Confidential Computing and Hardware TEEs

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Outline

- Confidential Computing (CC)
- Technologies enabling Confidential Computing
- Use-cases Examples for Confidential Computing
- Challenges with Confidential Computing
- Intel's Project Amber - overview
- Summary

The “Last Mile” Problem with Data

Protect Data
at Rest

Storage Encryption

Protect Data
in Transit

Network Encryption

Protect Data
in Use

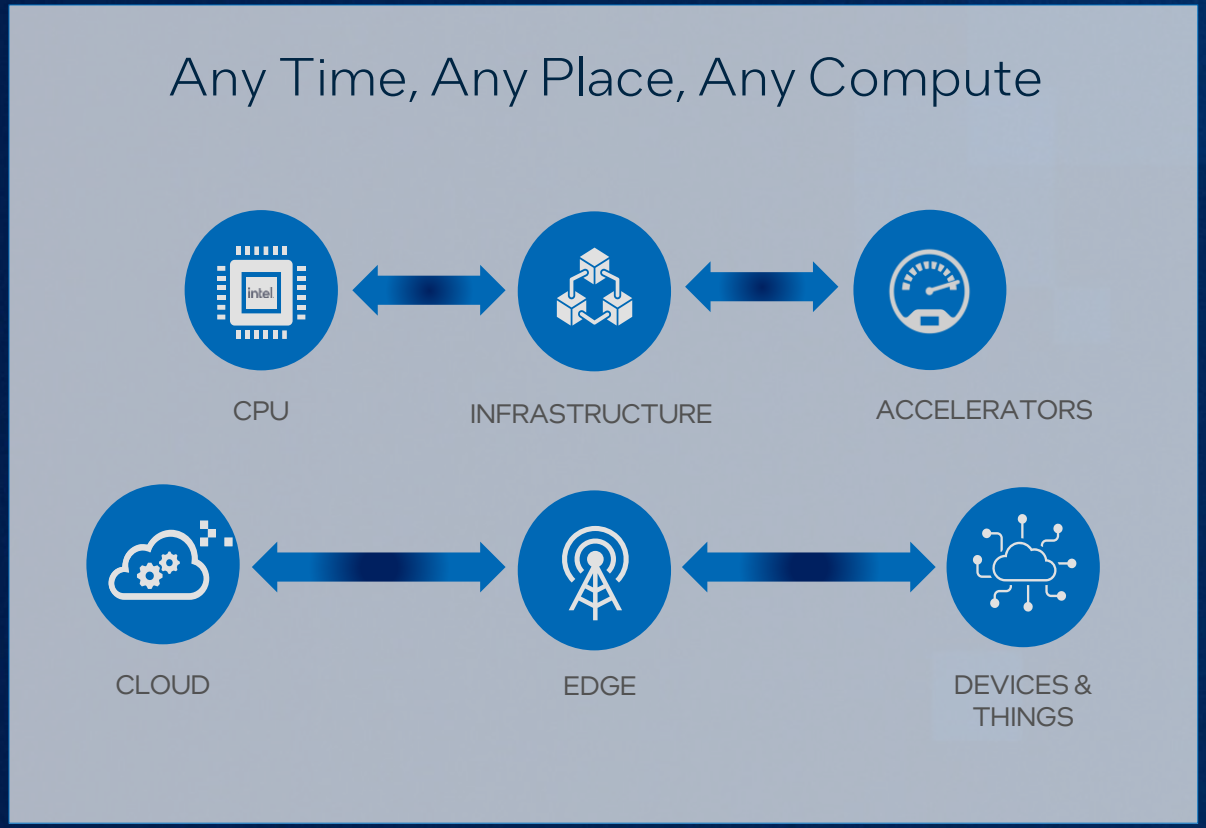
Confidential Computing

Confidential Computing (CC)

Protection/separation of data processing from the platform owner/administrator

- Enables data privacy & governance
- Accelerates cloud transformation for sensitive workloads
- Largest shift in computer security since the 1970's

Relies on a Trusted Execution Environment (TEE)

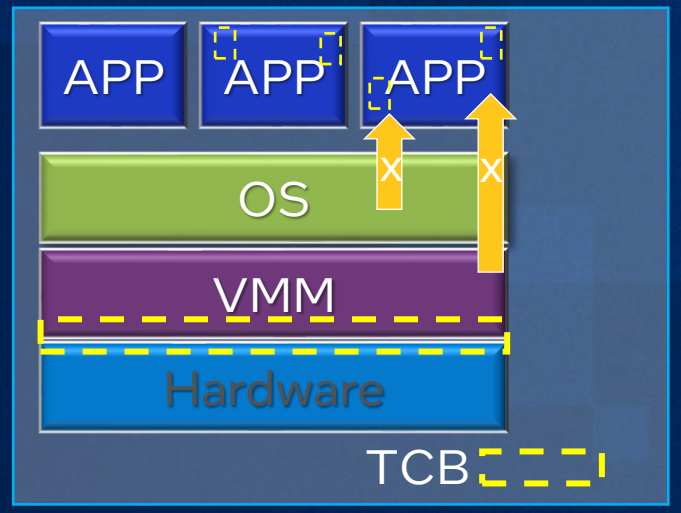


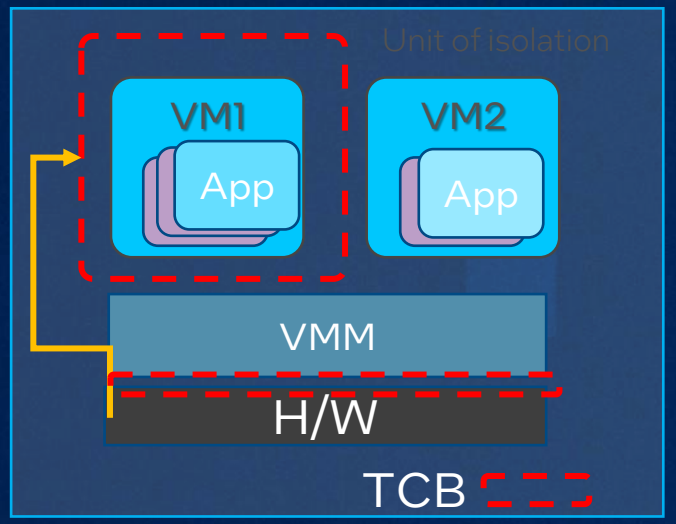
Confidential Computing: Workloads run in Trusted Execution Environment (TEE) to protect against unauthorized viewing and tampering of code and data

TEE enables Confidential Computing

- ✓ A **Trusted Execution Environment (TEE)** is a secure area protected by the processor. (aka. Enclave)
- ✓ Provides hardware-enforcement so that:
  - Code loaded inside TEE is operator-authorized code.
  - Data inside TEE cannot be read/modified from the outside.
  - Confidentiality and integrity for both code and data.
- ✓ Threats protected:
  - Malicious/compromised admin
  - Malicious/compromised tenant of a hypervisor
  - Malicious/compromised network
  - Compromised operating system/BIOS

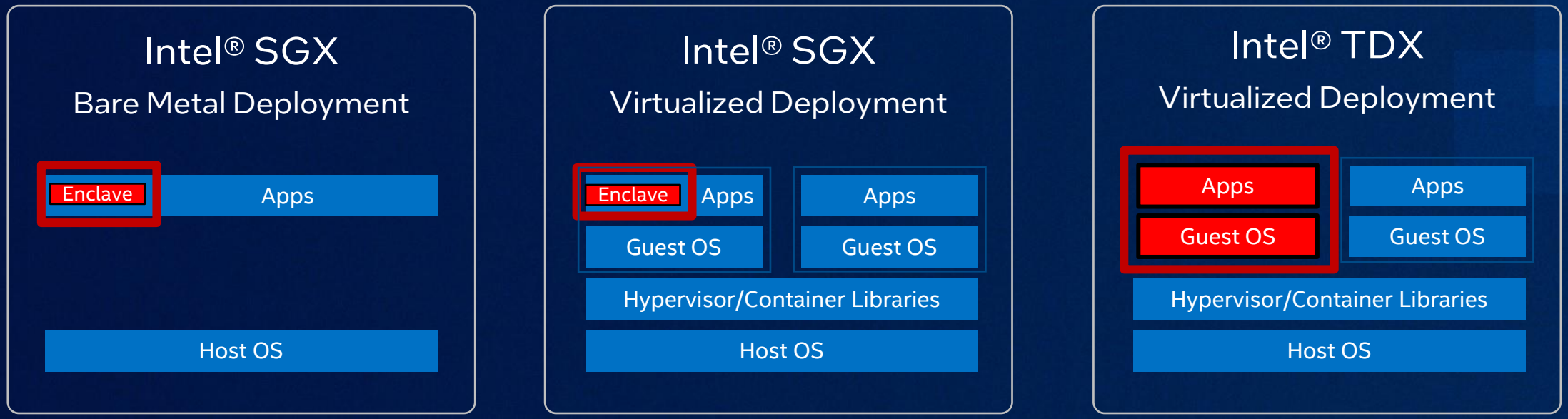
Examples of TEEs: Intel® SGX, Intel TDX, AMD SEV-SNP, ARM Realms





TCB: Trusted Compute Base

Intel Hardware TEEs

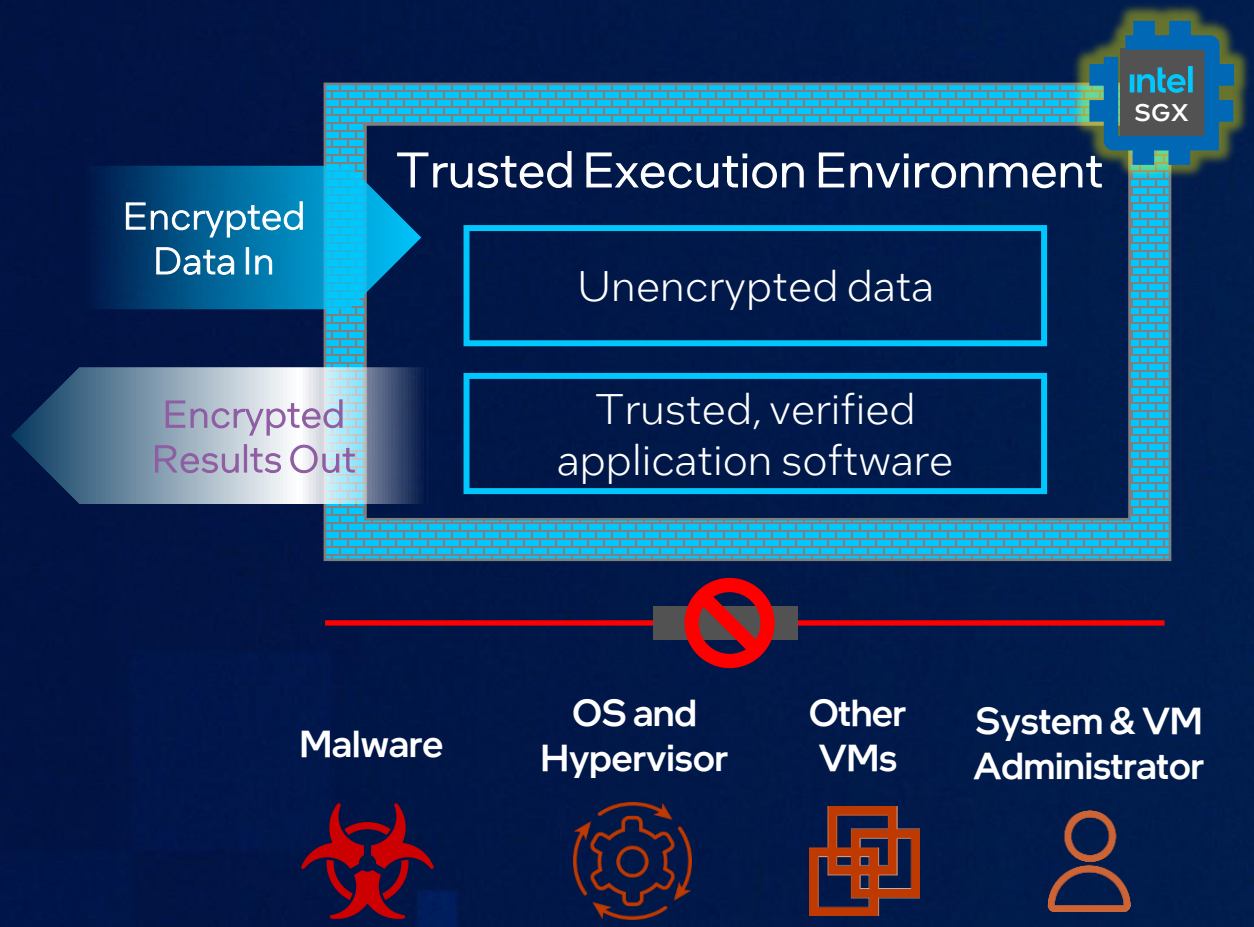


- Maximum data isolation
- Single tenancy

- Simplest migration of existing software
- Multi-tenancy

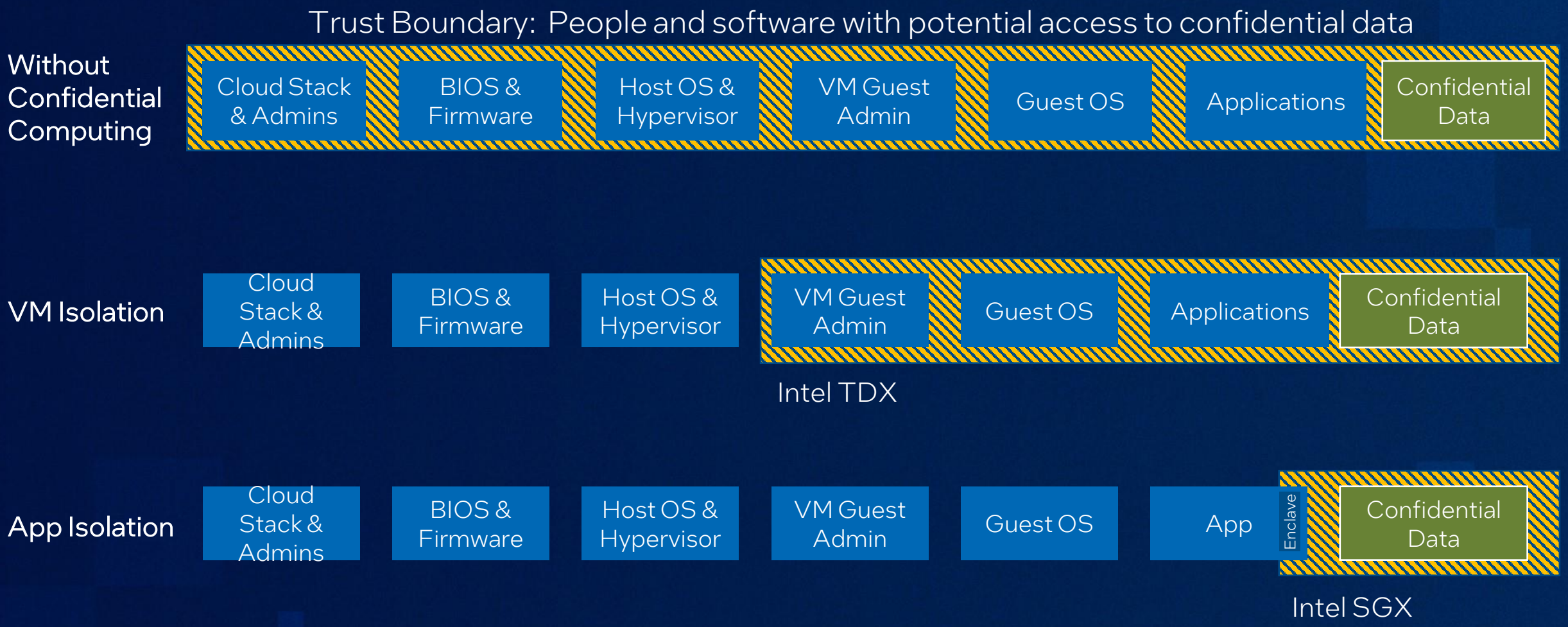
Trust Boundary: Software with access to Confidential Data

Intel® SGX: A Trusted Execution Environment for Protecting Date In-Use



- Data in-use is protected inside a hardware-enforced Trusted Execution Environment (TEE) called an “Enclave”
- Designed so software outside the enclave cannot access data inside it, even with escalated privileges
- Enclave configuration & Software load is verified with strong attestation

Trust Boundary: Smaller is Better



Real World Usages

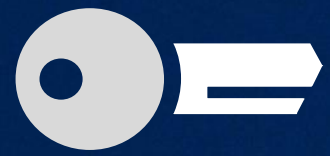
Trusted Multi-party Compute

Federated Learning

Privacy Preserving Analytics

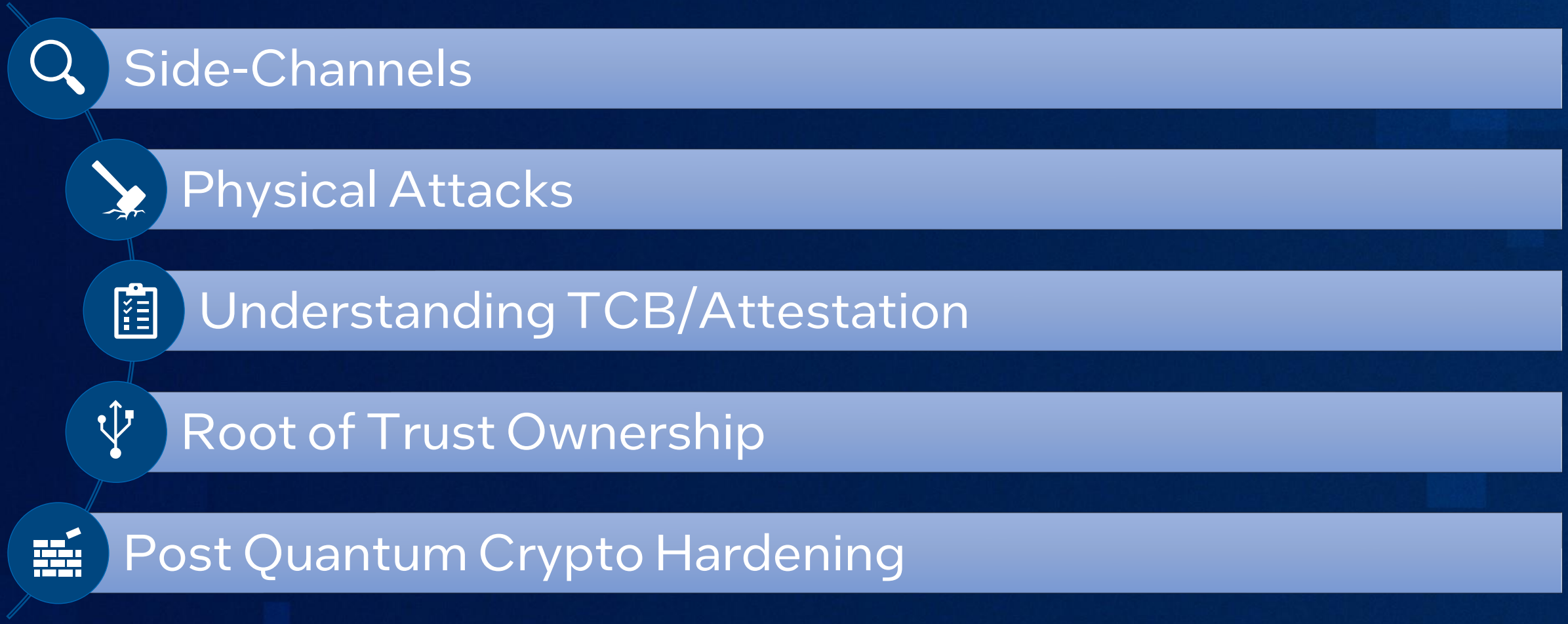
Blockchain

Cloud & Edge Infrastructure

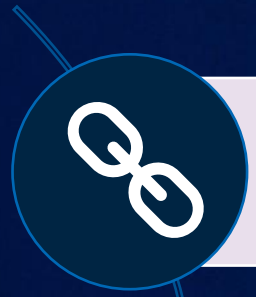


Key Management

Security Challenges



Attestation: Challenges in Today's CC Model



Linking infrastructure & attestation

Scaling attestation across vendors & geos

Complexity of home-grown attestation

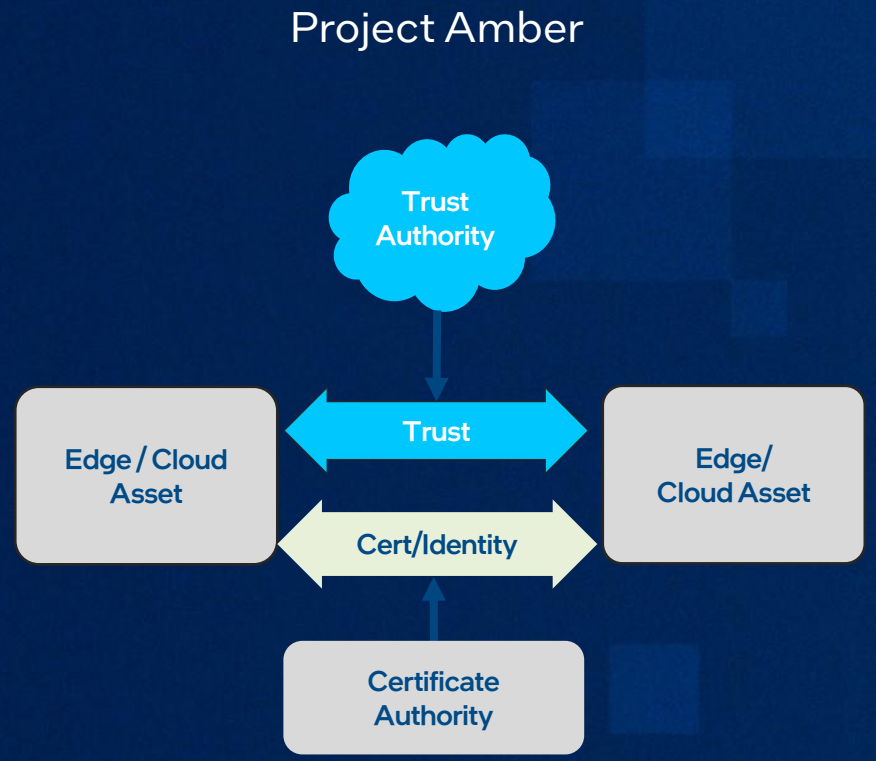
Expanding Confidential Computing Requires Better Attestation Solutions

What is Project Amber?

An Intel® service to remotely verify and assert trustworthiness of compute assets (TEEs, devices, Roots of Trust, etc.)

Enables Zero Trust Model for Confidential Computing

Operationally independent from the Cloud/Edge infrastructure provider that is hosting confidential compute customer workloads



Zero Trust: Extending Attestation Services
In Cloud Environments

Project Amber 1.0 Objectives:

- SaaS service w/ 99.9% uptime SLA
- Multi/Hybrid cloud & Edge Workload support
- Multi-TEE support
  Initially: Intel® Software Guard Extensions (Intel® SGX) and Intel® Trust Domain Extensions (Intel® TDX)
- Federated model for Geo-support
- Provable Integrity of Verification Process
- CSP agnostic & Multi-cloud deployment

Summary

- Confidential Computing (CC) is the biggest change to computer security in multiple decades.
- Confidential Computing enables data privacy & governance solutions.
- Ground truth of Trust in CC is via a process called Attestation.
- Expanding Confidential Computing requires better Attestation solutions.
- Project Amber is a new multi-cloud, multi-TEE SaaS for 3rd party attestation.
- Project Amber Pilot engagements are starting in Q4 2022, target launch in 2H 2023.

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