A technical introduction to Enarx

Rust + WebAssembly + TEEs = Confidential Computing

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https://enarx.dev

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State of the project

(skip to the interesting part)

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- End-to-end demo available
  - SEV (AMD) - working!
  - SGX (Intel) - imminent!

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Enarx overview

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- Easy development and deployment
- Strong security design principles
- Cloud-native → Openshift, kubernetes
- Open source: *project*, not production-ready (yet)

Isolation

Workloads and the host

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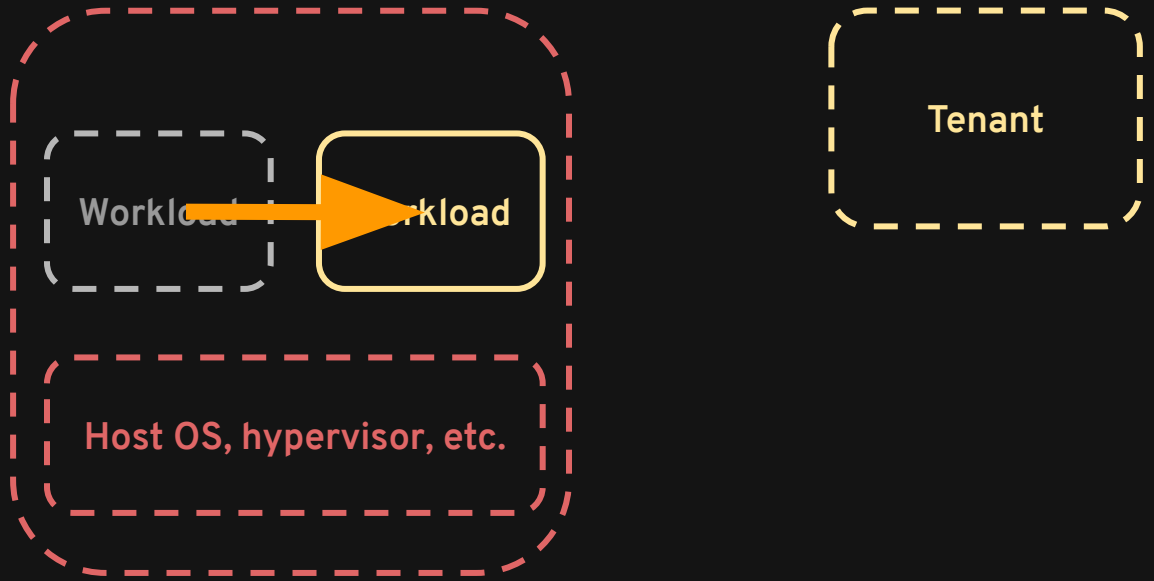
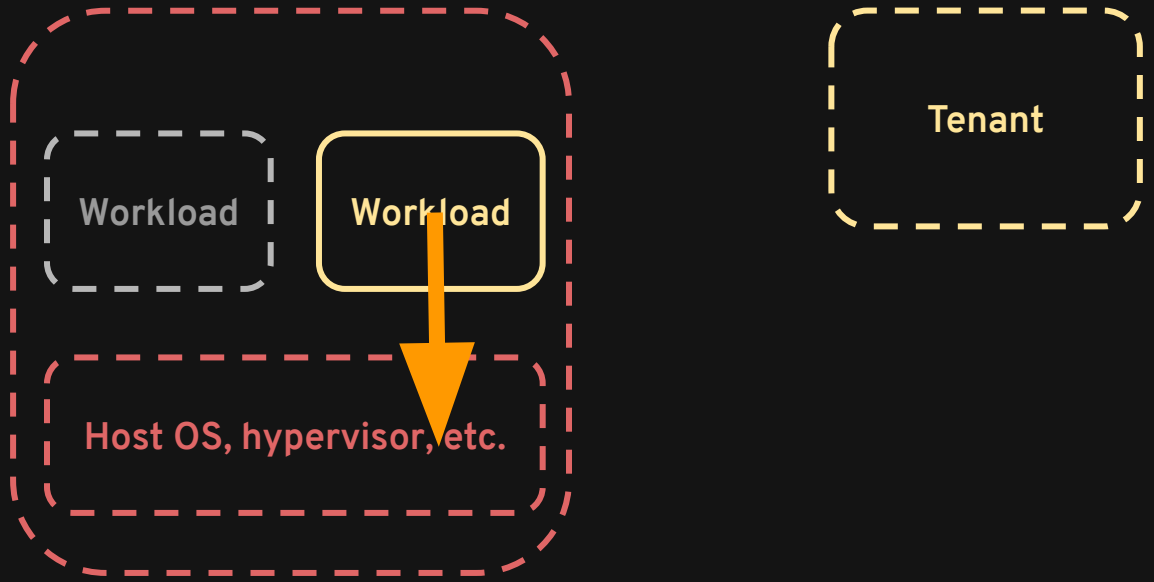
The 3 types of isolation

Workload from workload isolation



Workload from workload isolation

Host from workload isolation



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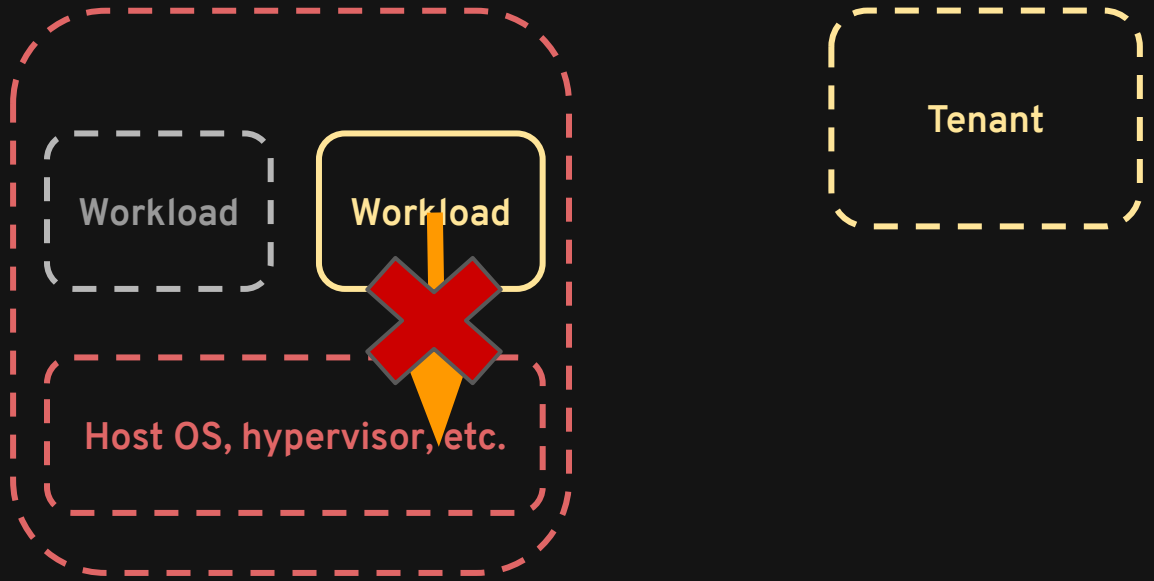
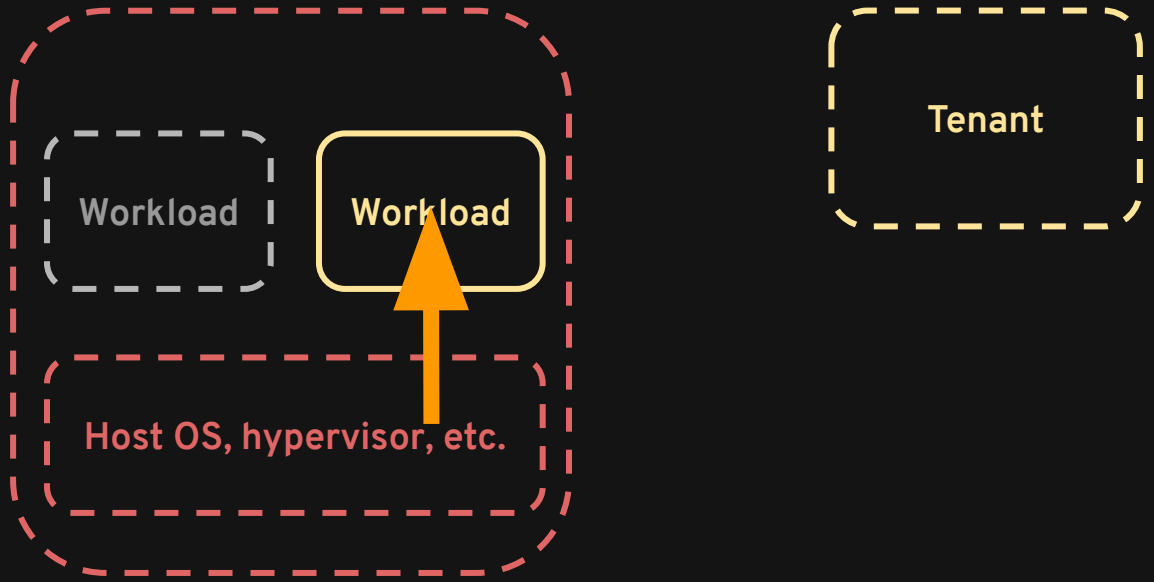


Workload from host isolation



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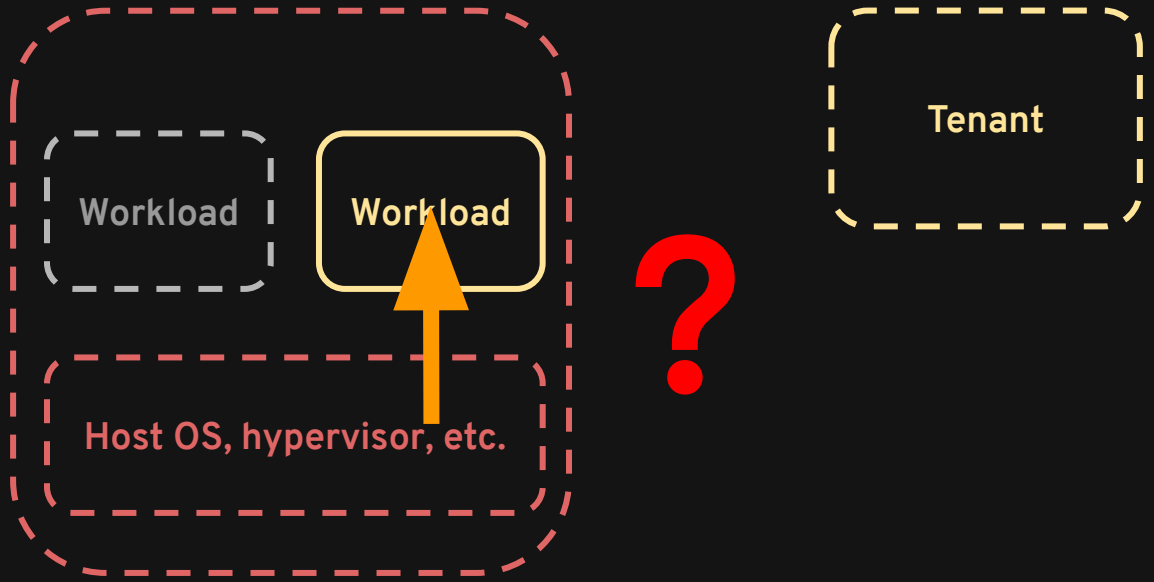
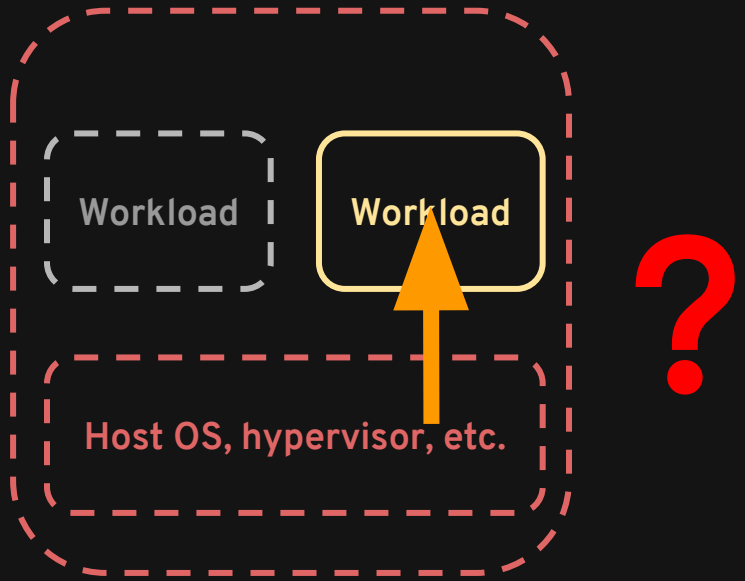


Workload from host isolation



Tenant

Sensitive workloads

Cloud for regulated sectors

- Healthcare, Finance, Government, Enterprise, ...

Vulnerable hosts

- Edge, IoT, ...

TEEs sound great, but…

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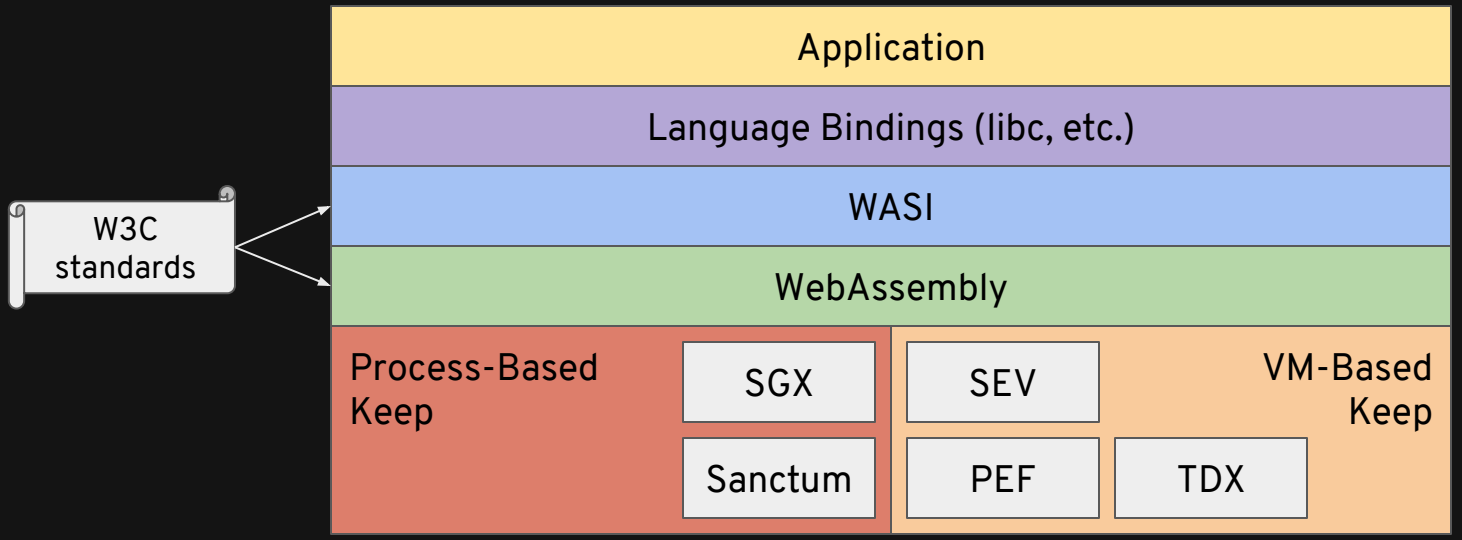
… I just want to deploy workloads!

Introducing Enarx

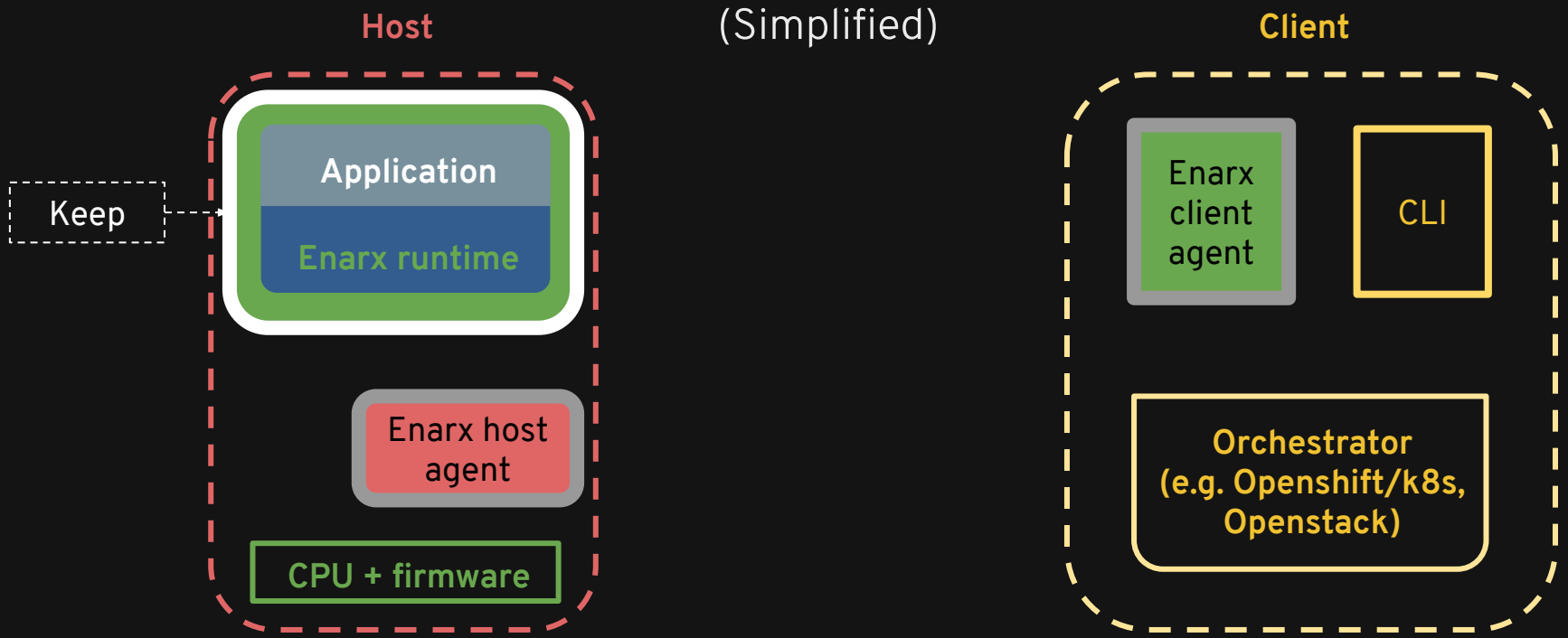
Enarx Runtime Architecture



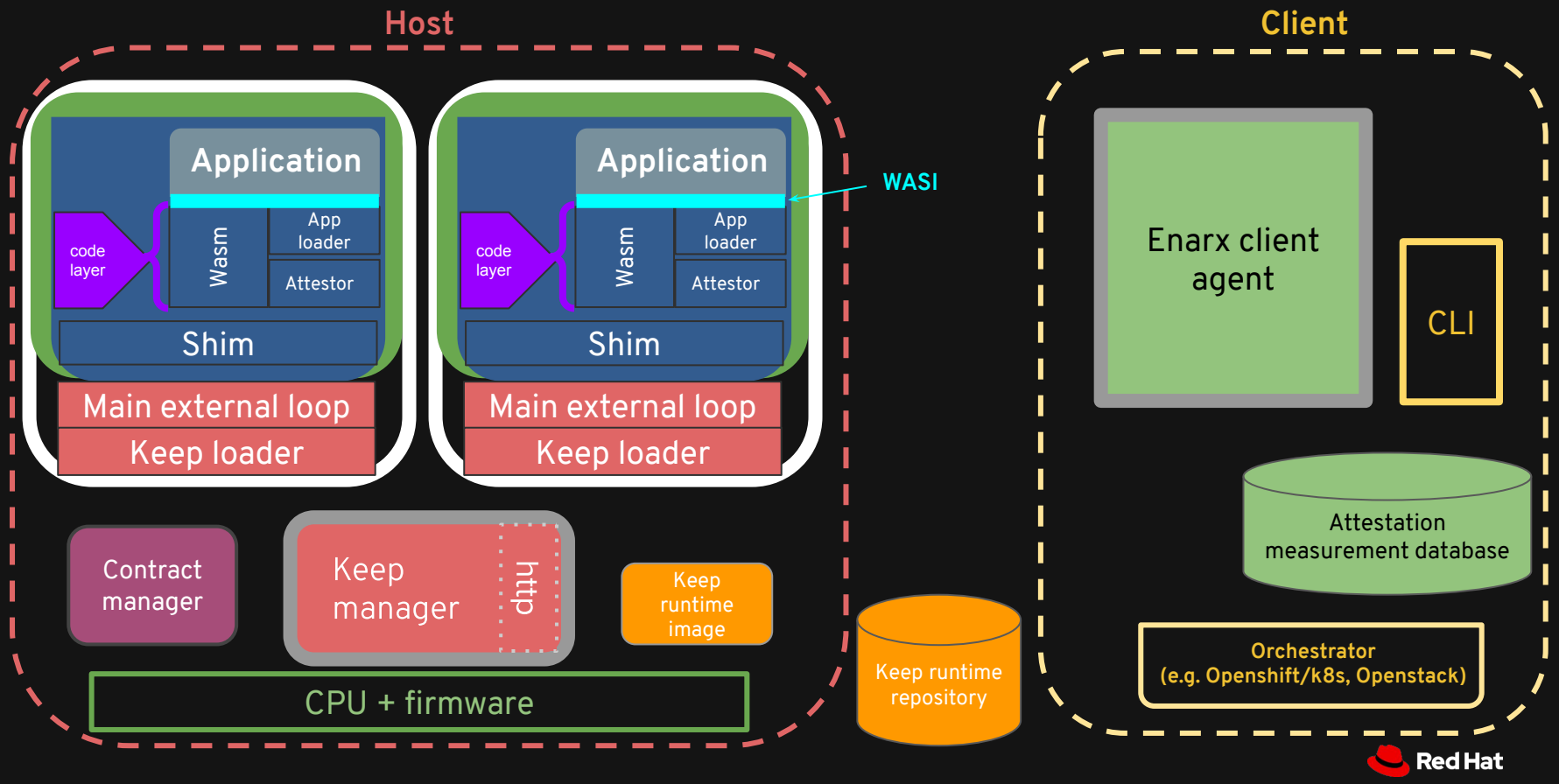
Architectural View

Enarx architectural components & integrations

(Simplified)



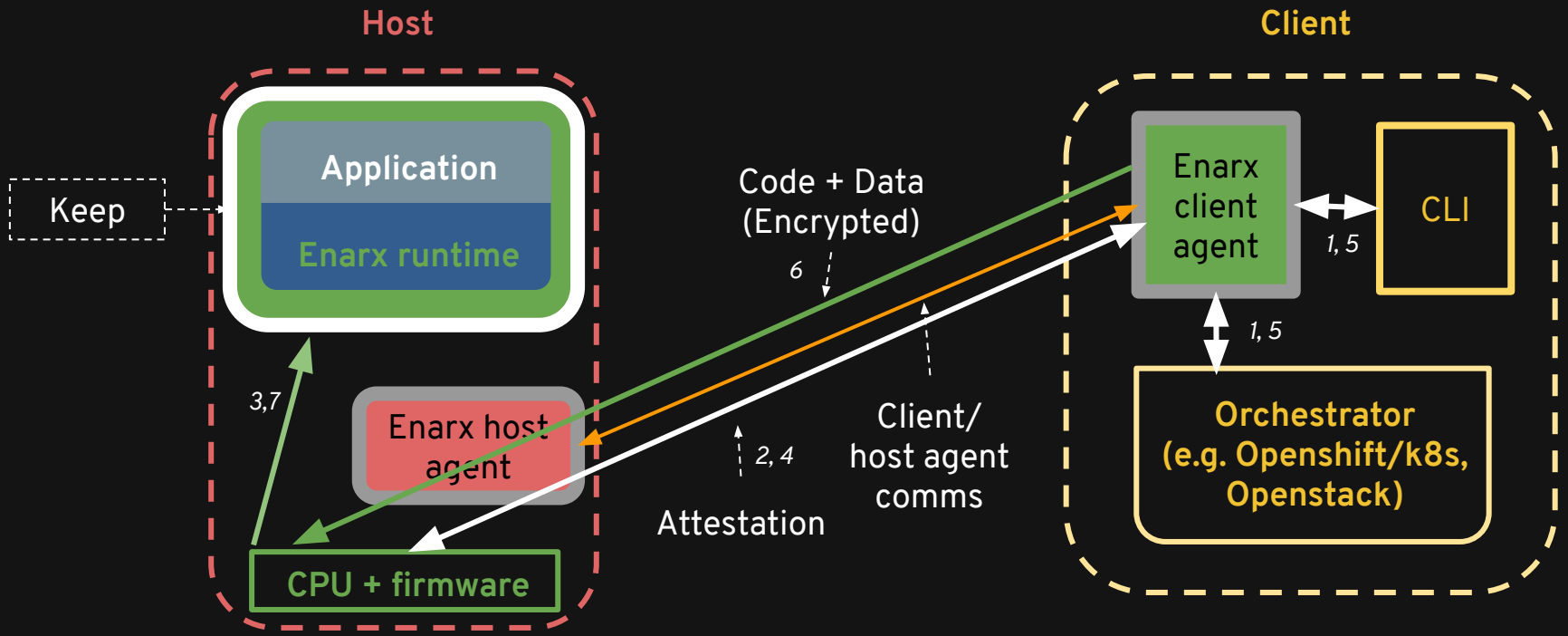
Enarx architectural components



Demo Time!

Process flow

Enarx architectural components



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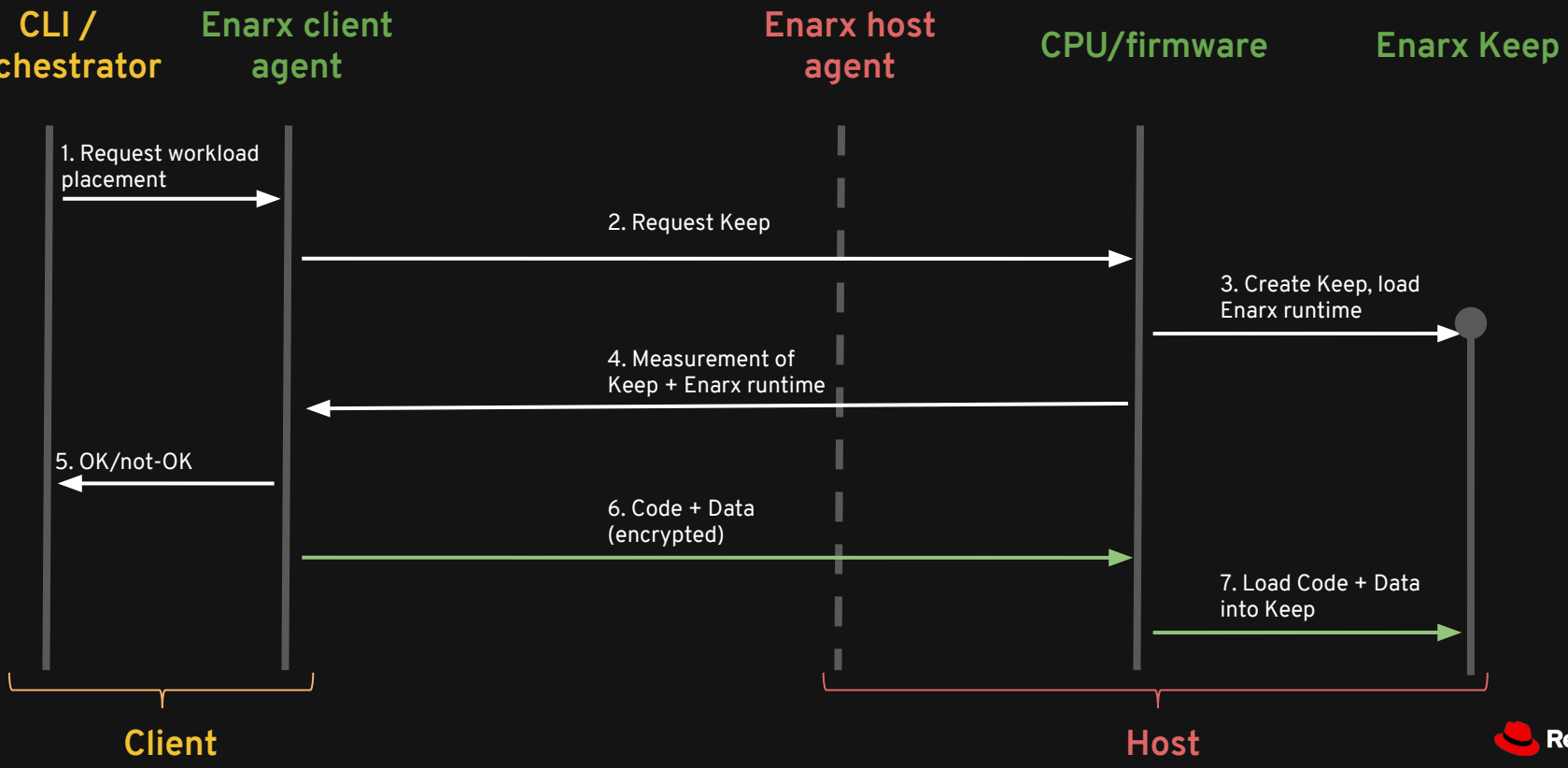
Enarx attestation process diagram



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Enarx Design Principles

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 importance of openness

Diversity of thought and experience

The importance of openness

Diversity of thought and experience

- Discover use cases
- Explore architecture
- Challenge designs
- Review implementation
- Increase test coverage
- Clarify documentation

The importance of openness

Diversity of thought and experience

Ease of involvement

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Ease of involvement

- More voices
- More expertise
- More welcoming environment

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Visibility of code and design

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Ease of involvement

Visibility of code and design

- Auditability
- But only if combined with ***diversity*** and ***involvement***

We are an open project

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

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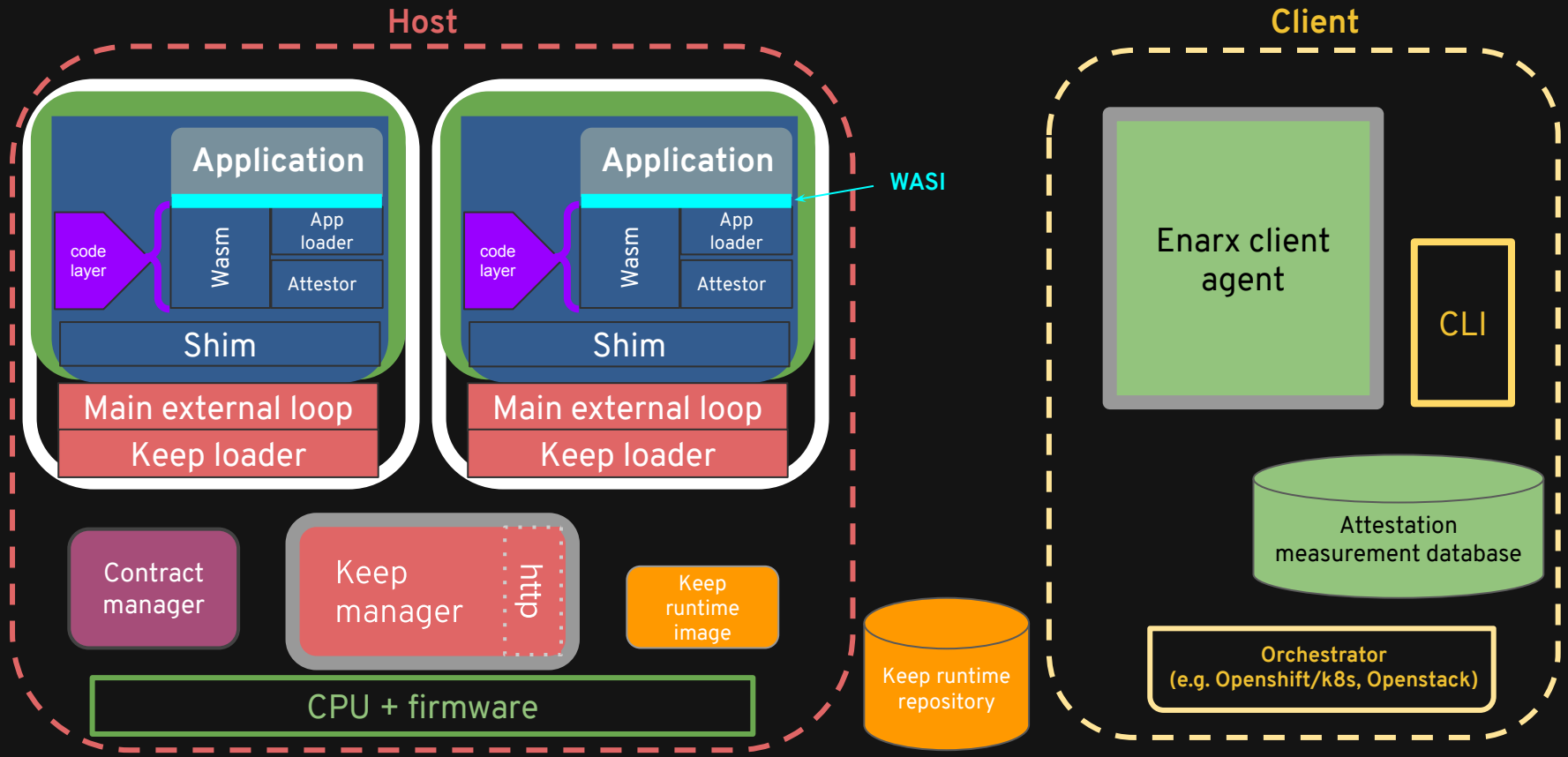

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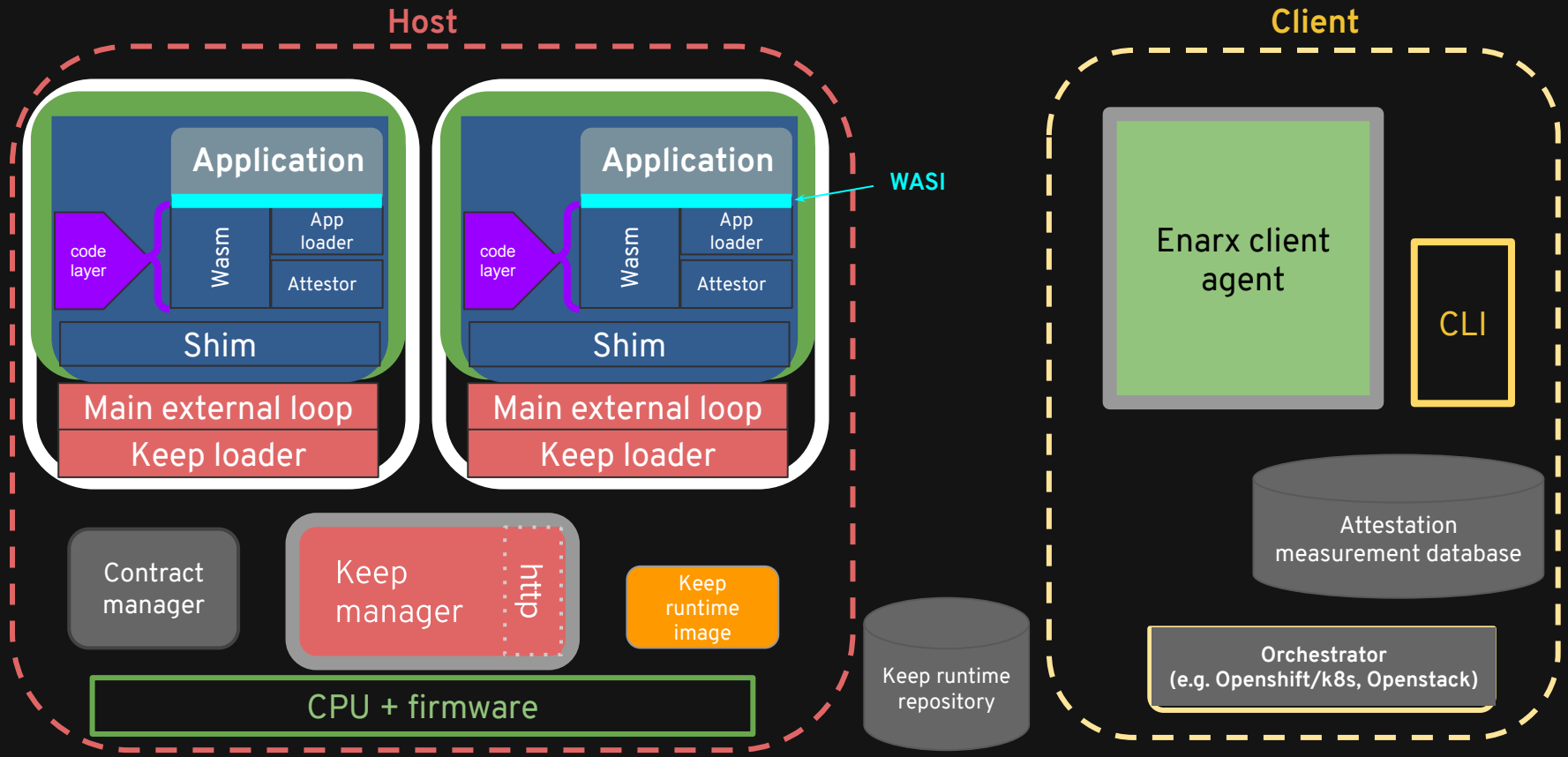

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Key component repositories

- enarx-keepldr - Keep loading, execution and management
- enarx-wasmldr - loads and executes workloads
- enarx-keepmgr - manages multiple Keeps per host
- client - requests and attests Keeps, provisions workloads
- Infrastructure/glue
  - Platform-specifics (e.g. sev, sevctl, sgx)
  - koine - shared communications pieces
  - ciborium - CBOR-encoding/decoding crate

Note: some code awaiting merging as of 2021-01-26!

Getting involved

- Follow us on social media!
- Download, (compile,) run, test, report
  - Users / workload developers
  - Project developers
- Audit designs and implementations
- Document
- Community building and outreach

Useful technical skill-sets

Most important is willingness to learn

- SEV, SGX expertise
- WebAssembly
  - Compiler
  - WASI
- Micro-kernel/syscall
- Linux systems programming
  - Networking, storage
- Kubernetes/Openshift integration skills
- Security auditing/research
- Rust!

Where to find us

Website:	https://enarx.dev
Code:	https://github.com/enarx
Chat:	https://chat.enarx.dev
Twitter:	@enarxproject
LinkedIn:	https://www.linkedin.com/company/enarx
YouTube:	Search “Enarx”
License:	Apache 2.0
Language:	Rust (with a smattering of x86 Assembly)

Questions?

https://enarx.dev

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Back-up slides

Component level trust

Enarx architectural components

Enarx Keep - trusted
Measured and attested
WebAssembly+WASI runtime
Inside a TEE instance

Enarx client agent

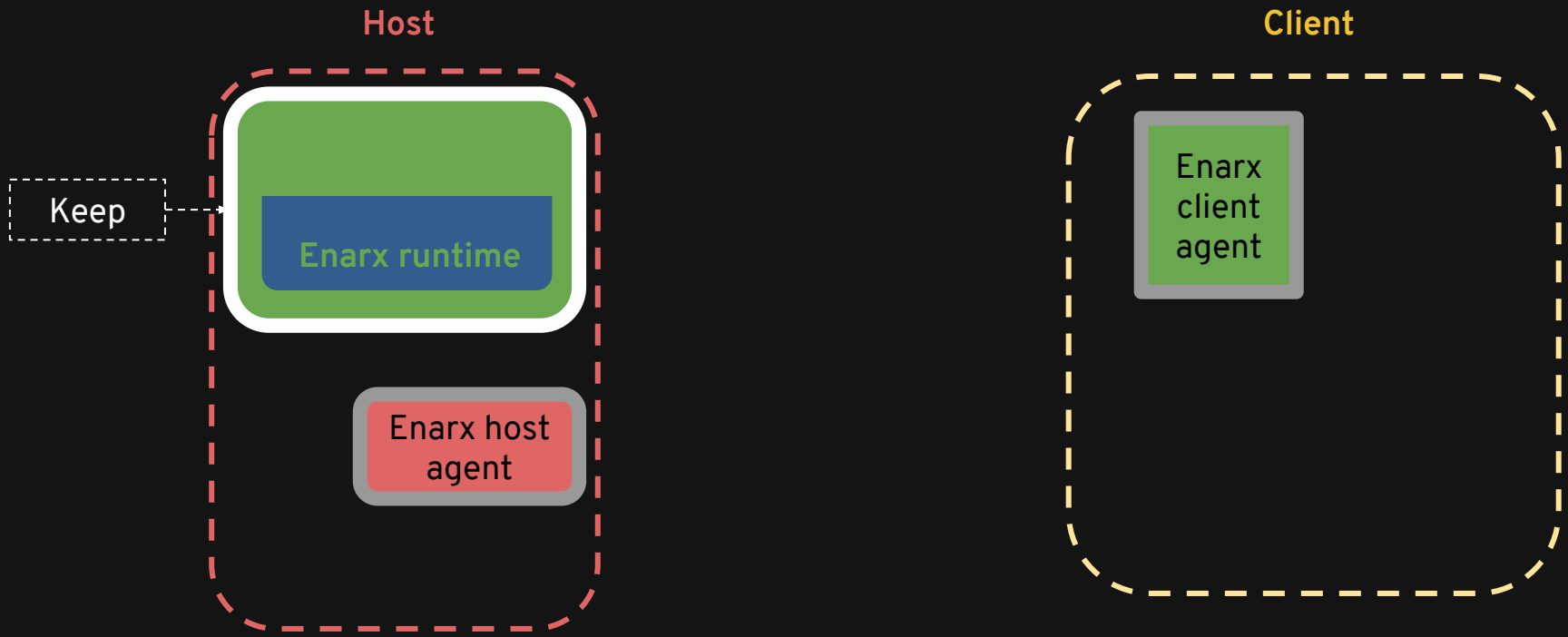
Enarx client agent - trusted
Works with orchestration/CLI
Manages attestation
Applies policy
Encrypts and transports workload

Enarx host agent

Enarx host agent - untrusted
Acts as proxy between Enarx client agent and:

- CPU/firmware
- Enarx Keep

Enarx architectural components



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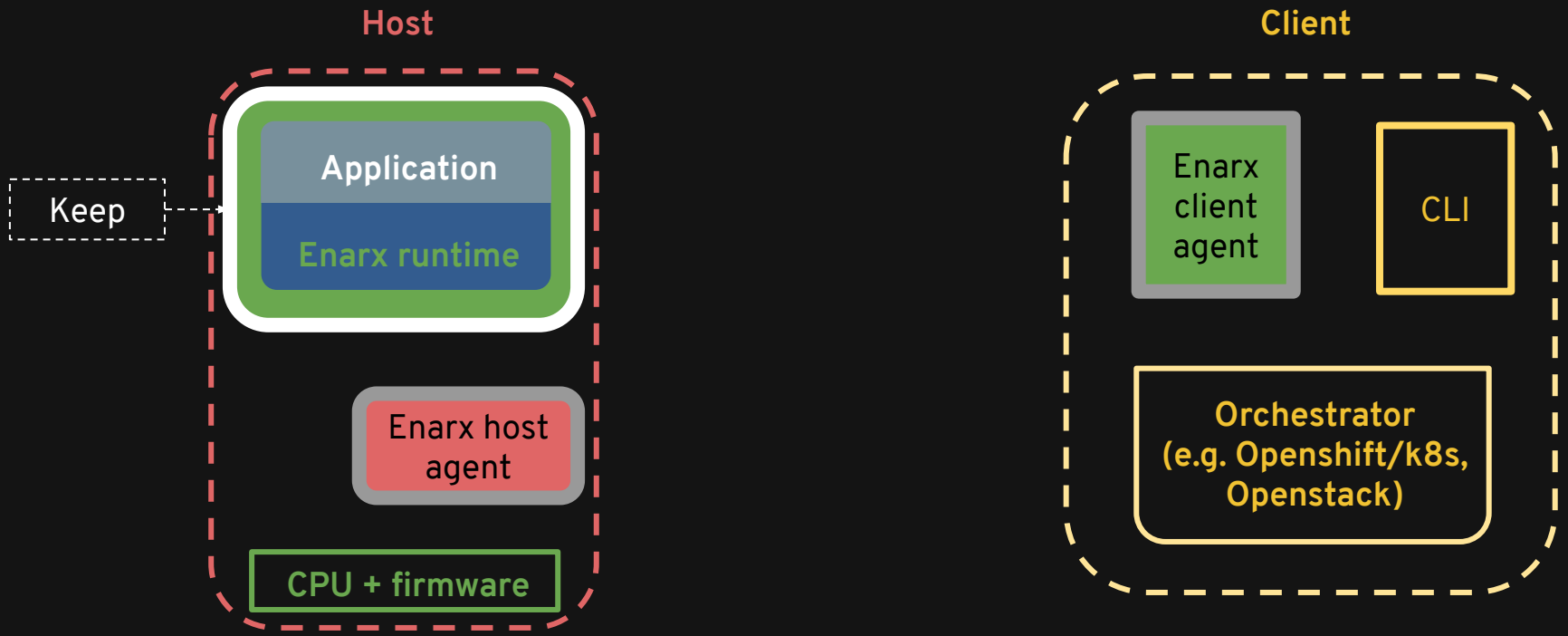
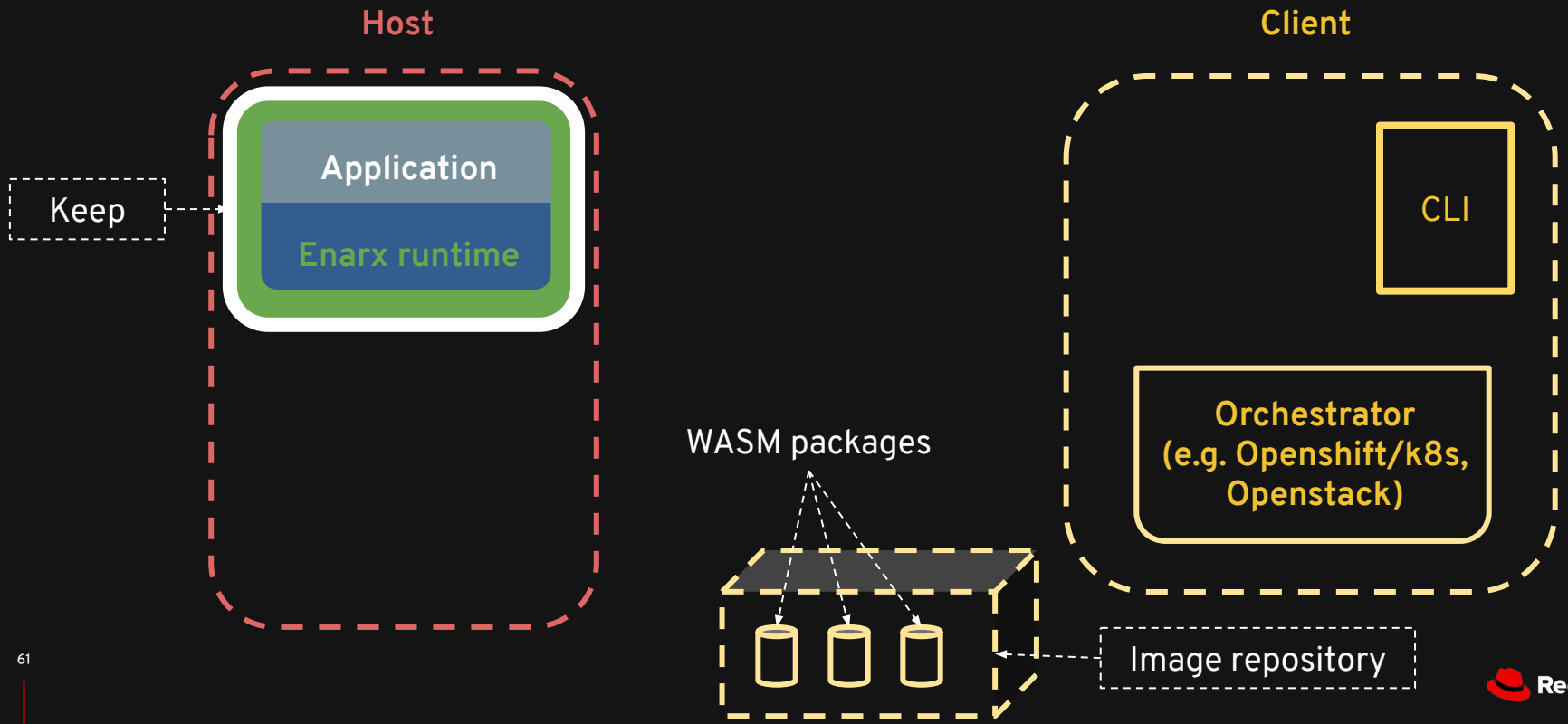
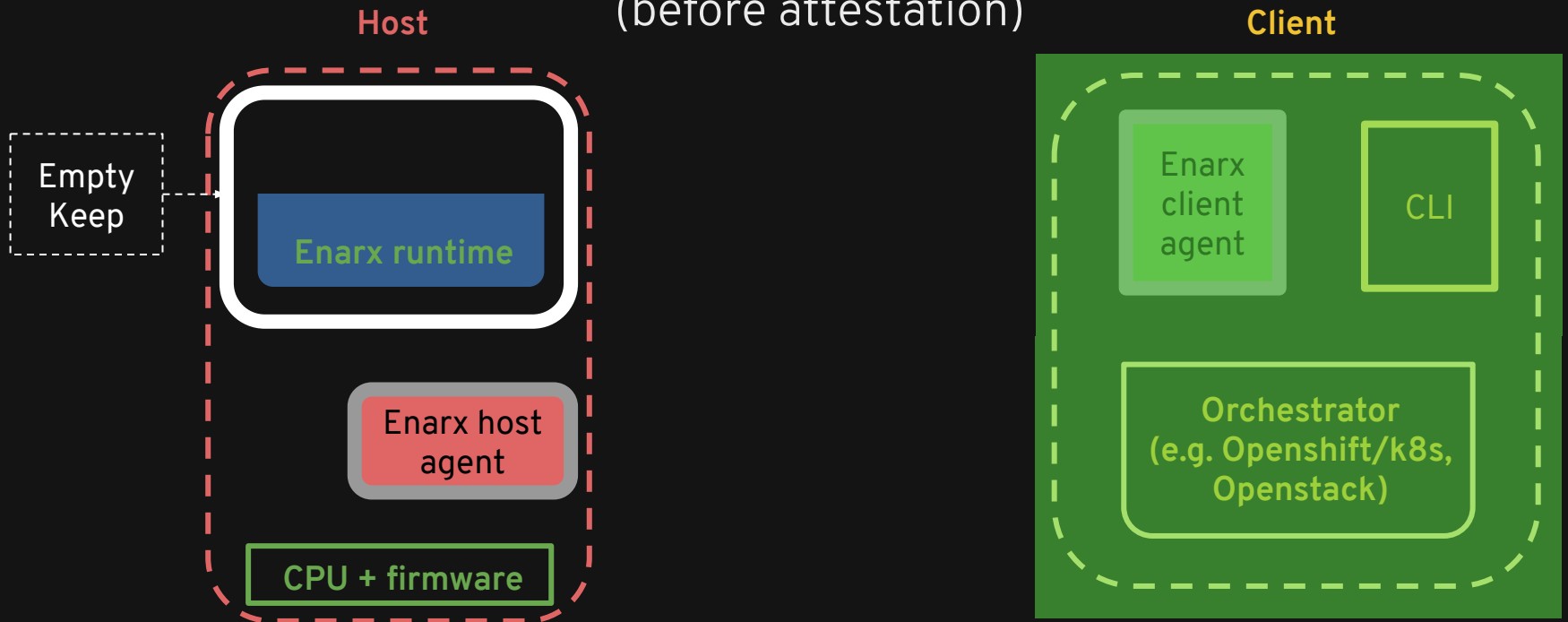


Basic deployment architecture



Standard Enarx trust domain (before attestation)



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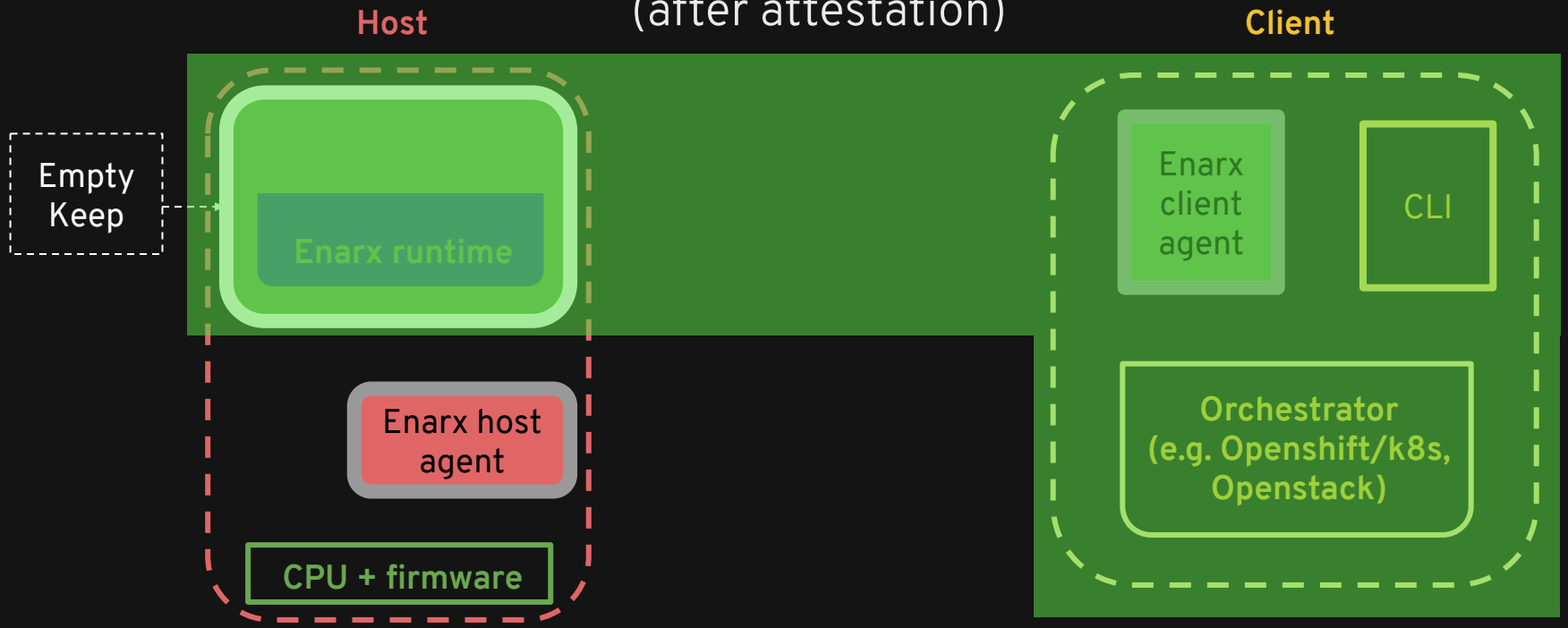
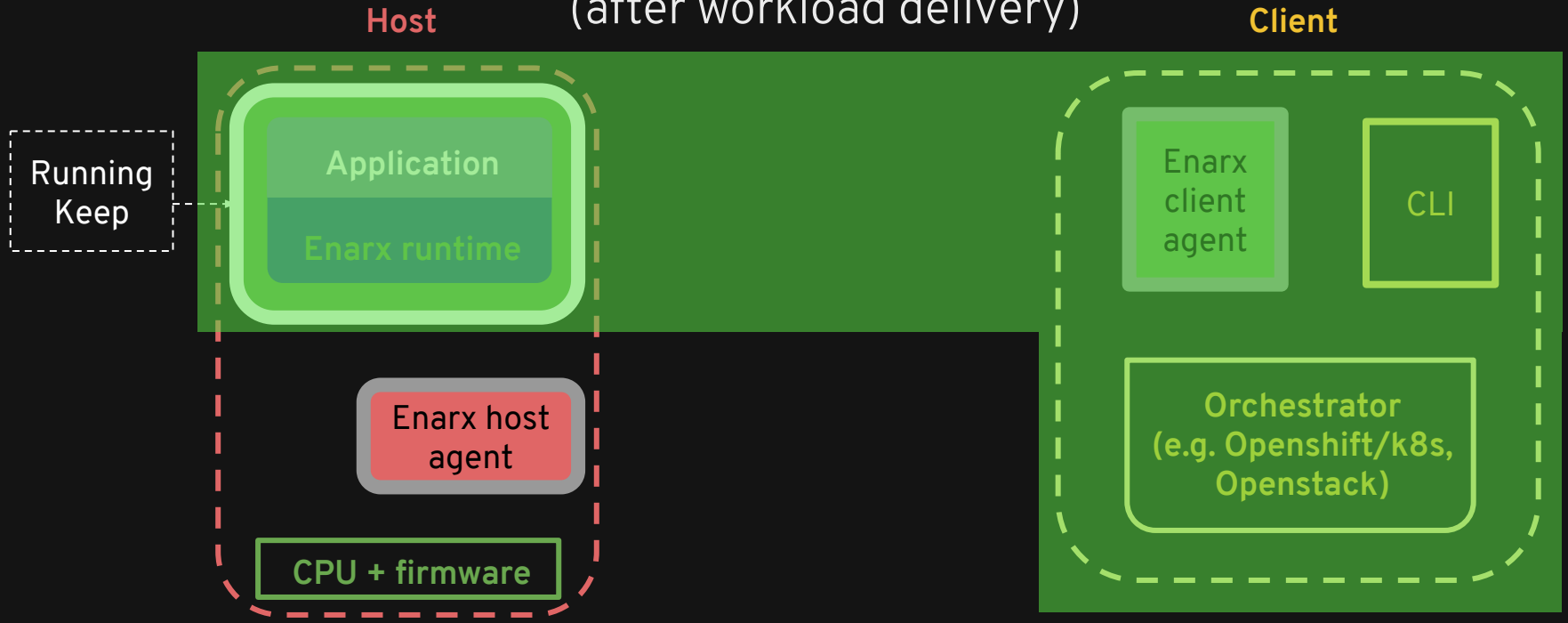


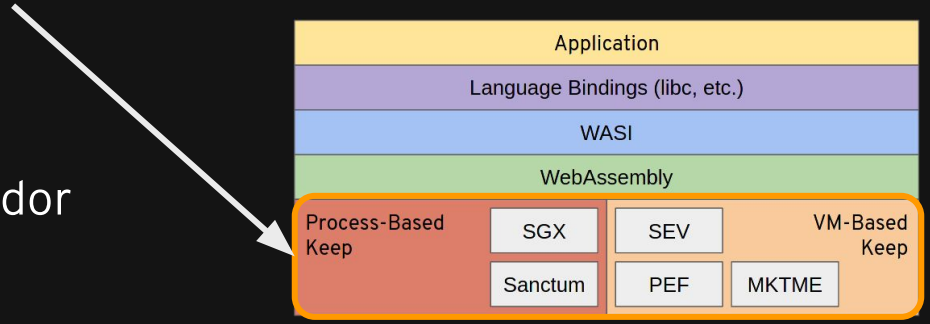
Standard Enarx trust domain (after workload delivery)



Keep layers

Keep - process or VM-based

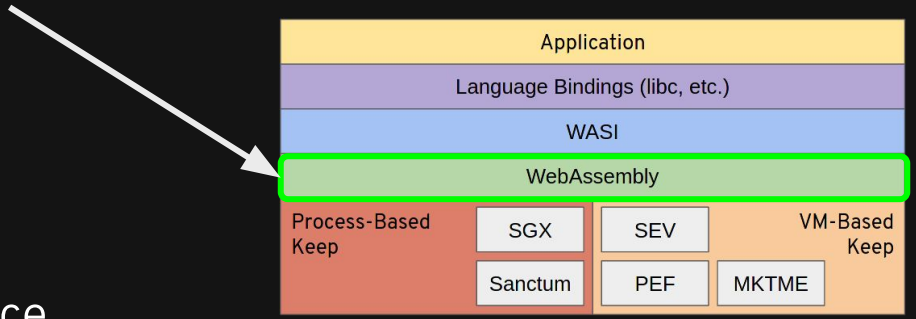
- Core Keep
- Platform-specific
  - Hardware (CPU): silicon vendor
  - Firmware: silicon vendor
  - Software: Enarx



Architecture varies between VM/Process-based platforms

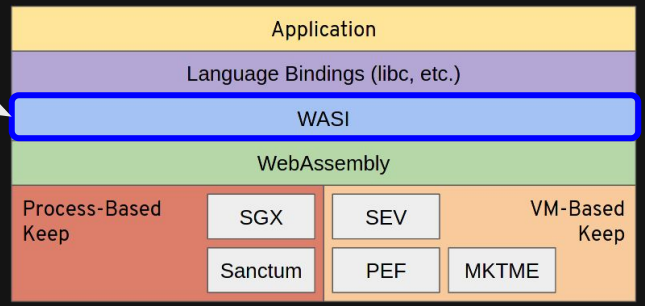
WebAssembly (WASM)

- 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)

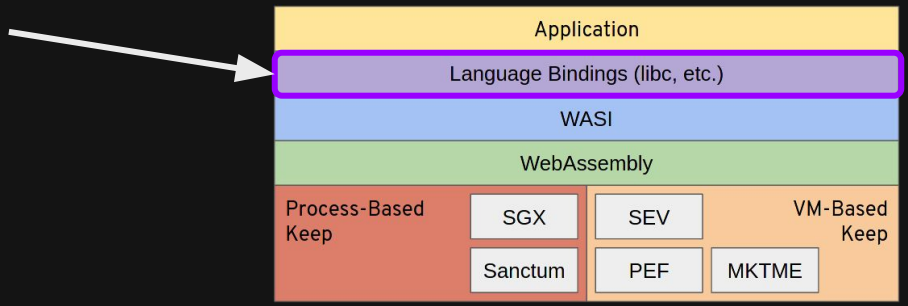
- W3C Standards Track
- Heavily inspired by a subset of POSIX
- Primary goals:
  - Portability
  - Security
- libc implementation on top
- Capability-based security:
  - No absolute resources
  - Think: openat() but not open()



Language Bindings (libc, etc.)

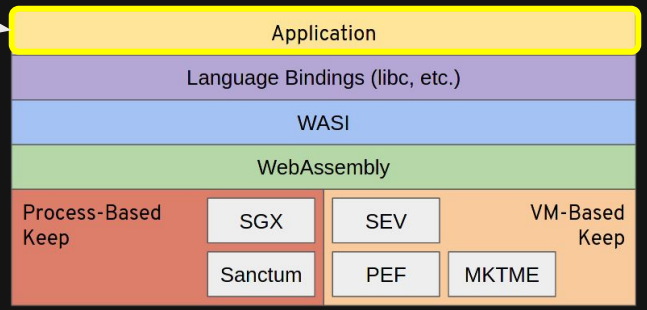
Compilation targets and includes, e.g.

- Rust: `--target wasm32-wasi`

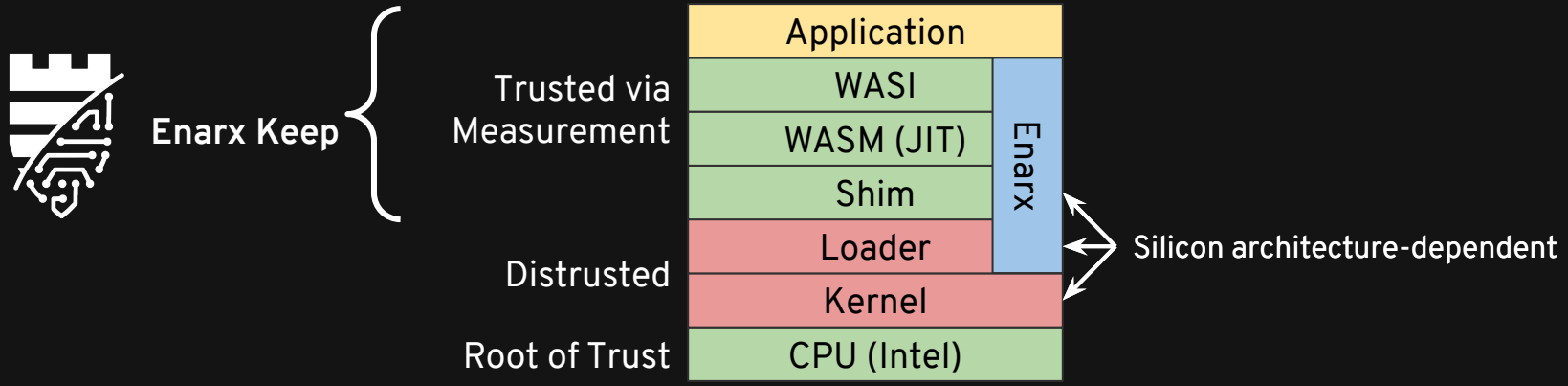


Application

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



Layers - process-based Keep



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