CONFIDENTIAL
CONTAINERS

KubeCon | CloudNativeCon

Europe 2023

Confidential Containers Made Easy

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Agenda

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- Confidential Containers in a Nutshell
- Basics: Kata Containers
- From Kata to Confidential Containers
- Different flavours of Confidential Containers
- Use Cases for Confidential Containers
- Demos

Confidential Containers in a Nutshell

Confidential Containers in a Nutshell

This is an umbrella project, which has its **Operator** as the project's front door

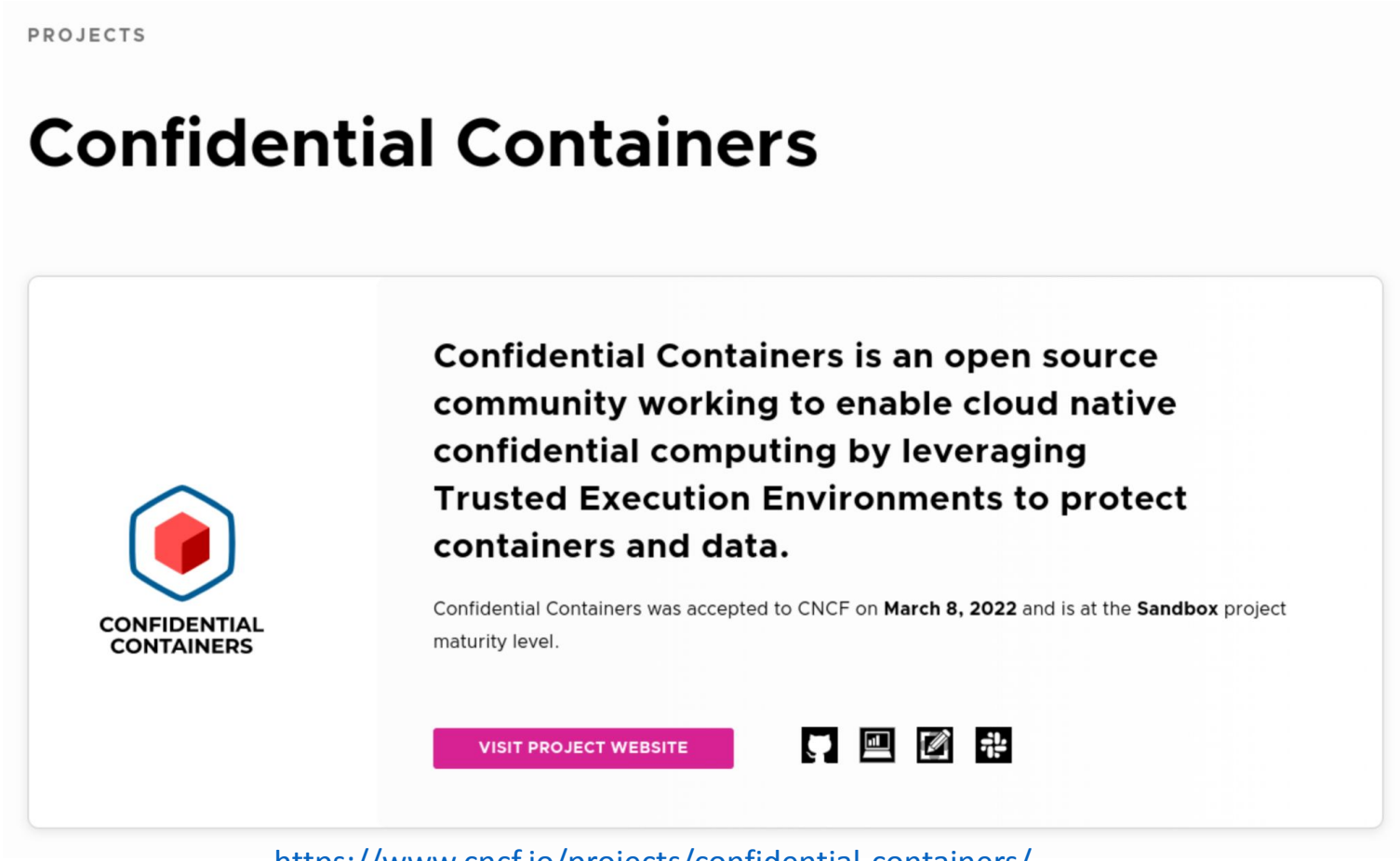
Apart from the Operator, we also develop:

- A key broker service
- An attestation agent and an attestation service
- A lightweight firmware for the Confidential Containers VMs (td-shim)
- Rust libraries for pulling, decrypting, and encrypting images (image-rs and ocicrypt-rs)
- Different flavours of Confidential Containers (cloud-api-adaptor, enclave CC)
- Have a strong relationship with Kata Containers

Confidential Containers in a Nutshell

Cloud Native Computing Foundation member

- Since March 8th, 2022



https://www.cncf.io/projects/confidential-containers/

Confidential Containers in a Nutshell

Community members

- Alibaba Cloud
- AMD
- ARM
- IBM
- Intel
- Microsoft
- NVIDIA
- Red Hat
- RivOS
- and others … :-)

Confidential Containers in a Nutshell

What is the value proposition of Confidential Containers?

Protect **data-in-use**, at the **pod level**, by leveraging **Trusted Execution Environments (TEE)**

- Simplify TEE technology usage for cloud native software with Confidential Containers
- Enforce security requirements and transparent deployment of unmodified containers
- Support multiple TEE and hardware platforms
- Separate Cloud Service Providers from guest applications, following least privilege principles for Kubernetes administration

Confidential Containers in a Nutshell

The project focuses on protecting …

- Hold on! Let's talk about it a little bit later!

Basics: Kata Containers

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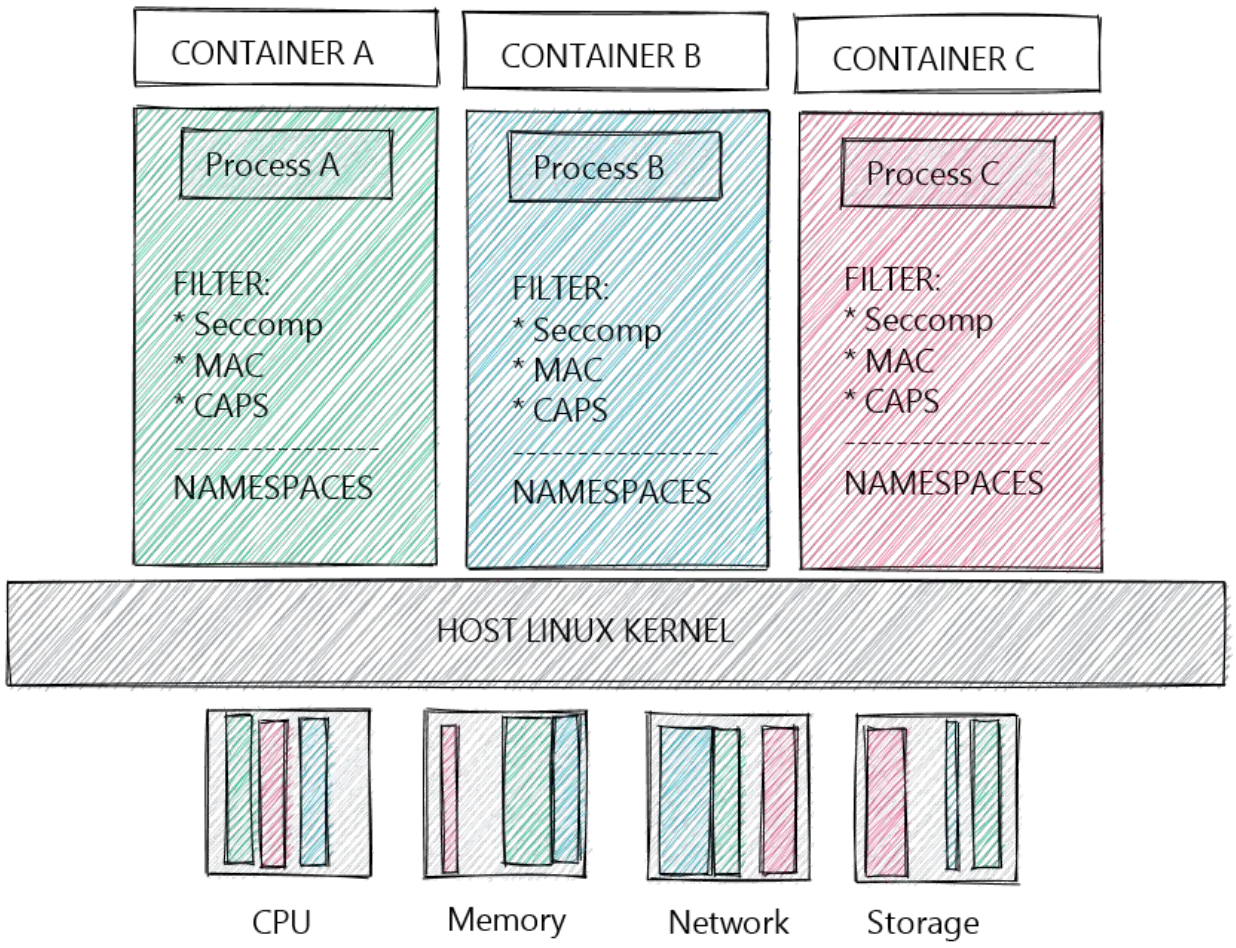
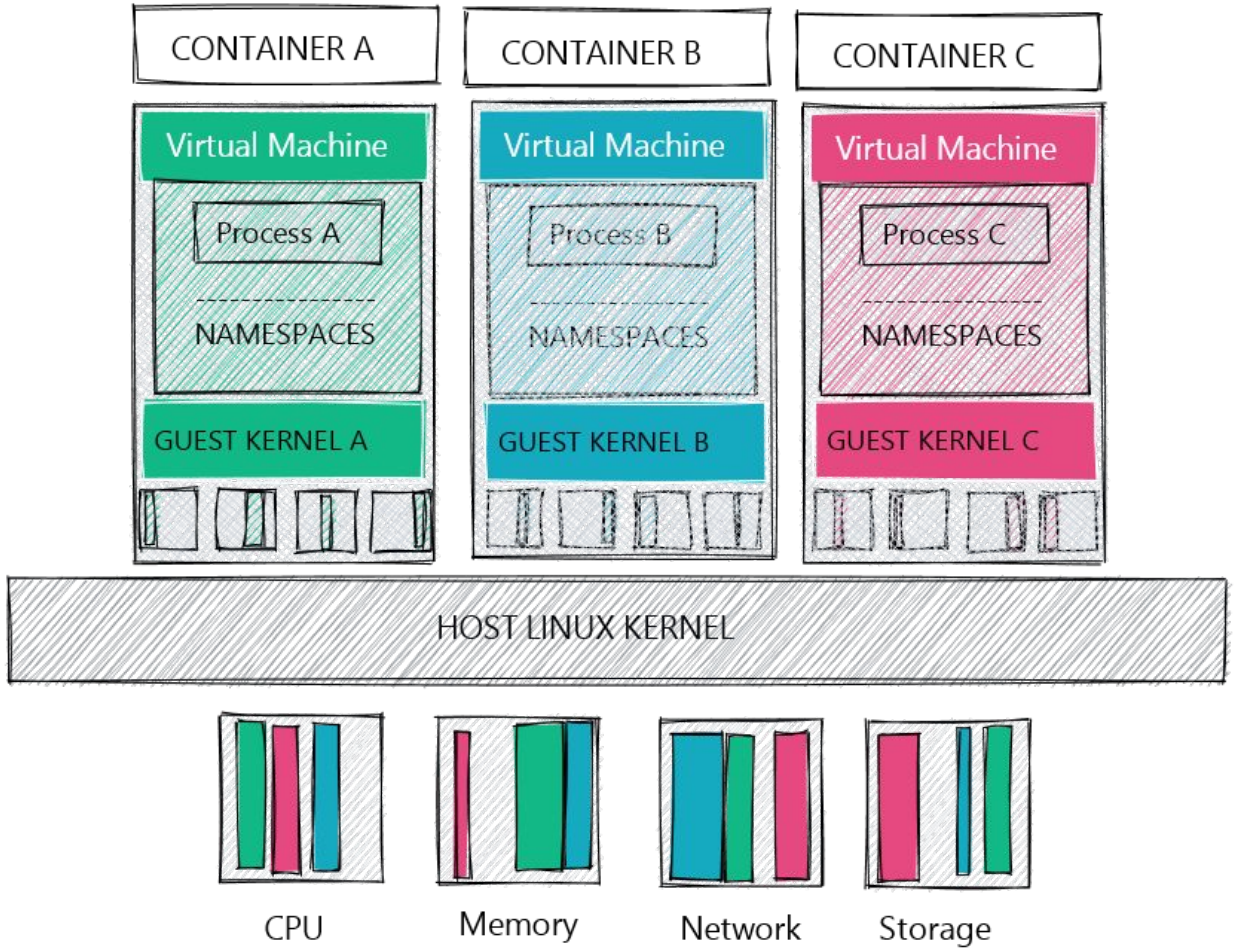
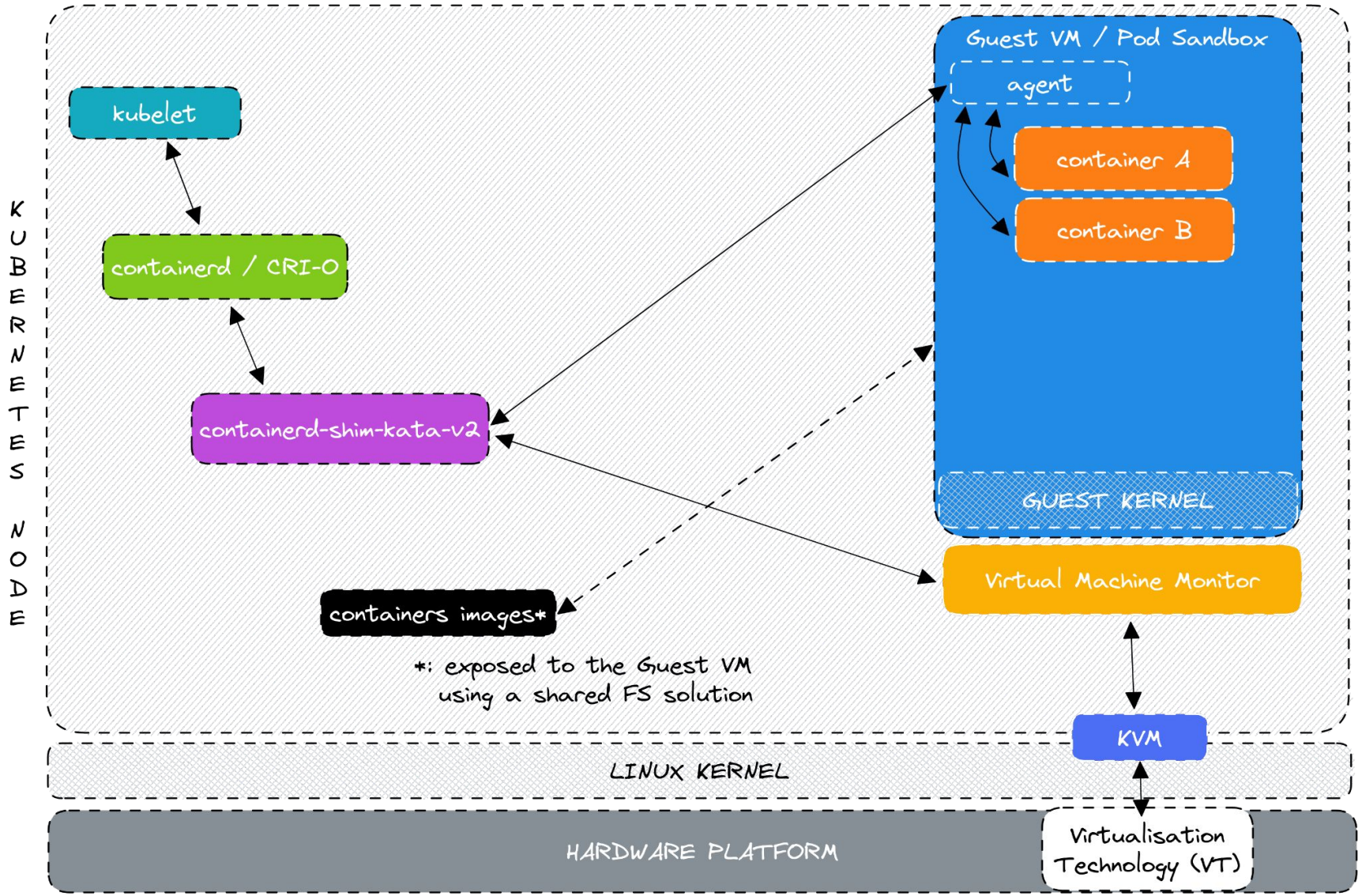
Traditional Containers



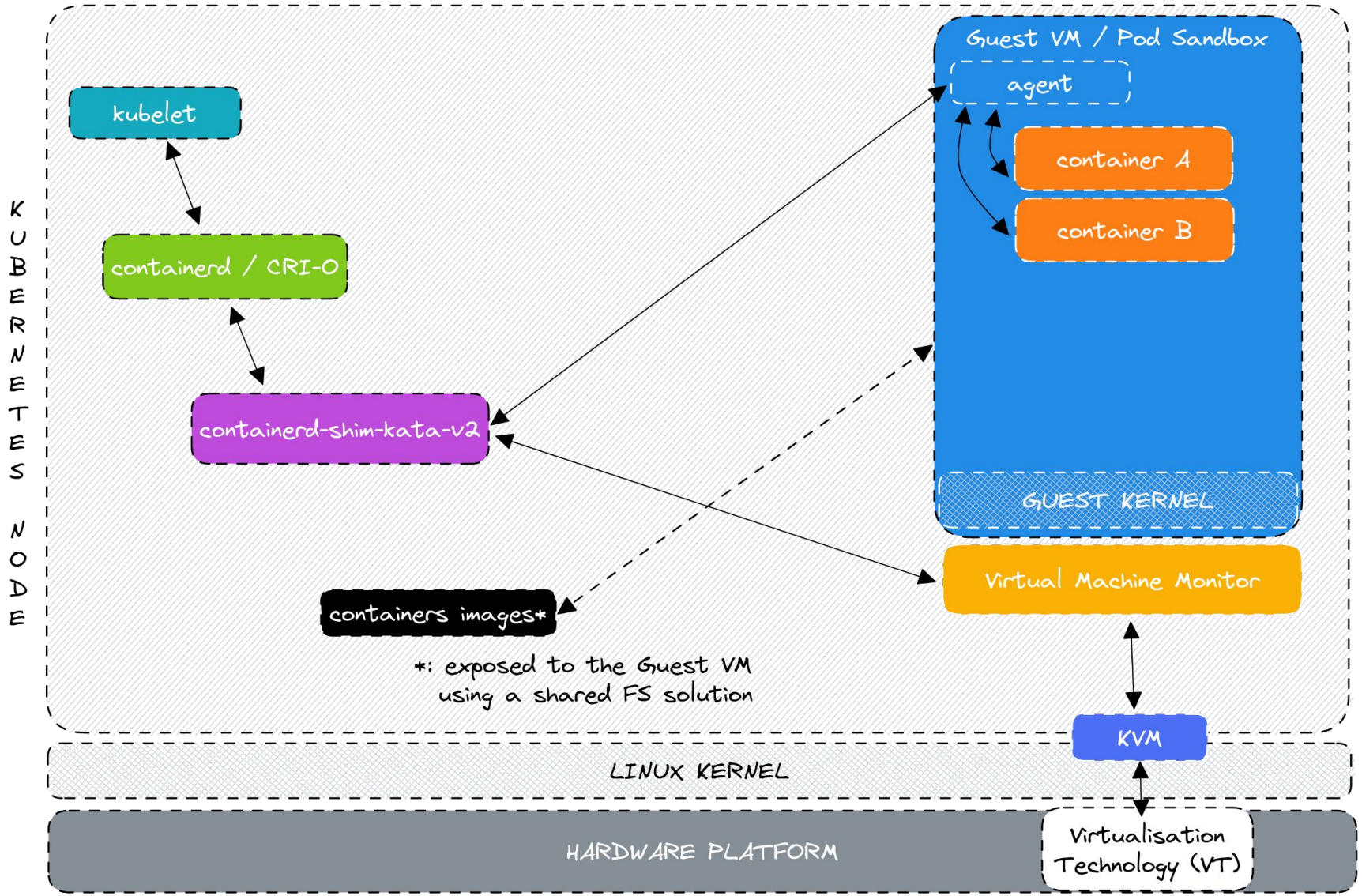
Kata Containers



Basics: Kata Containers



From Kata to Confidential Containers



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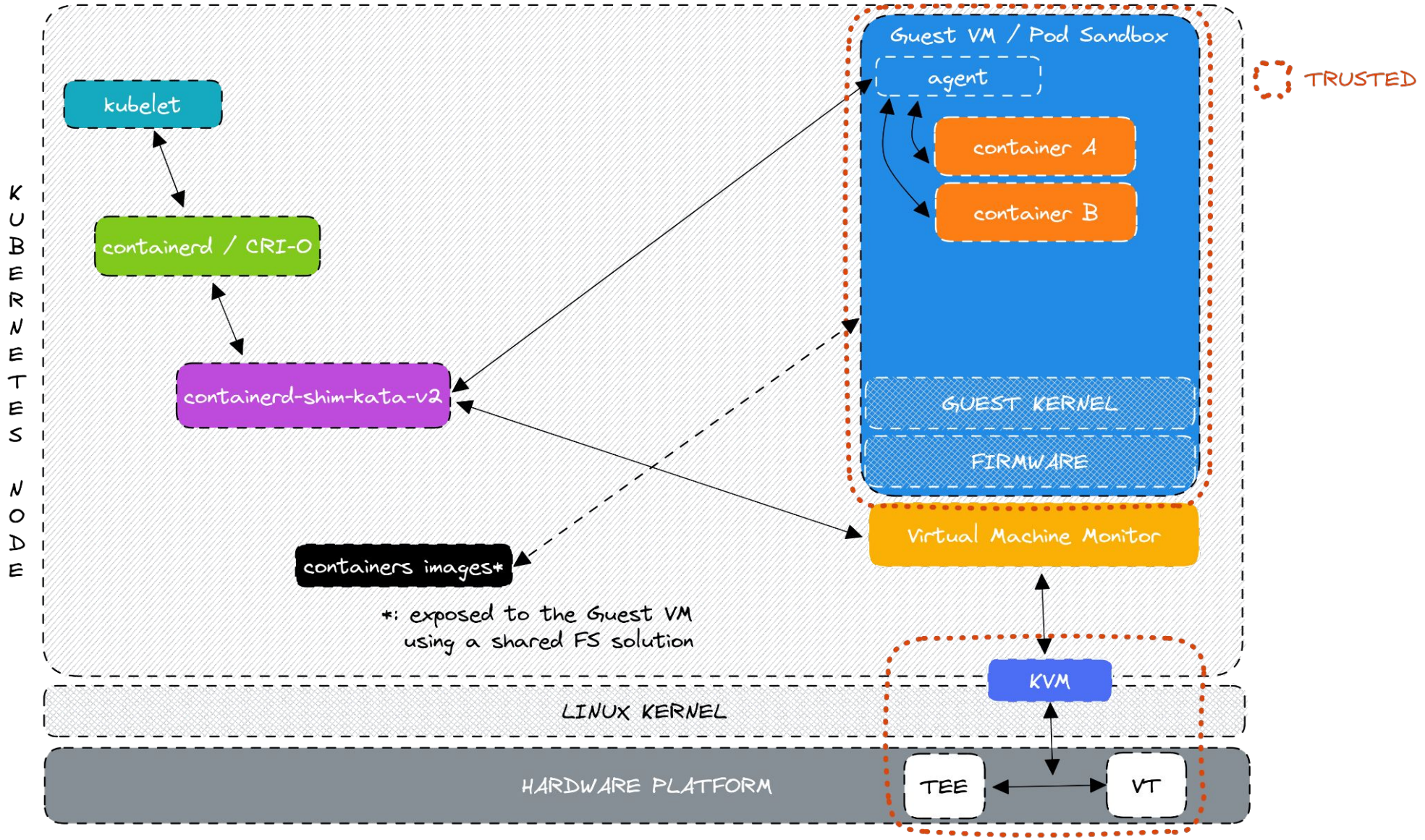
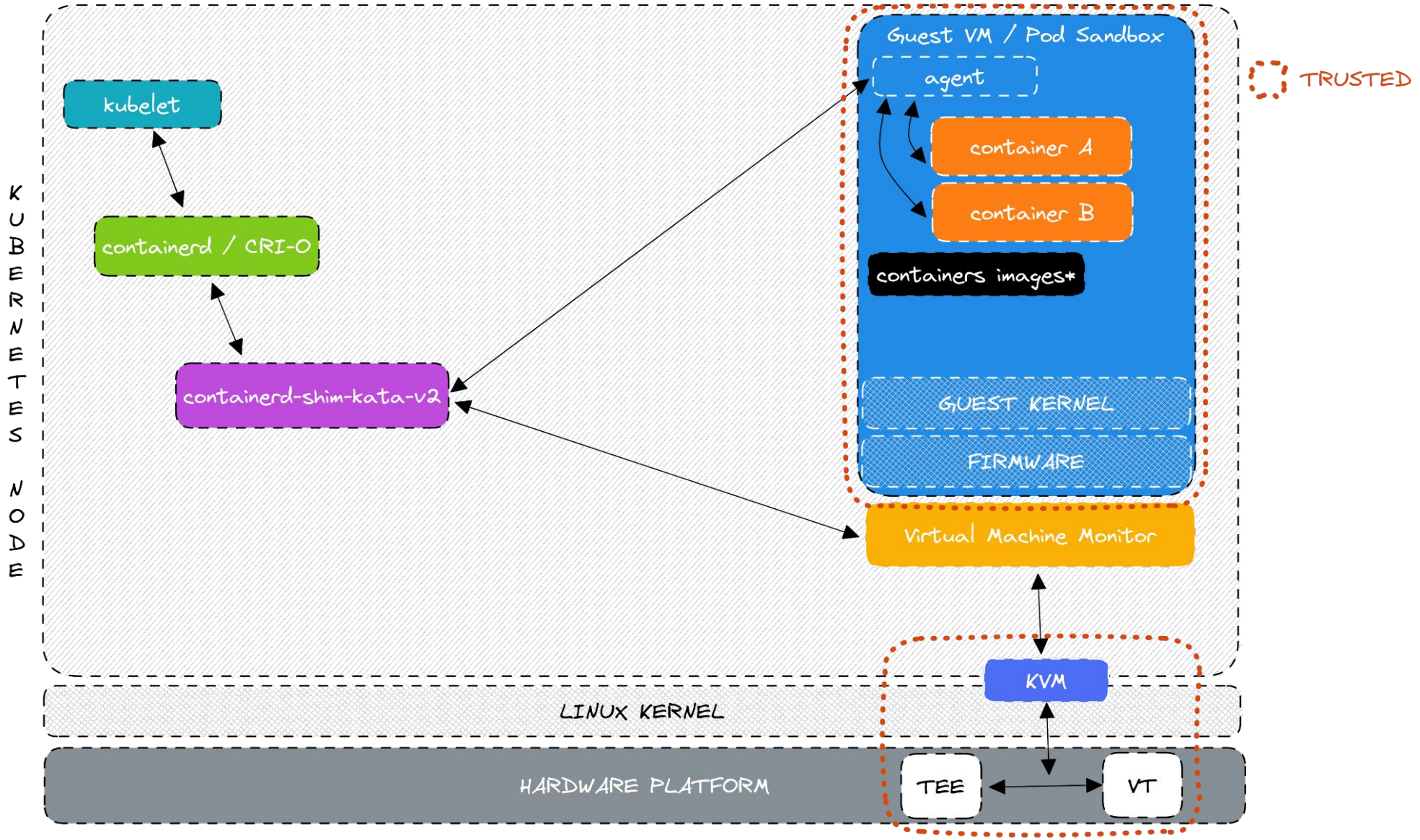
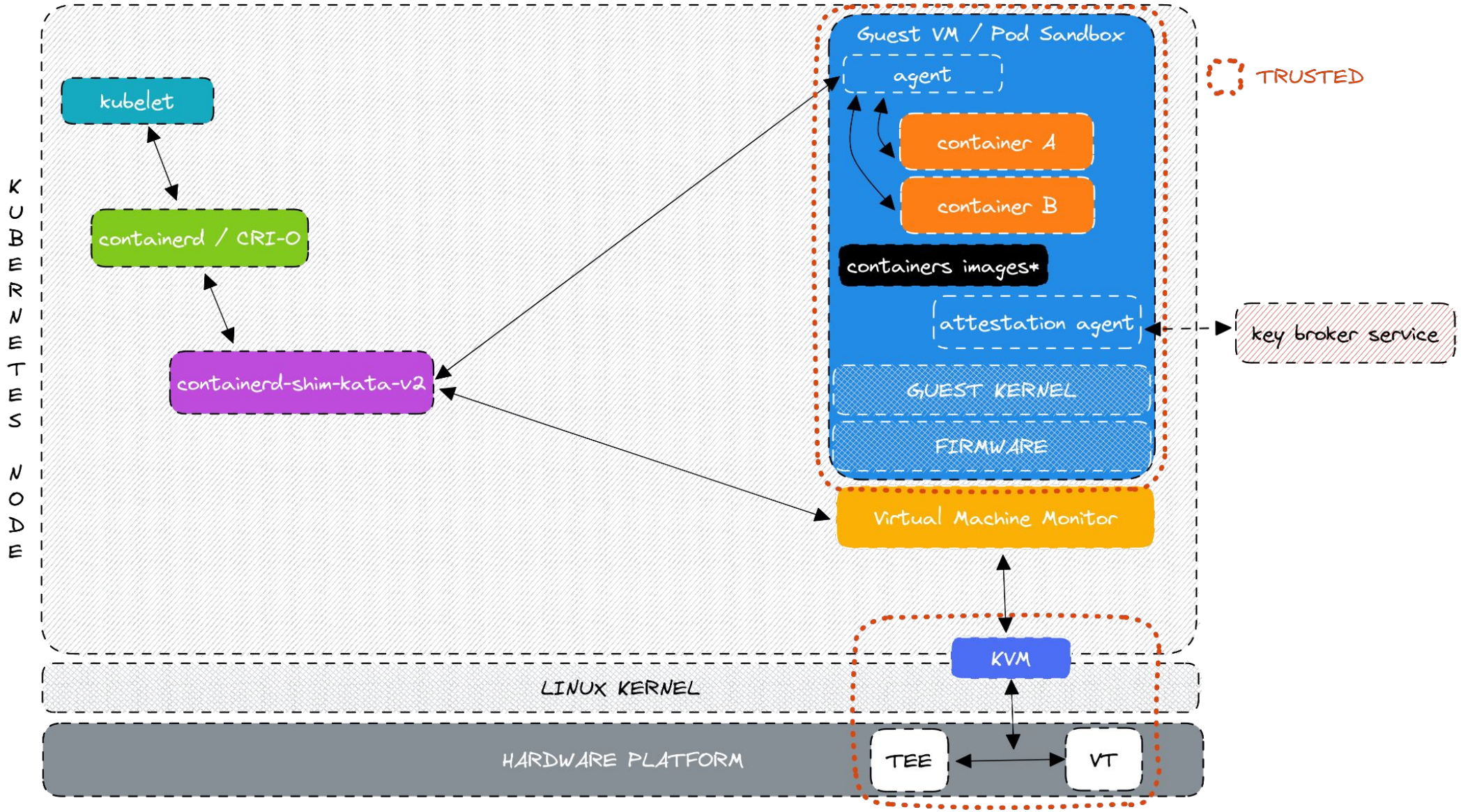


From Kata to Confidential Containers



From Kata to Confidential Containers



From Kata to Confidential Containers

The projects focus on …

- Kata Containers:
  - Protecting the Host from a non-trusted workload
  - Protecting workloads from each other

- Confidential Containers adds:
  - Protecting the workload from a non-trusted infrastructure

From Kata to Confidential Containers

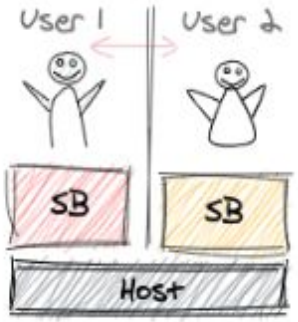
Types of Sandboxing

VTx, Linux namespaces, Seccomp, SE-Linux, …

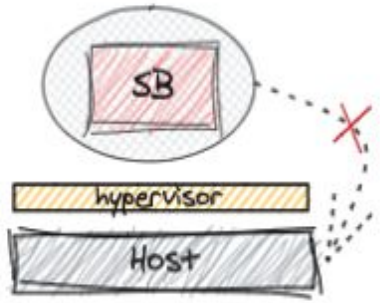
AMD SEV-*, IBM SE, Intel SGX, and Intel TDX

Virtualization: Hypervisor + Container-based

Workload from Workload

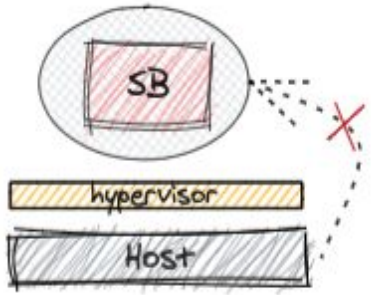


Host From Workload



Trusted Execution Environments

Workload from Host



The different flavours

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Process-based isolation

- Provided by Enclave CC
  - SGX (Intel)

VM-based isolation

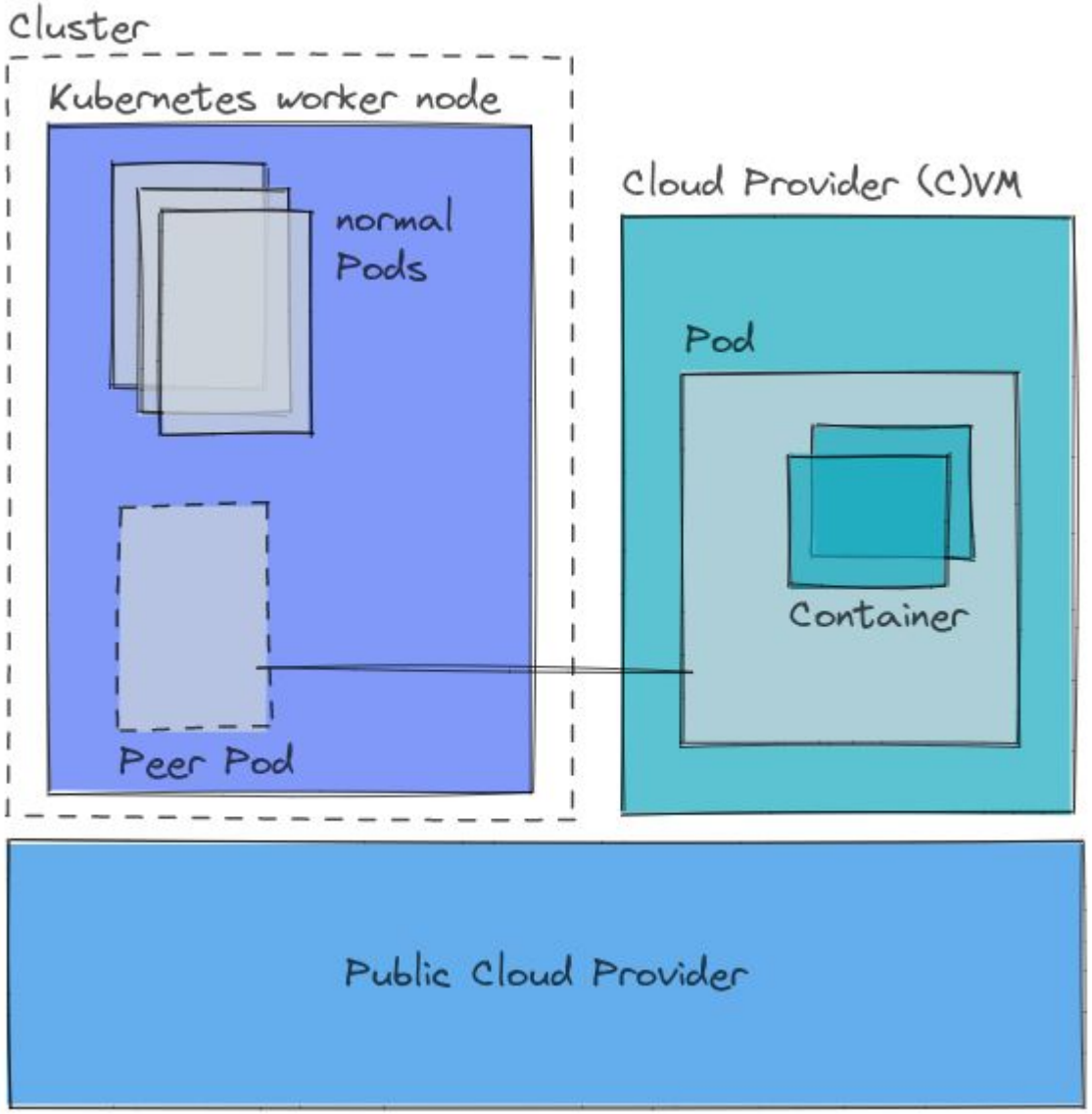
- Provided by Kata Containers
  - SE (IBM) / SEV-ES (AMD) / TDX (Intel)

The different flavours

Cloud API Adaptor (aka, Peer Pods)

- It could be its own talk!
- Takes advantage of the Kata Containers' remote hypervisor support
- Allows users to use a CSP's VM as the Guest VM / PodSandbox
  - AWS
  - Azure
  - GCP
  - IBM Cloud

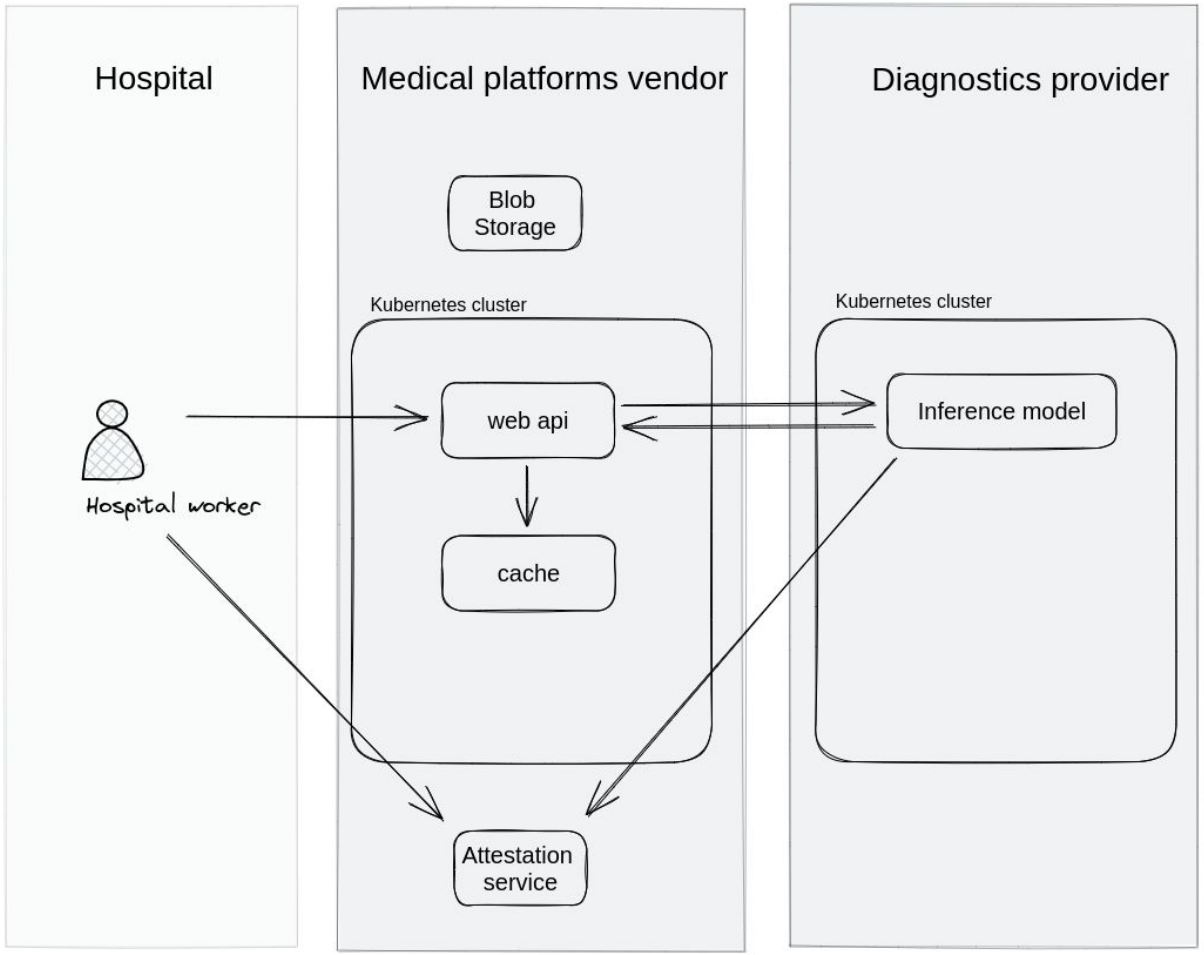
https://www.youtube.com/watch?v=QPOcEGcgYfU



Use cases of Confidential Containers

Confidential Containers in Healthcare Data Analysis

- Collaborate on sensitive patient data for research and analysis while ensuring data privacy and complying with regulations
- Use Confidential Containers to safeguard patient data in a Trusted Execution Environment
- Build your solution with Kubernetes cluster and Confidential Computing technologies, like TEEs
- Rely on Attestation Services, Key Management and other Confidential Computing building blocks for secure data sharing and analysis among collaborating institutions
- Achieve compliance with data privacy regulations and enhance trust in the execution environment

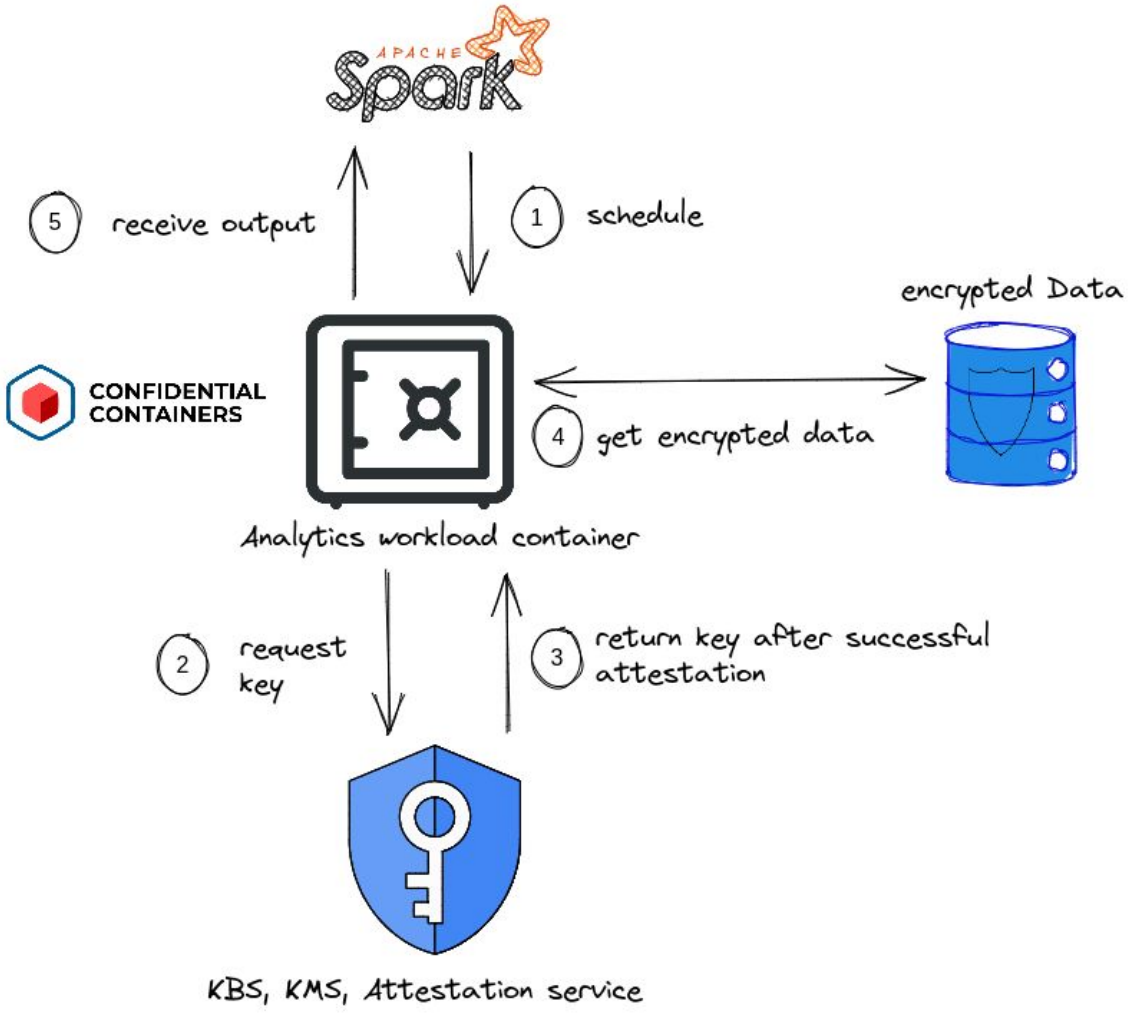


Source: https://learn.microsoft.com/en-us/azure/architecture/example-scenario/confidential/healthcare-inference

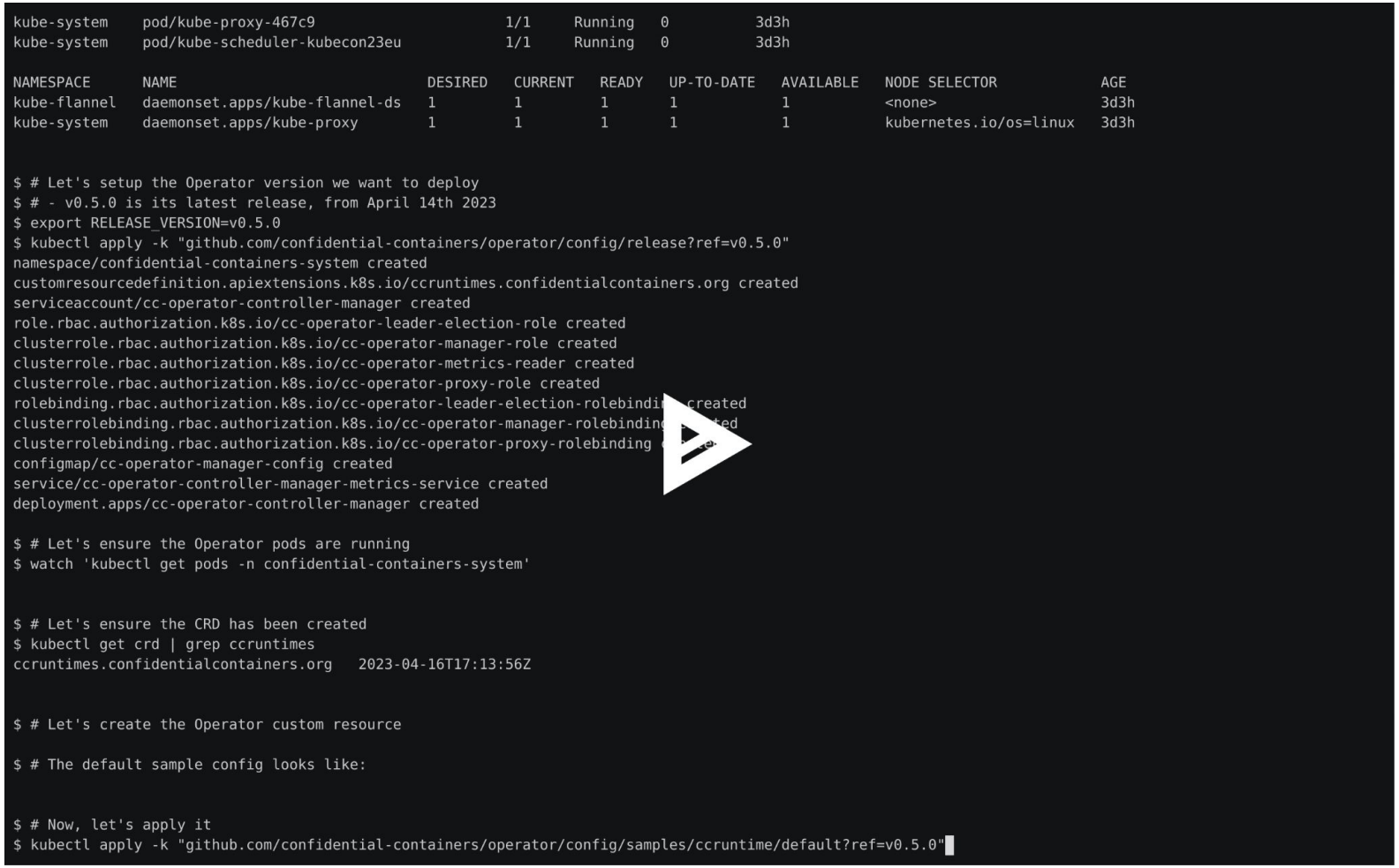
Use cases of Confidential Containers

Confidential Data Analytics with Apache Spark/PySpark

- Container Encryption: Datasets are encrypted, not the containers
- Remote Attestation: Used for secure key release
- K8s Dependency: Optimized for K8s deployments, HPA for large datasets
- Multi-Party Analytics: Extendable for data schema contracts between parties
- Forked Scenarios: Apache Spark Master Scheduler modified for secure job scheduling



DEMO



https://asciinema.org/a/577943

Confidential Containers 0.5.0 Release

Expanding Cloud-Native Confidential Computing Capabilities

- Largest release to date, featuring:

1. Generic Key Broker Service (KBS)
   - Attestation Service and Resource Value Provider Service for diverse platforms and use cases
2. Peer-pods for Kata Containers on multiple public clouds
3. Resource URL for uniform attestation resources and secrets identification
4. Enclave-CC for process-based confidential containers using Intel SGX

Q/A

Check out the Confidential Containers project

- Contribute, join community meetings
- Slack: #confidential-containers in CNCF workspace

Also watch this talk which will happen directly after lunch
The Next Episode in Workload Isolation: Confidential Containers - Jeremi Piotrowski

Talks from previous KubeCon + CloudNativeCon editions
Trust No One: Bringing Confidential Computing to Containers- Samuel Ortiz & Eric Ernst
Confidential Containers Explained - James Magowan & Samuel Ortiz

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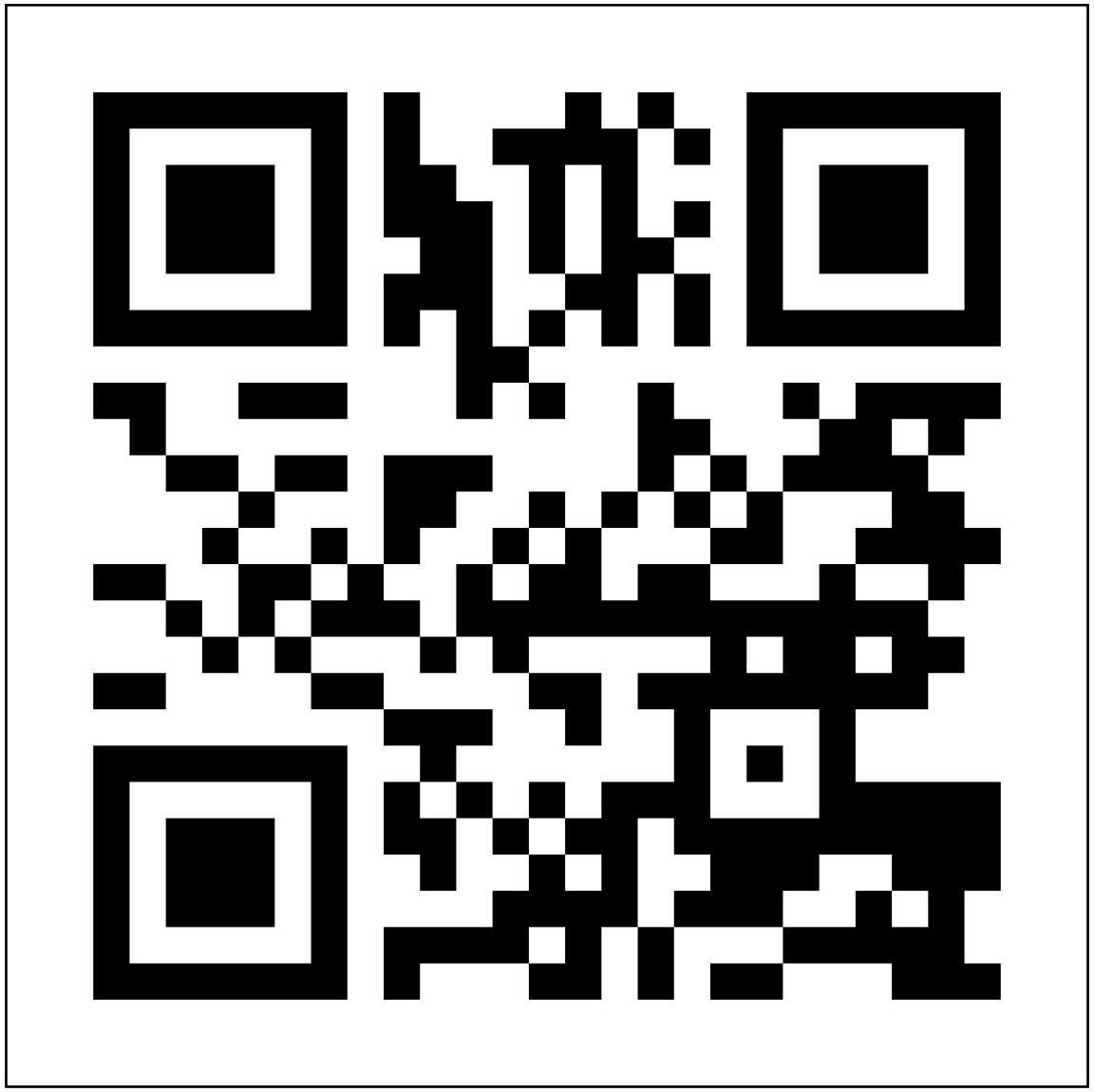

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to leave feedback on this session

Why Confidential Computing?

- Confidential Computing technology is already being used in everyday devices such as smartphones and game consoles to protect biometric data, payments, and against cheating and piracy.

- Confidential Computing can be used for existing programming languages, toolchains, and applications, without requiring developers to change their programming approach.

- Confidential Computing ensures the code executed, data processed, and output results cannot be tampered with or disclosed.