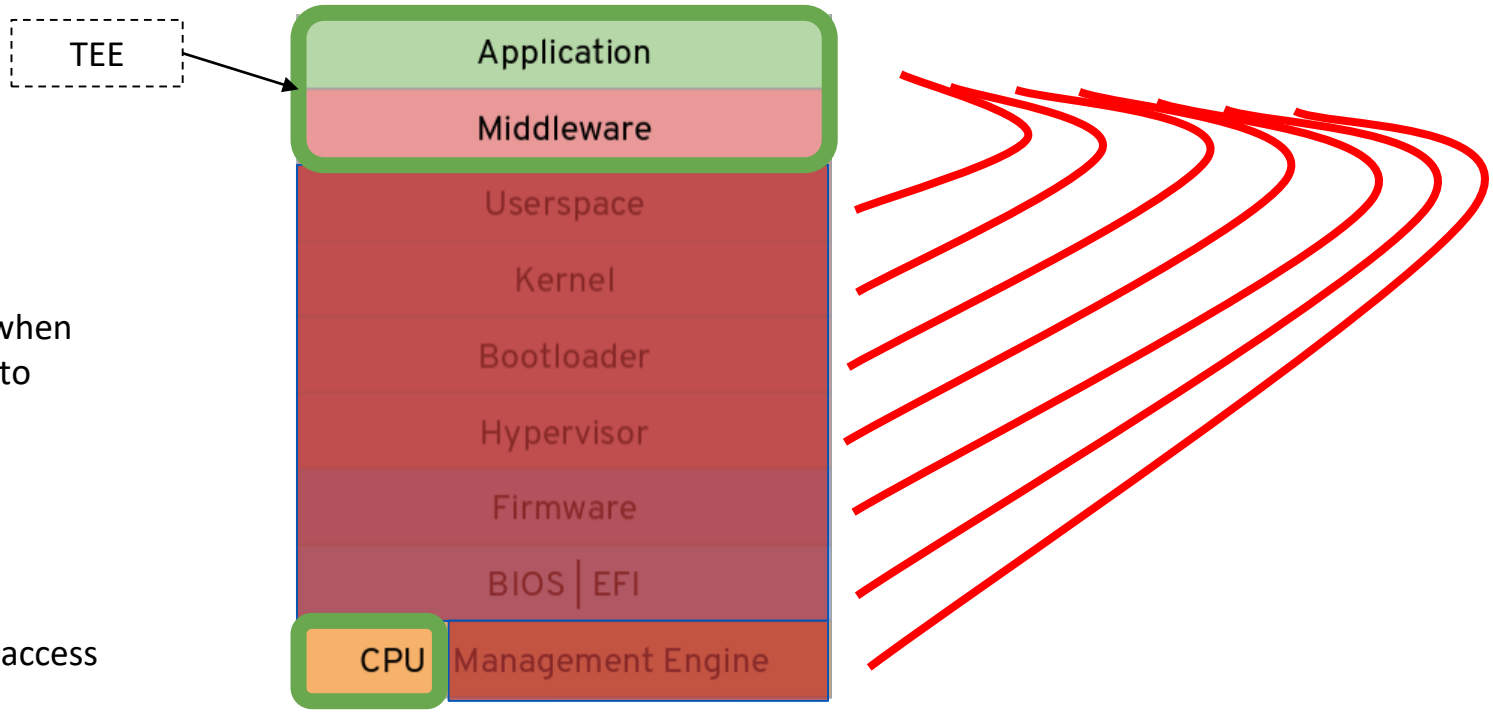


Only the CPU has access

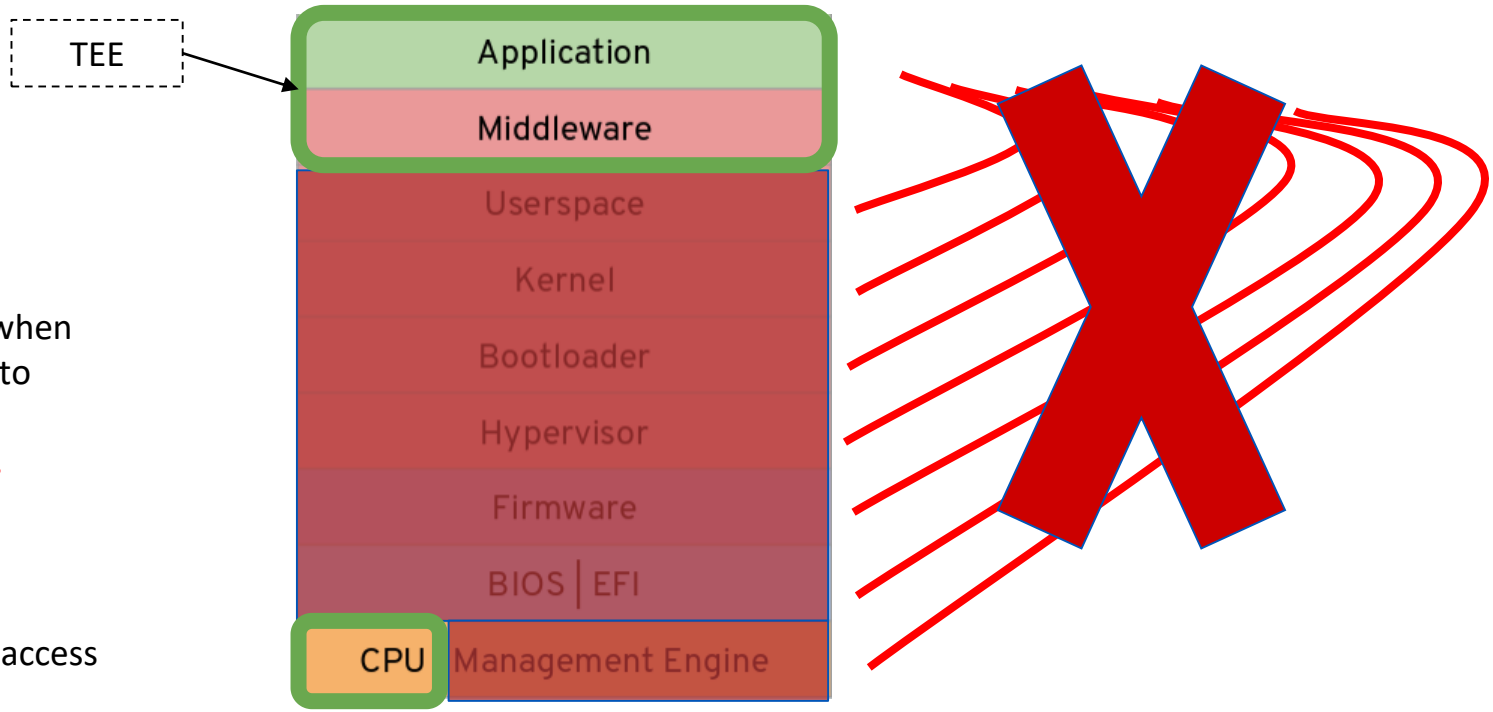
What's a TEE?



What happens when other layers try to access?

Only the CPU has access

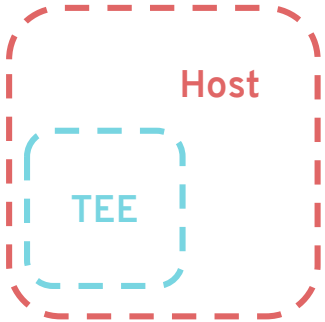
What's a TEE?



What happens when other layers try to access?
Blocked by CPU.

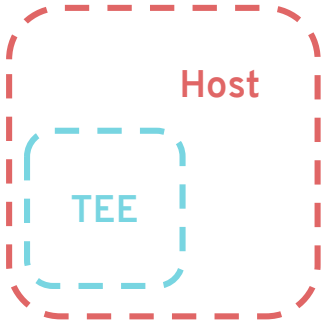
Only the CPU has access

Trusted Execution Environments



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

Trusted Execution Environments



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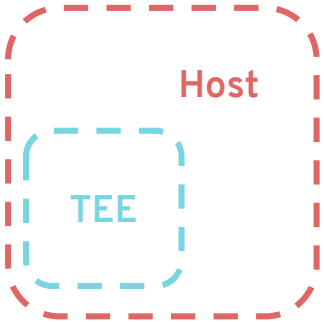
TEE provides:

- Memory Confidentiality
- Integrity Protection
- General compute
- HWRNG

Trusted Execution Environments



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

TEE provides:

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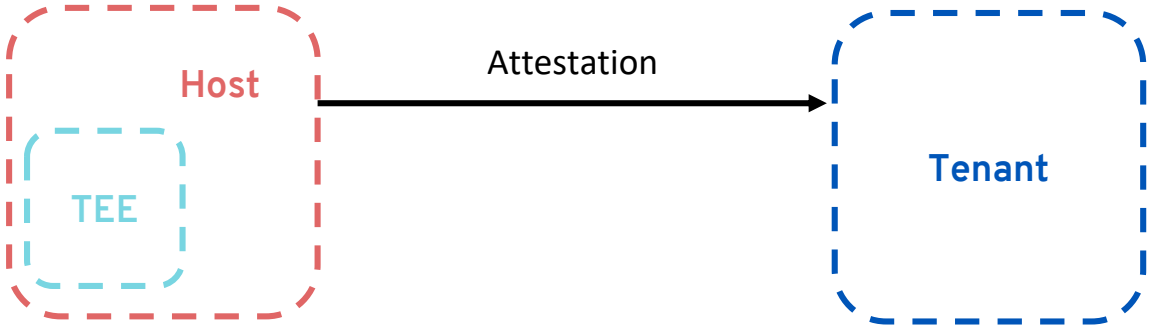
Trusted Execution Summary



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

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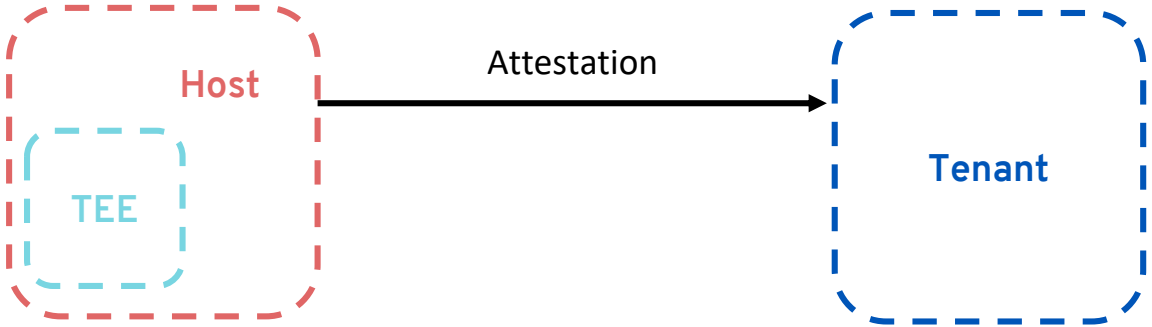

Attestation includes:

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

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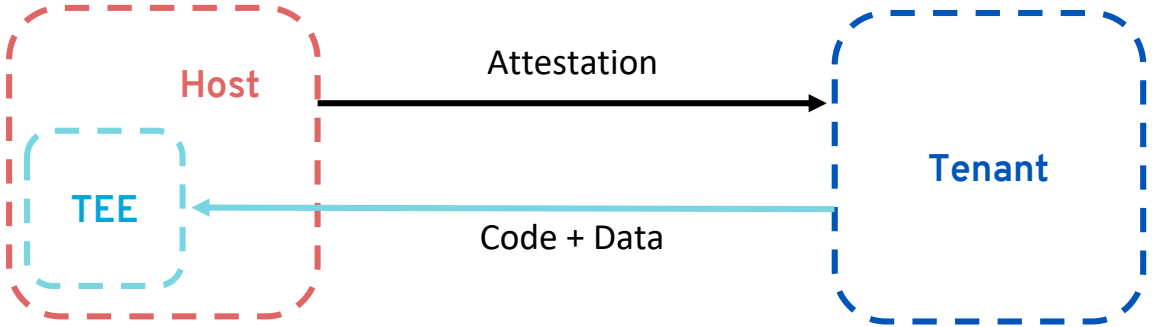

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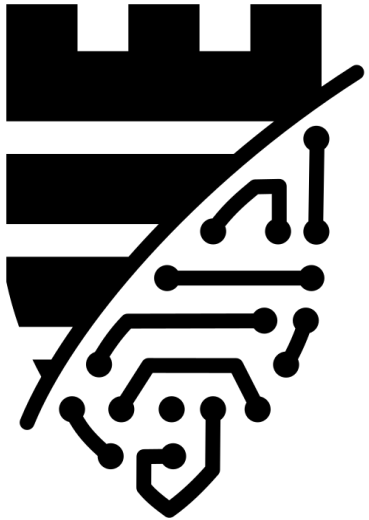
On which technology do I build my application?

Introducing Enarx



Enarx Principles

1. We don’t trust the host owner
2. We don’t trust the host software
3. We don’t trust the host users
4. We don’t trust the host hardware
    a. … but we’ll make an exception for CPU + firmware

Enarx Design Principles

1. Minimal Trusted Computing Base
2. Minimum trust relationships
3. Deployment-time portability
4. Network stack outside TCB
5. Security at rest, in transit and in use
6. Auditability
7. Open source
8. Open standards
9. Memory safety
10. No backdoors

The Enarx 5-bullet overview

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

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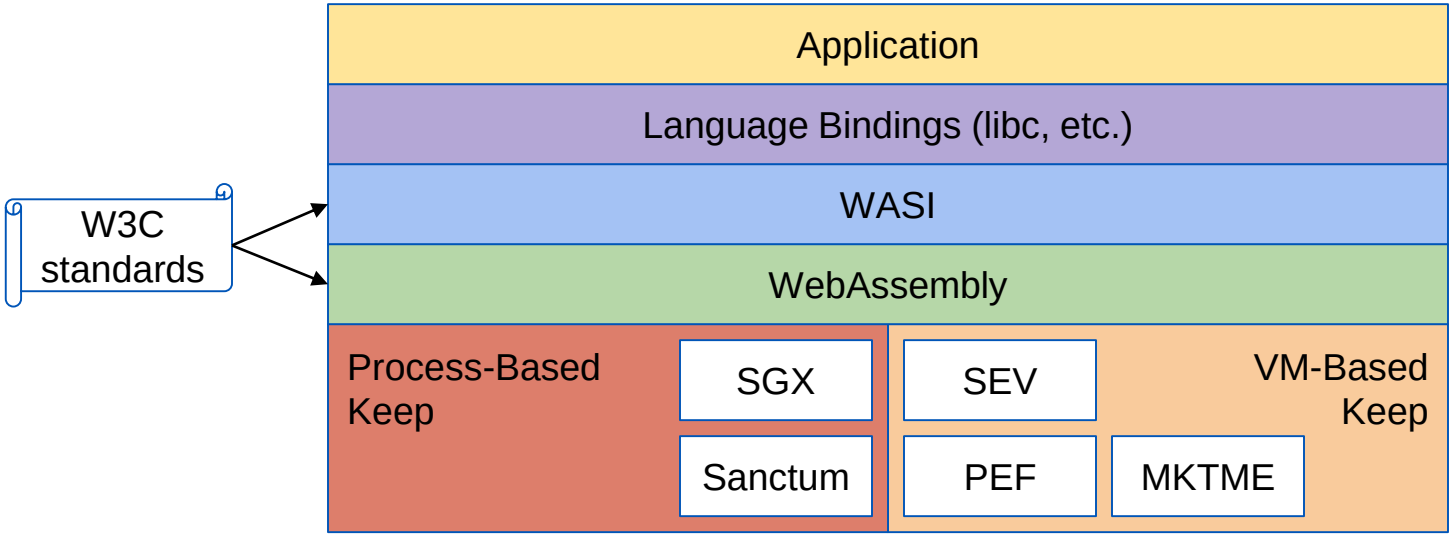
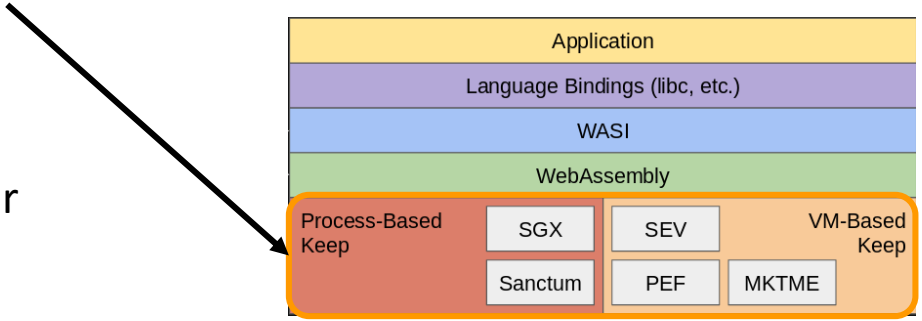
Enarx Architecture



Keep - process or VM-based

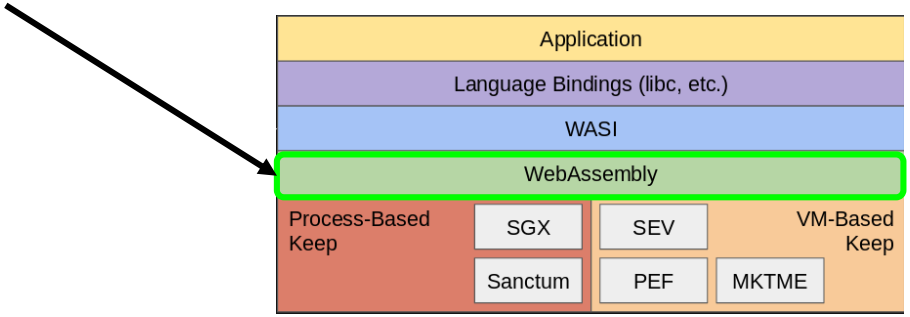
- Core Keep
- Platform-specific
  - Hardware (CPU): silicon vendor
  - Firmware: silicon vendor
  - Software: Enarx



Architecture varies between VM/Process-based platforms

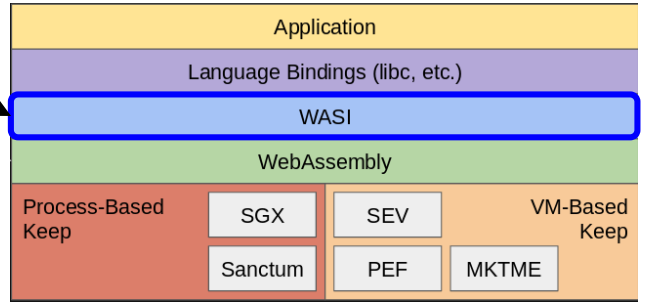
WebAssembly (WASM)

- W3C standard
- Stack Machine ISA
- Sandboxed
- Supported by all browsers
- Exploding in the “serverless” space
- Implementations improving rapidly
  - cranelift and wasmtime



WebAssembly System API (WASI)

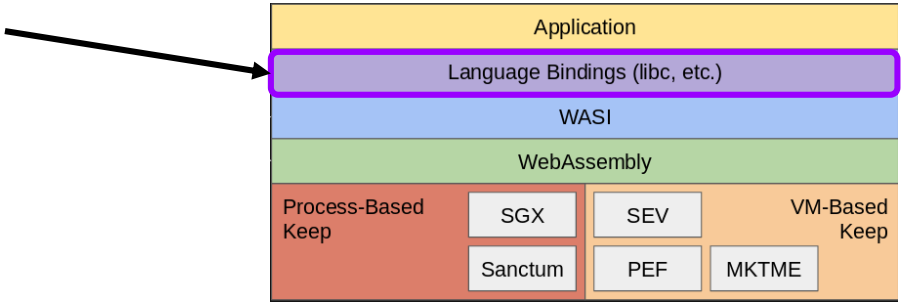
- W3C Standards Track
- Heavily inspired by a subset of POSIX
- Primary goals:
  - Portability
  - Security
- libc implementation on top
- Capability-based security:
  - No absolute resources
  - Think: openat() but not open()



Language Bindings (libc, etc.)

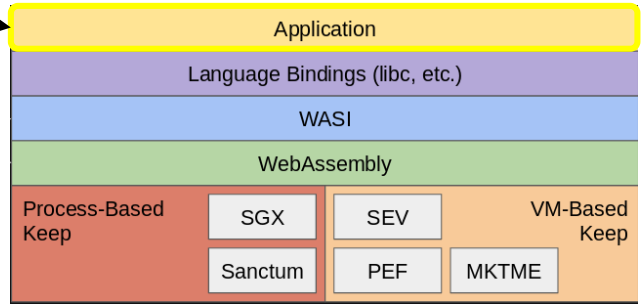
Compilation targets and includes, e.g.

- Rust: --target wasm32-wasi

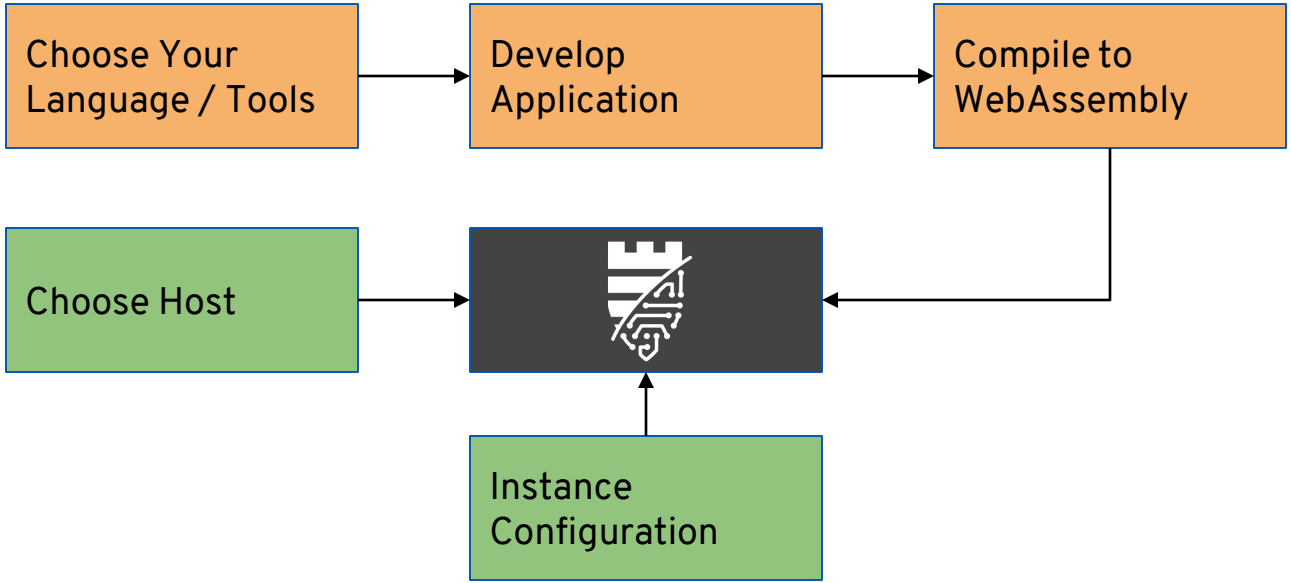


Application

- Written by
  - Tenant (own development)
    OR
  - 3rd party vendor
- Standard development tools
- Compiled to WebAssembly
- Using WASI interface

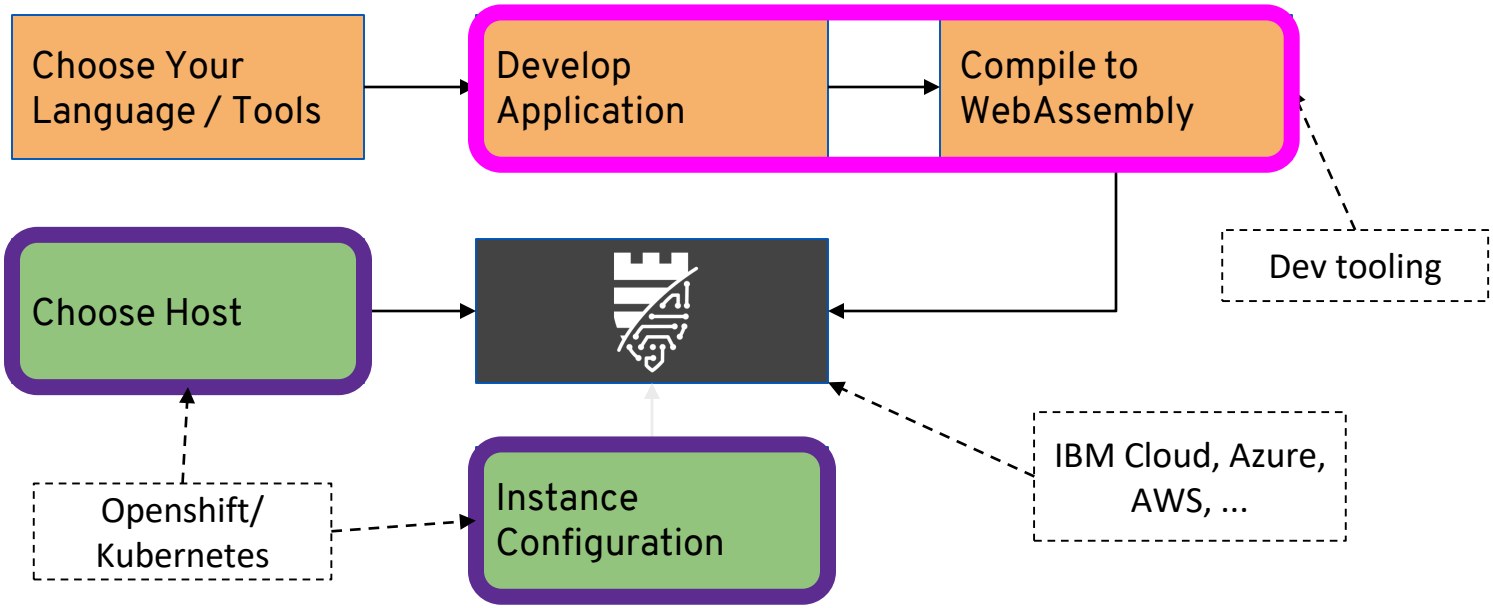


Enarx is a ~~Development~~ Deployment Framework



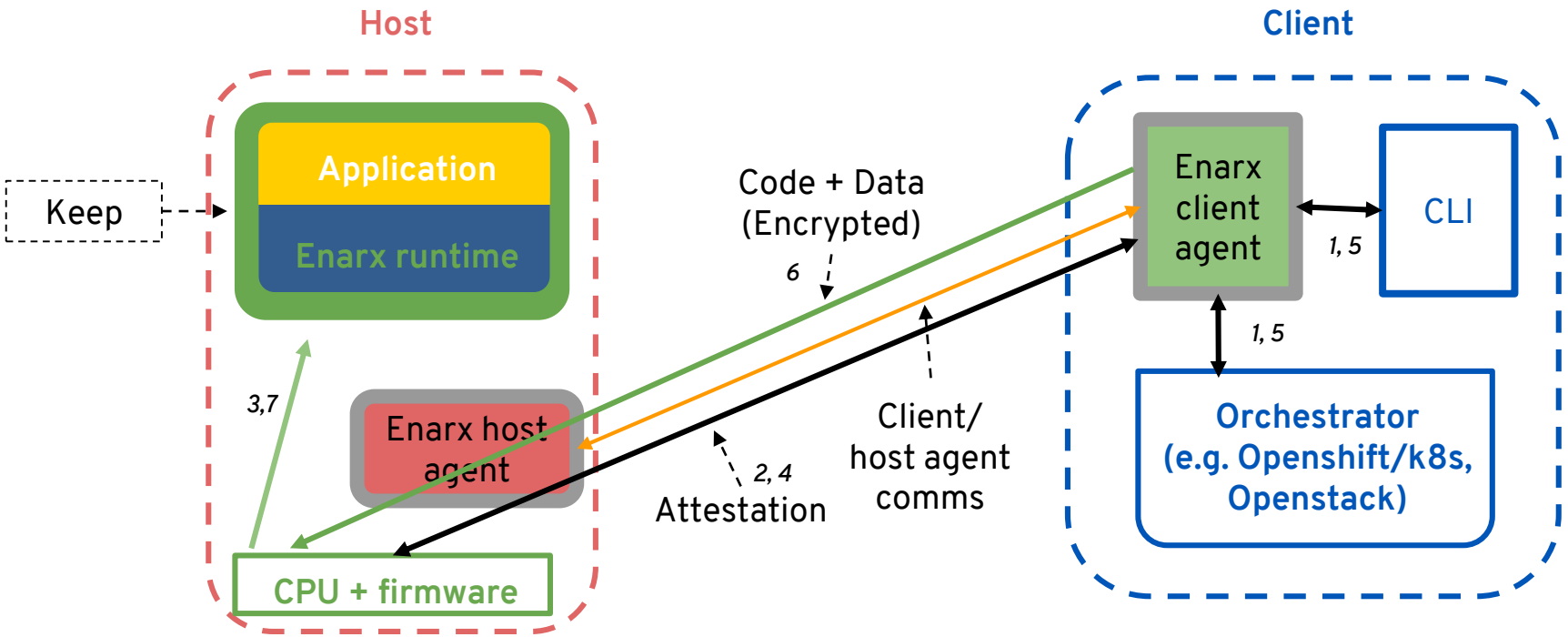
Enarx is a ~~Development~~ Deployment Framework

(Example components)

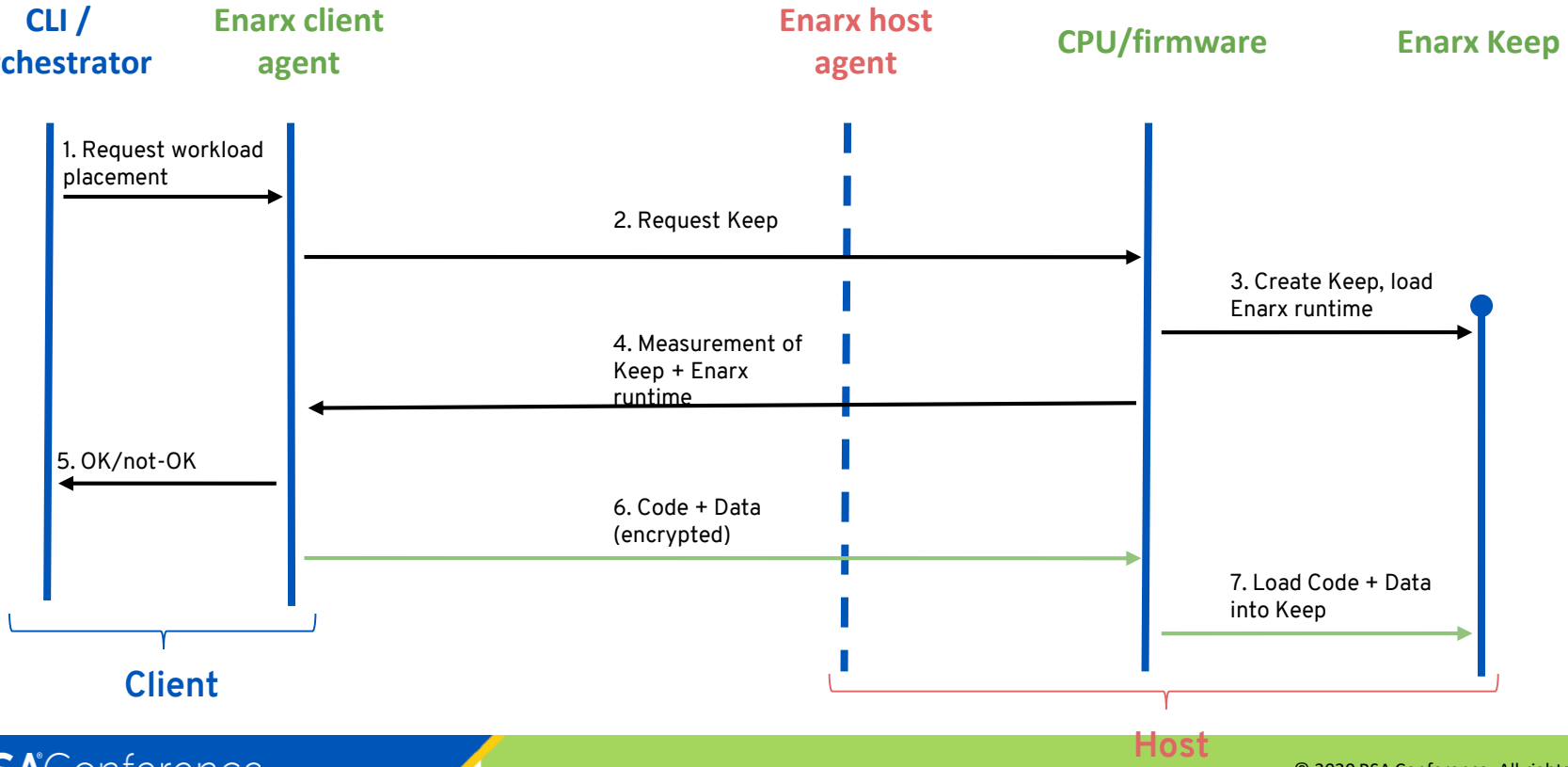


Process flow

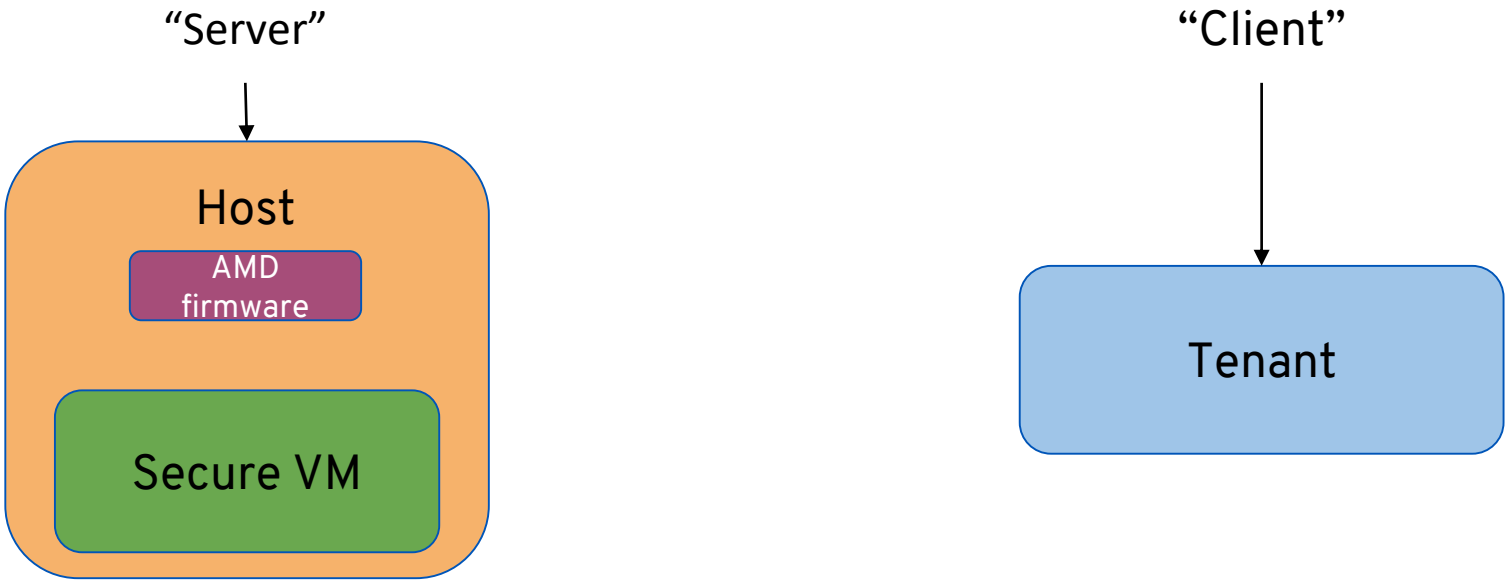
Enarx architectural components



Enarx attestation process diagram



What happens?



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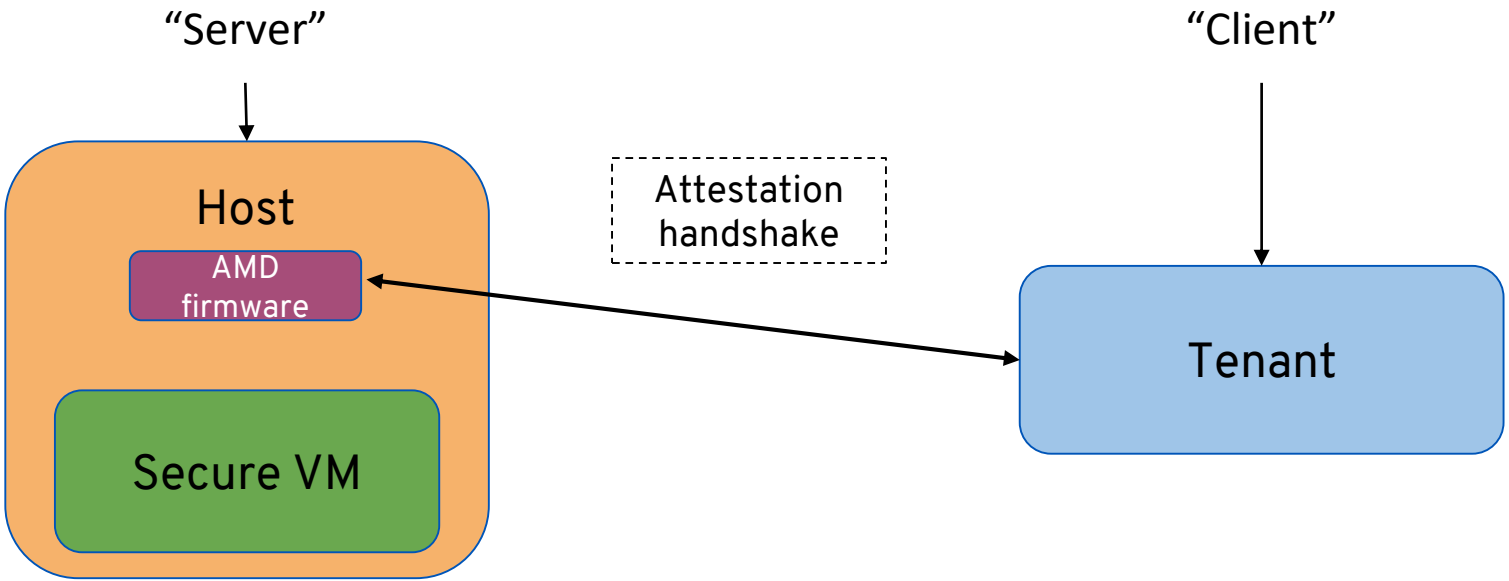

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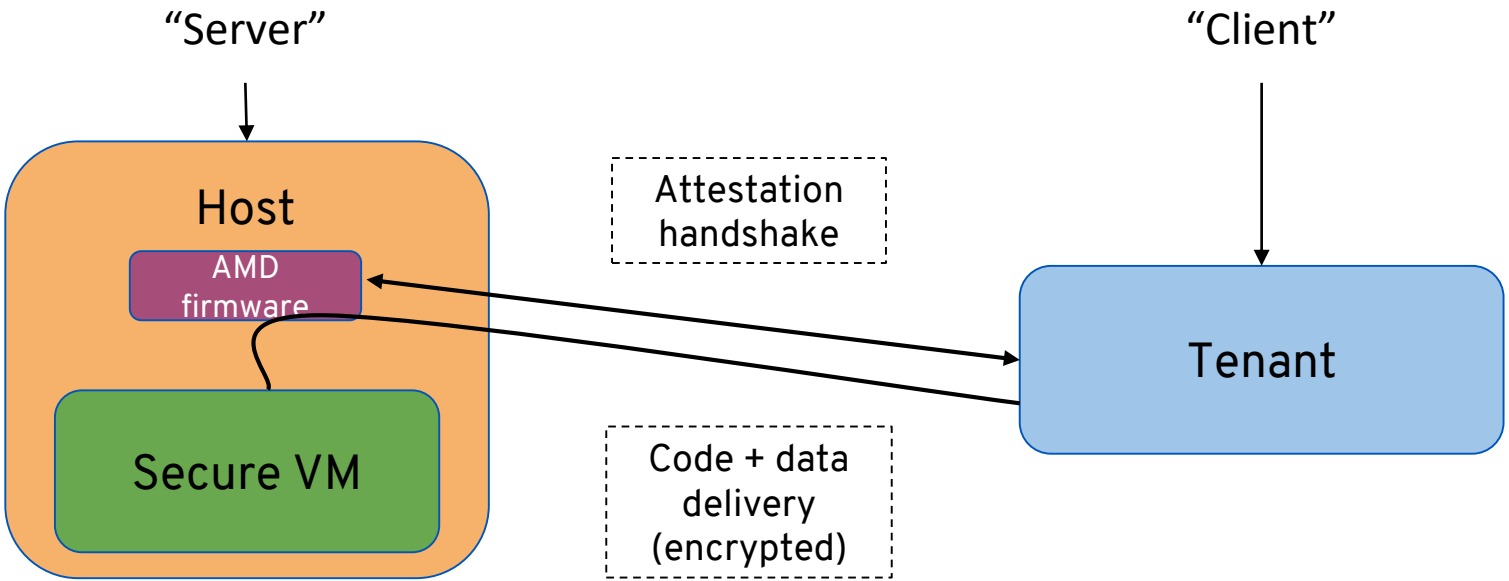

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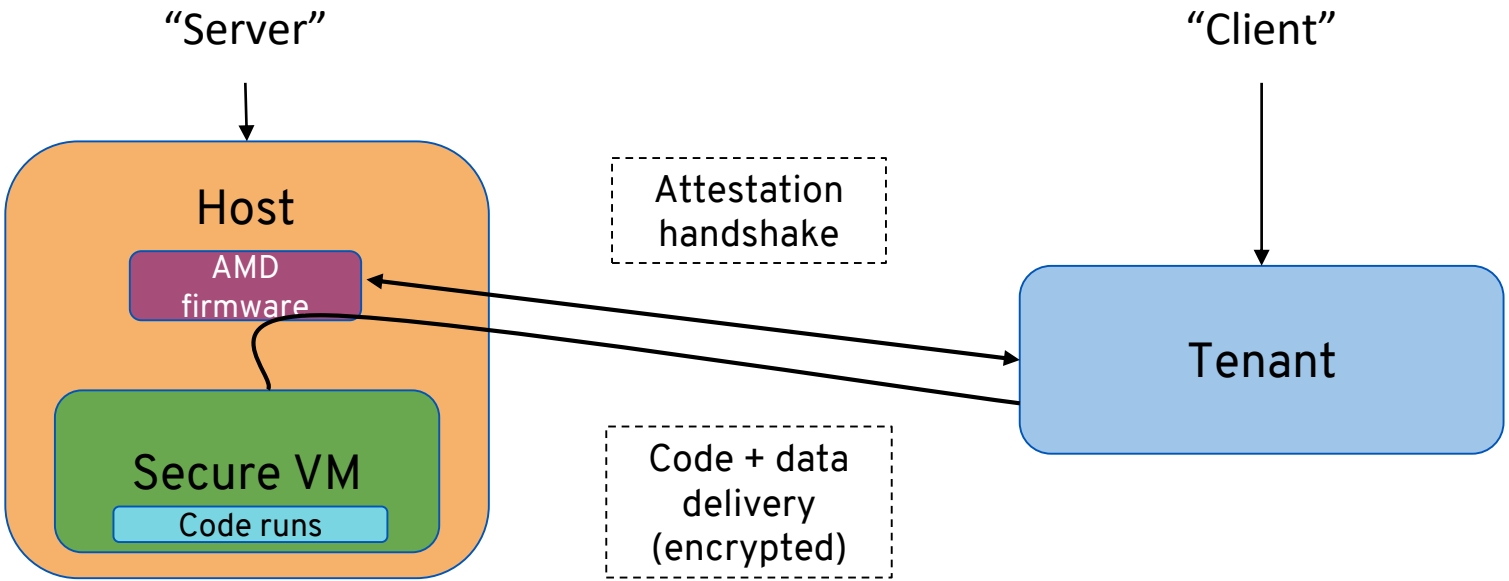
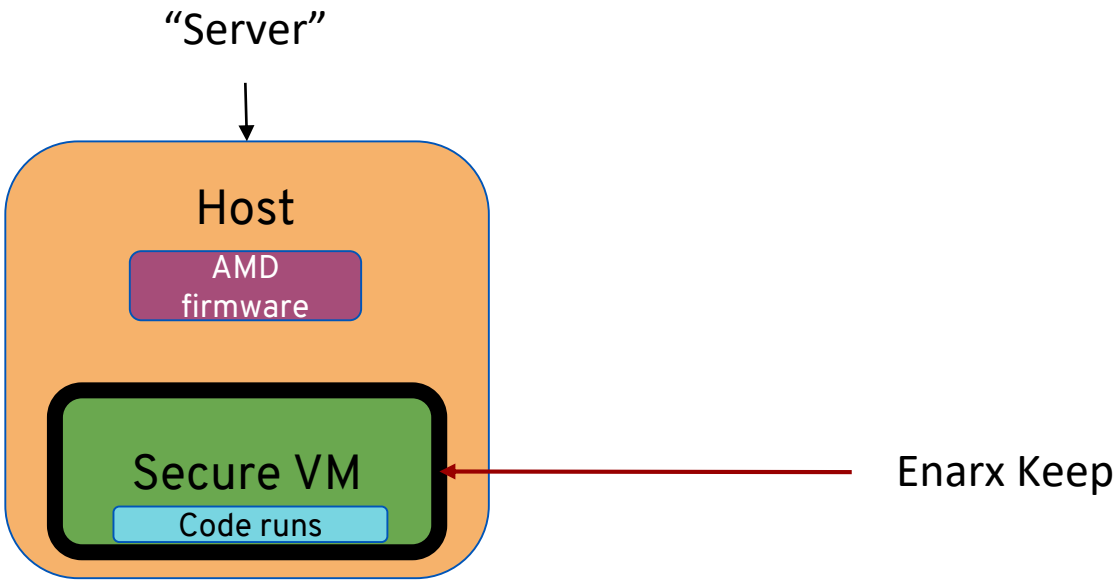
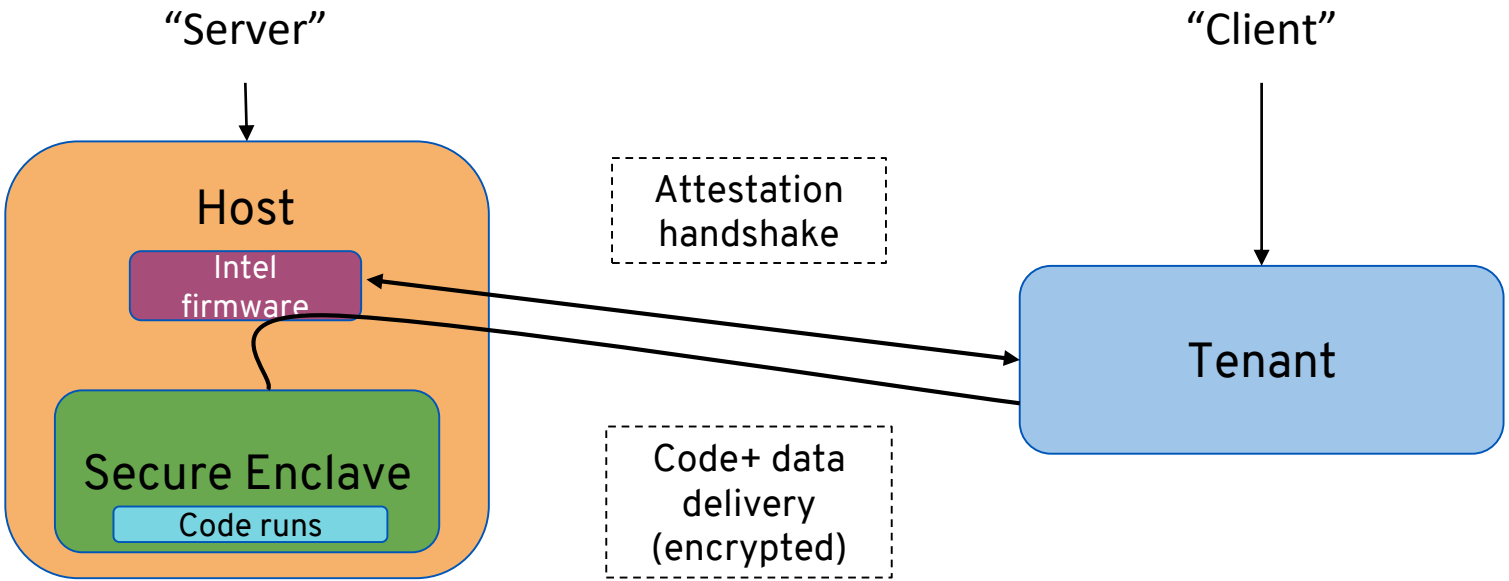


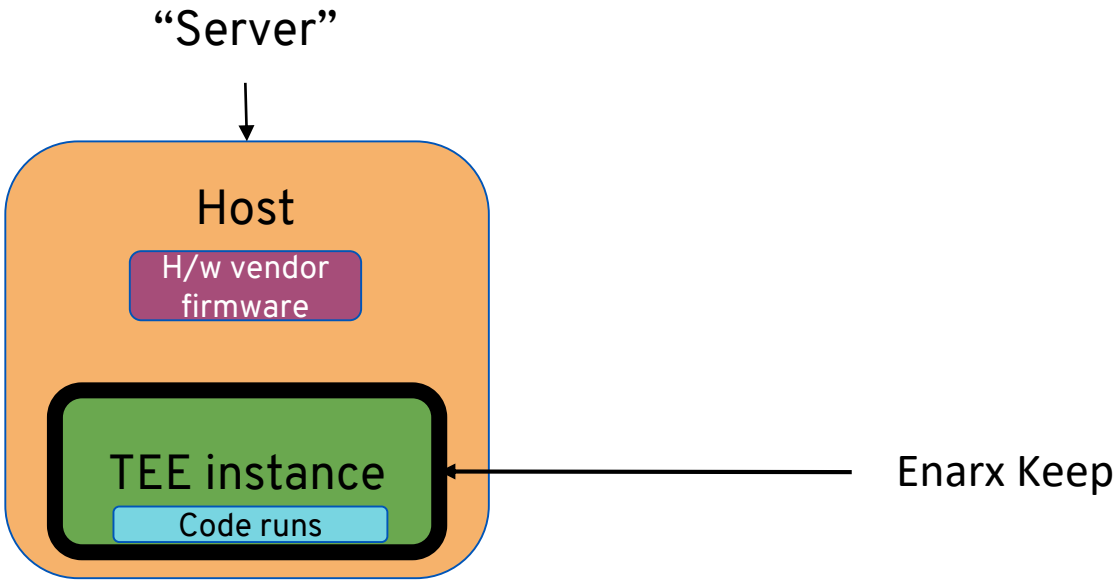
What happens? (SEV)



What happens? (SGX)



What is Enarx?



We Need Your Help!

Website: https://enarx.io

Code: https://github.com/enarx

Gitter: https://gitter.im/enarx/

License: Apache 2.0

Language: Rust

What should I do now?

When I leave this room

- Check out https://enarx.io/

When I get back to the office

- Evaluate our existing existing deployments of sensitive workloads

When my boss asks me what I learnt from the RSAC webinar

- Disclose existing weaknesses, explain the opportunities
- Ask them to let me get involved in the Enarx project

When the CTO asks my boss what I learnt from the RSAC webinar

- Ask them about joining the Confidential Computing Consortium

Questions?

https://enarx.io