CONFIDENTIAL COMPUTING SUMMIT 2023

vmware

An Open-Source Certifier Framework for Confidential Computing

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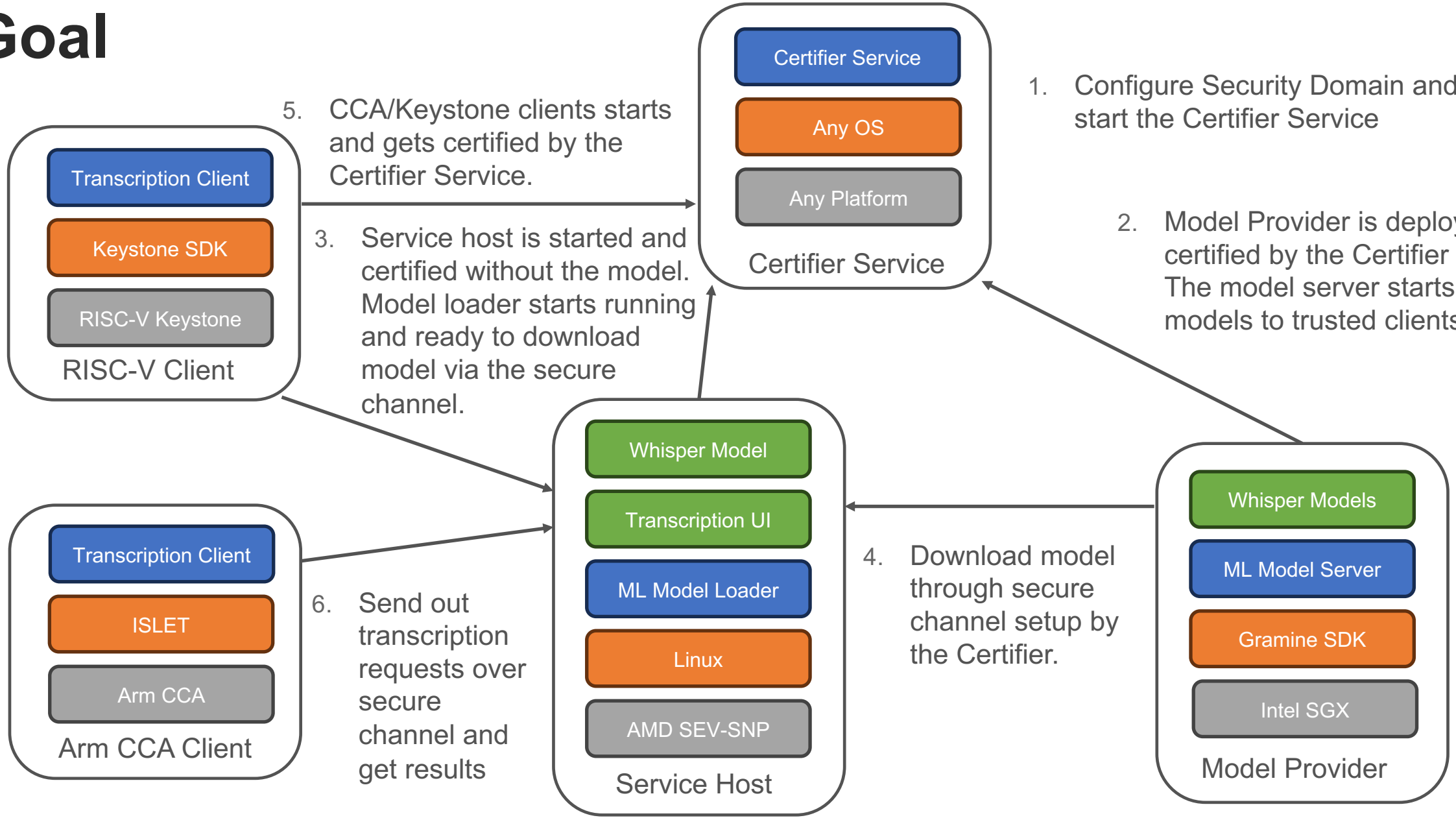
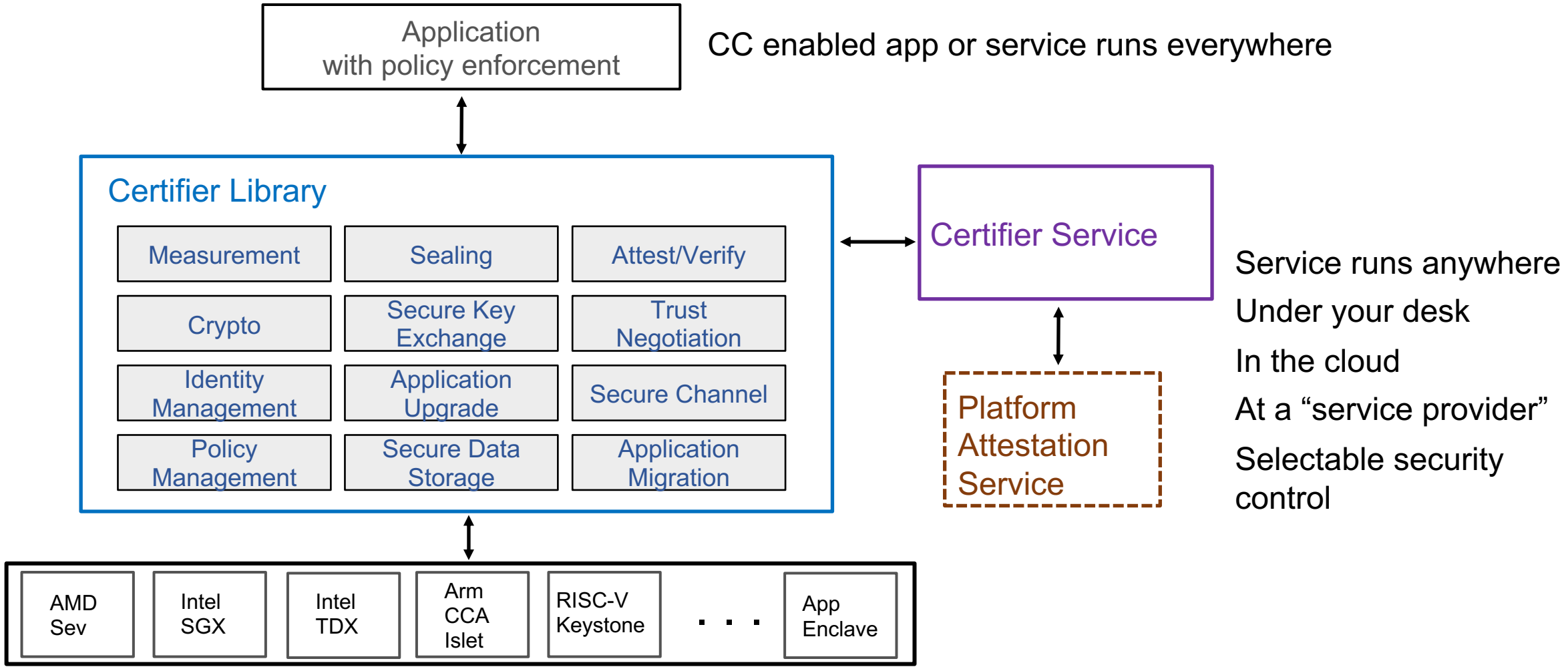
Organized by Opaque and Confidential Computing Consortium

Goal


Certifier Service
Any OS
Any Platform
Certifier Service
1. Configure Security Domain and start the Certifier Service
2. Model Provider is deployed and certified by the Certifier Service. The model server starts serving models to trusted clients.
5. CCA/Keystone clients starts and gets certified by the Certifier Service.
3. Service host is started and certified without the model. Model loader starts running and ready to download model via the secure channel.
Transcription Client
Keystone SDK
RISC-V Keystone
RISC-V Client
Whisper Model
Transcription UI
ML Model Loader
Linux
AMD SEV-SNP
Service Host
Whisper Models
ML Model Server
Gramine SDK
Intel SGX
Model Provider
4. Download model through secure channel setup by the Certifier.
Transcription Client
ISLET
Arm CCA
Arm CCA Client
6. Send out transcription requests over secure channel and get results

The Certifier Framework for Confidential Computing

Taking the devil out of the details in CC software development



Certifier Concepts and API

Key Concepts:

Security Domain	Identified by a public key associated with all application code within a trusted environment.
Certification	Refers to the verification of all properties in the security domain (including program identity, involving attestation) resulting in an x509 certificate for trust.
Trust and Policy	Should not be hard-coded in an application which should be able to operate in compliance in different security domains. Don't complicate program development or deployment.

C++ Classes:

`cc_trust_data`	Basic interface to establish keys, policy and manage certification with the certifier service.
`secure_authenticated_channel`	Establishes secure channel with an "authenticated program in security domain
`policy_store`	Stores policy, keys, communications endpoints securely. Additional helper function APIs for complicated applications.

Additional helper function APIs for complicated applications.

Most applications will use exactly this (and nothing else)

```
string public_key_alg("rsa-2048"); string symmetric_key_alg("aes-256-gcm");
cc_trust_data app_trust_data(“sev-enclave”, “authentication”, “store”);

app_trust_data.initialize_sev_enclave_data(…); // init enclave
app_trust_data.init_policy_key(initialized_cert_size, initialized_cert)
app_trust_data.cold_init(public_key_alg, symmetric_key_alg);
app_trust_data.certify_me(host, port); // Get admission certificate

secure_authenticated_channel channel(“client”);
channel.init_client_ssl(host, port, policy-key, auth_key, admissions-cert);

// Your application here
```

Certifier: “Simple Example” App

```
Running App as server
    Client peer id is Measured
    8522d8e996e0089b26cb5dde06341c728e3017fa78974e3dce364bef56bdd307
    SSL server read: Hi from your secret client
```

```
Running App as client
    Server peer id : Measured
    8522d8e996e0089b26cb5dde06341c728e3017fa78974e3dce364bef56bdd307
    SSL client read: Hi from your secret server
```

You may want to add:

- API serialization
- ACLs for differentiated access
- Standard “distributed programming” primitives

Works on all CC platforms:

- Simulated enclave
- AMD Sev-SNP
- Intel SGX (Gramine and OE)
- Arm CCA (Samsung Islet)
- RISC-V Keystone
- Intel TDX (when it’s ready)
- Application enclave service

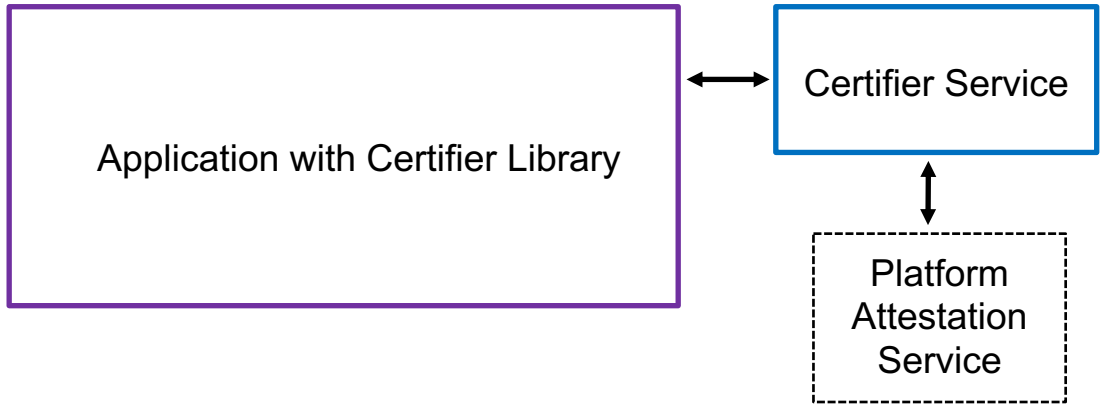
Certifier API: Observations

1. **Simple** for most applications (and **adequate** for complex ones)
2. Abstracts underlying **isolate**, **measure**, **seal/unseal**, and **attest** primitives
3. Provides a **secure store** for save/recovery operations (in one statement!).
4. Includes mechanism to establish a **secure channel** within security domain
    - Encrypted, integrity protected, bi-directional, with authenticated trusted enclave named by their measurements

5. Almost as simple as **“Hello world”**

Certifier Service

“Centralized” management for a security domain



- Policy-driven (rooted in key associated with application)
- Admits new components without changing old ones
- Application upgrade without changing other applications
- Facilitates data migration and sharing in a domain
- Enforce security domain wide policy
- Machine capabilities
- Revocation

Scalable, resilient deployment supporting all environments

Policy example

```
1. Key[rsa, policyKey, a5fc2b7e629fbbfb04b056a993a473af3540bbfe] is-trusted

2. Key[rsa, policyKey, ... ] says Measurement[a051a41593ced366462caea392830628742943c3e81892ac17b70dab6fff0e10] is-trusted

3. Key[rsa, policyKey, ...] says Key[rsa, platformKey, ...] is-trusted-for-attestation

4. Key[rsa, platformKey, ...] says Key[rsa, attestKey, ...] is-trusted-for-attestation
```

Proof from the Certifier Service

1. `Key[rsa, policyKey, ...] is-trusted and Key[rsa, policyKey, ...] says Measurement[a051a41593ced366462caea3928306287429 43c3e81892ac17b70dab6fff0e10] is-trusted, imply via rule 3, Measurement[...] is-trusted`
2. `Key[rsa, policyKey, ...] is-trusted and Key[rsa, policyKey, ...] says Key[rsa, platformKey, ...] is-trusted-for-attestation, imply via rule 5, Key[rsa, platformKey, ...] is-trusted-for-attestation`
3. `Key[rsa, platformKey, ...] is-trusted-for-attestation and Key[rsa, platformKey, ...] says Key[rsa, attestKey, ...] is-trusted-for-attestation, imply via rule 5, Key[rsa, attestKey, ...] is-trusted-for-attestation`
4. `Key[rsa, attestKey, ...] is-trusted-for-attestation and Key[rsa, attestKey, ...] says Key[rsa, program-auth-key, ...] speaks-for Measurement[...], imply via rule 6, Key[rsa, program-auth-key, ...] speaks-for Measurement[...]`
5. `Measurement[...]is-trusted and Key[rsa, program-auth-key, ...] speaks-for Measurement[...], imply via rule 1, Key[rsa, program-auth-key, ...] is-trusted-for-authentication`

Proved: Key[rsa, program-auth-key, ...] is-trusted-for-authentication

Platform Policy

Used to verify platform characteristics

- Key[rsa, policyKey, a5fc2b7e629fbbfb04b056a993a473af3540bbfe] says Key[rsa, ARKKey, aeb214025256a56863fe9aa9c9f1cca153af4416] is-trusted-for-attestation
- Key[rsa, policyKey, a5fc2b7e629fbbfb04b056a993a473af3540bbfe] says platform[amd-sev-snp, debug: no, migrate: no, api-major: >= 0, api-minor: >= 0, smt: no, tcb-version: = 34587645138205739 73] has-trusted-platform-property

Supplants the need to use external attestation services and preserves privacy and control.

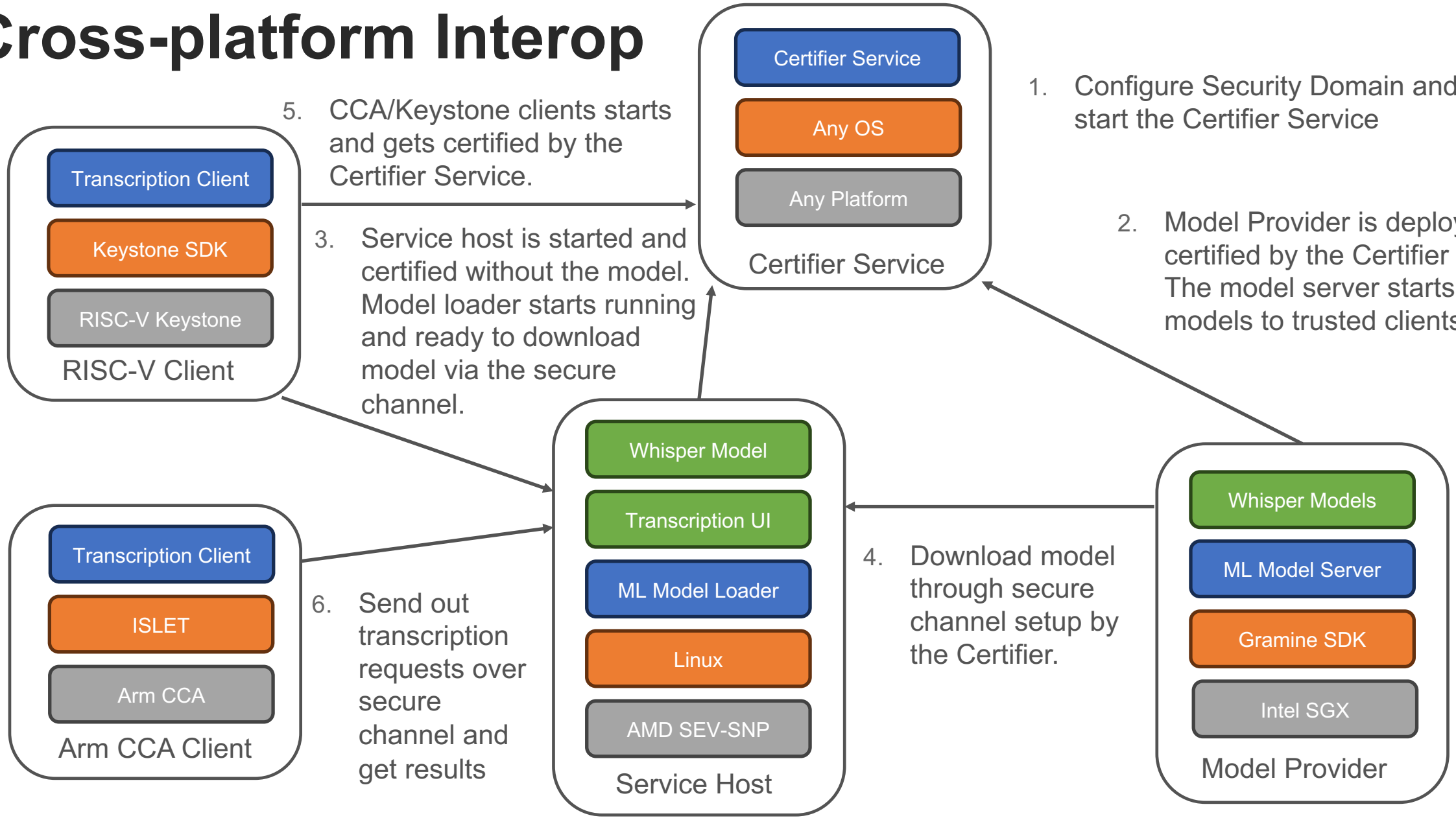
Certifier Service: Observations

1. Service provides a **policy language**, **evidence formats**, and **policy evaluation** to determine when a Confidential Computing application should be trusted.

   Evidence submitted and evaluated includes platform attestation reports. Other formats converted to “canonical form.”

2. Utilities to **generate keys** and **write policy**.
3. Checks **program** and **platform policy**
4. Issues “**Admissions Certificate for Security Domain**”

Cross-platform Interop



More to come...

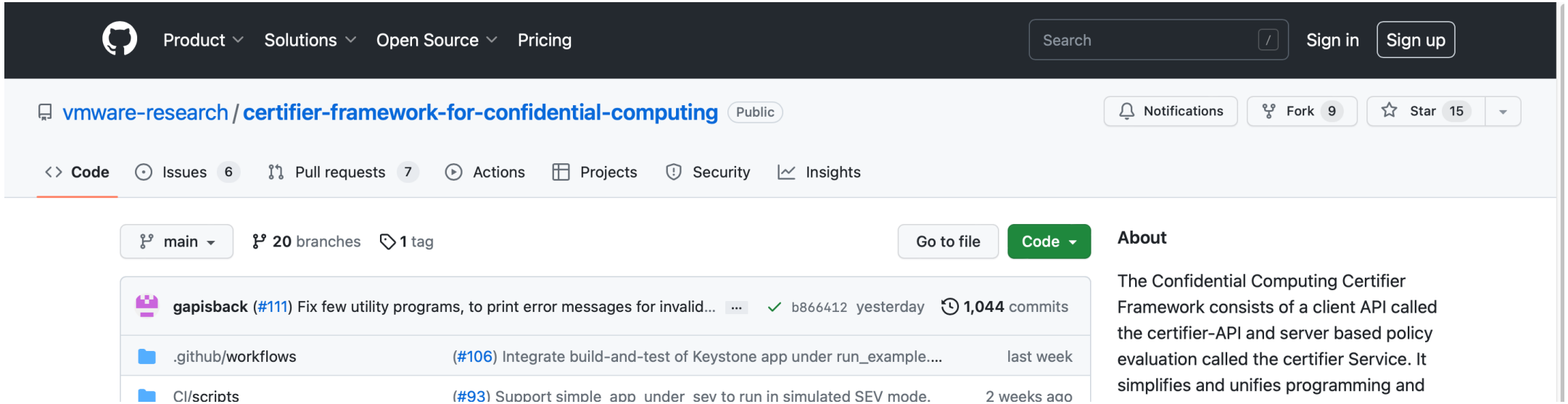
- Security review
- GPU support
- Python bindings
- Rust Client

Join the Party...

GitHub

Open-Source project

- github.com/vmware-research/certifier-framework-for-confidential-computing
- Apache license
- Contributions and new contributors are welcome
- Make Confidential Computing an open Universal Platform



Thank you!

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An Open-Source Certifier Framework for Confidential Computing

Abstract: Confidential Computing is a foundational technology, but its adoption has been inhibited by the difficulty in implementing programs quickly even on a single platform. In addition, fragmentation in the TEE platform market has prevented software portability and reuse across TEE technologies. In this session, we will discuss the *Certifier Framework for Confidential Computing*, an open-source project offering a simple, general API and accompanying service for managing attestation in scaled CC programs. With a half dozen or so API calls, a developer can incorporate CC into their software without deep expertise in security and platform-specific TEE technologies. Furthermore, the framework also decouples trust policy from program code and supports managed deployment. We'll cover the programming model, trust model and support (including policy and key storage) that makes the Certifier Framework easy to use and broadly applicable.

Summary: Removing Barriers with CC + Certifier

Verifiably secure operational properties (confidentiality, integrity, policy compliance) no matter where a program runs. Safe against malware and "insiders."

Before CC: developer/deployer must

1. Write applications correctly
2. Deploy the program safely (no changes)
3. Configure operating environment correctly
4. Ensure other programs can't interfere with safe program execution
5. Generate and deploy keys safely
6. Protect keys during use and storage
7. Ensure data is not visible to adversaries and can't be changed in transmission or storage
8. Ensure trust infrastructure is reliable
9. Audit to verify this all happened

Consequence:

- App writer/deployer entirely reliant on provider for all security --- unverifiable

With CC: developer/deployer must

1. Write the application correctly
   - For every backend
   - Manage migration
   - Support each providers deployment model
   - Implement all the crypto
   - Implement secure communications and storage
   - Make it scalable and upgradable
2. Implement the trust policy
   - Maintain trust policy
   - Different for every app/deployer
   - Make it scalable

Consequence:

- You can have safe application but it's platform dependent and a lot of work

With CC + Certifier: developer/deployer must

1. Write the application correctly using VMware APIs
2. Write the trust policy
3. Use Certifier Service to manage it!

Consequence:

- You write the application once.
- Need only add a few dozen lines of code to enable CC protection.
- Trust policy is independent of application.
- Can move to another "backend" effortlessly

Thanks to David Wagner