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Tencent Cloud Blockchain

Privacy-Preserving Data Sharing on Blockchain via TEE

- A case study on Tencent Cloud Blockchain

Midas (Tencent Billing Platform)

Tencent Cloud Blockchain

ZHANG Tao

Content

Tencent Cloud Blockchain

- Blockchain & its privacy issues
- Trusted execution environment (TEE)
- TEE-enhanced Blockchain
  - Design of Shuliantong, a TEE-enhanced blockchain platform provided by Tencent Cloud
- Application Scenarios for Shuliantong

ITU-T SG17 passed “Security Requirements for Smart Contract Management”, X.srscm-dlt

Blockchain & Its Security

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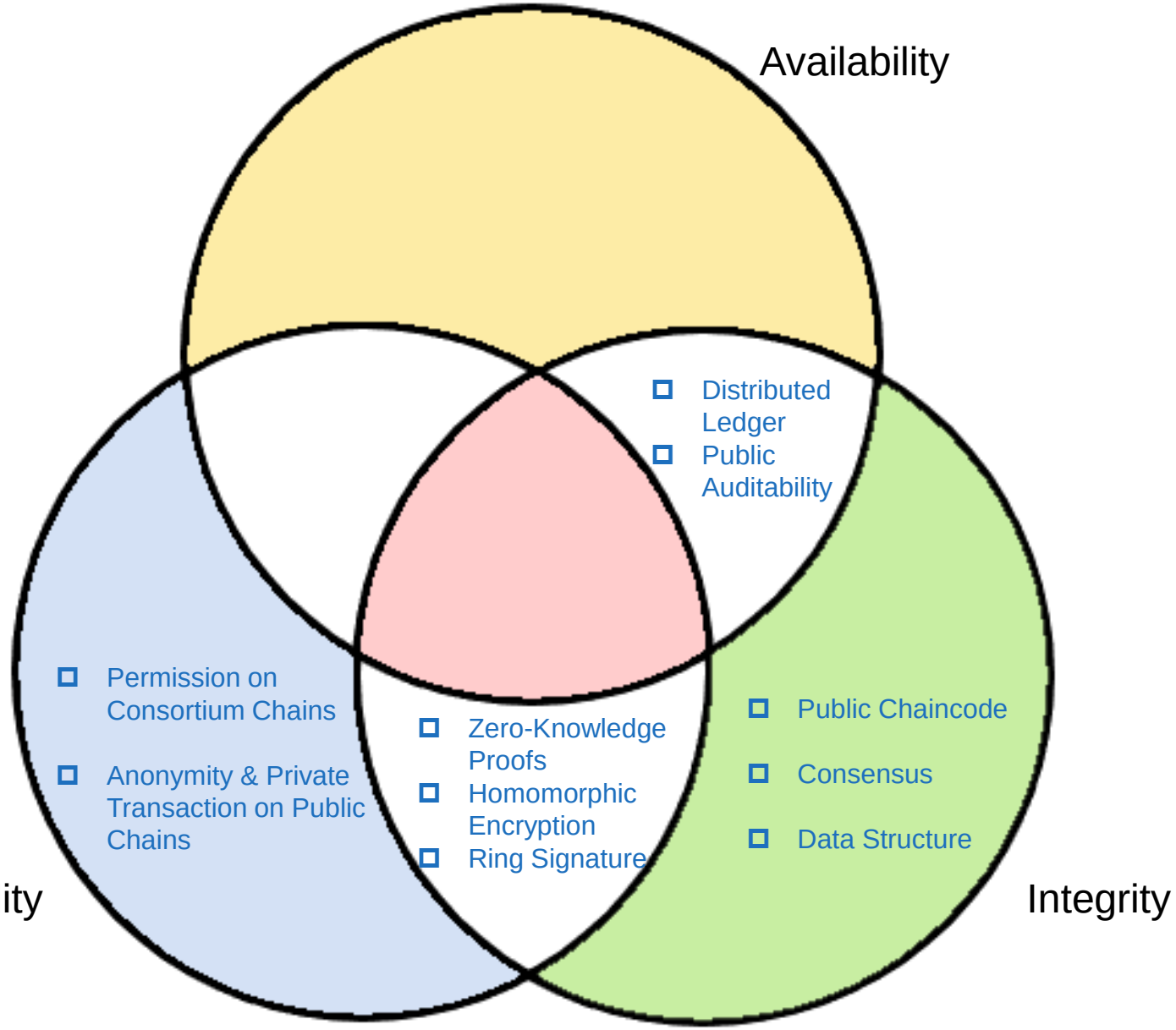
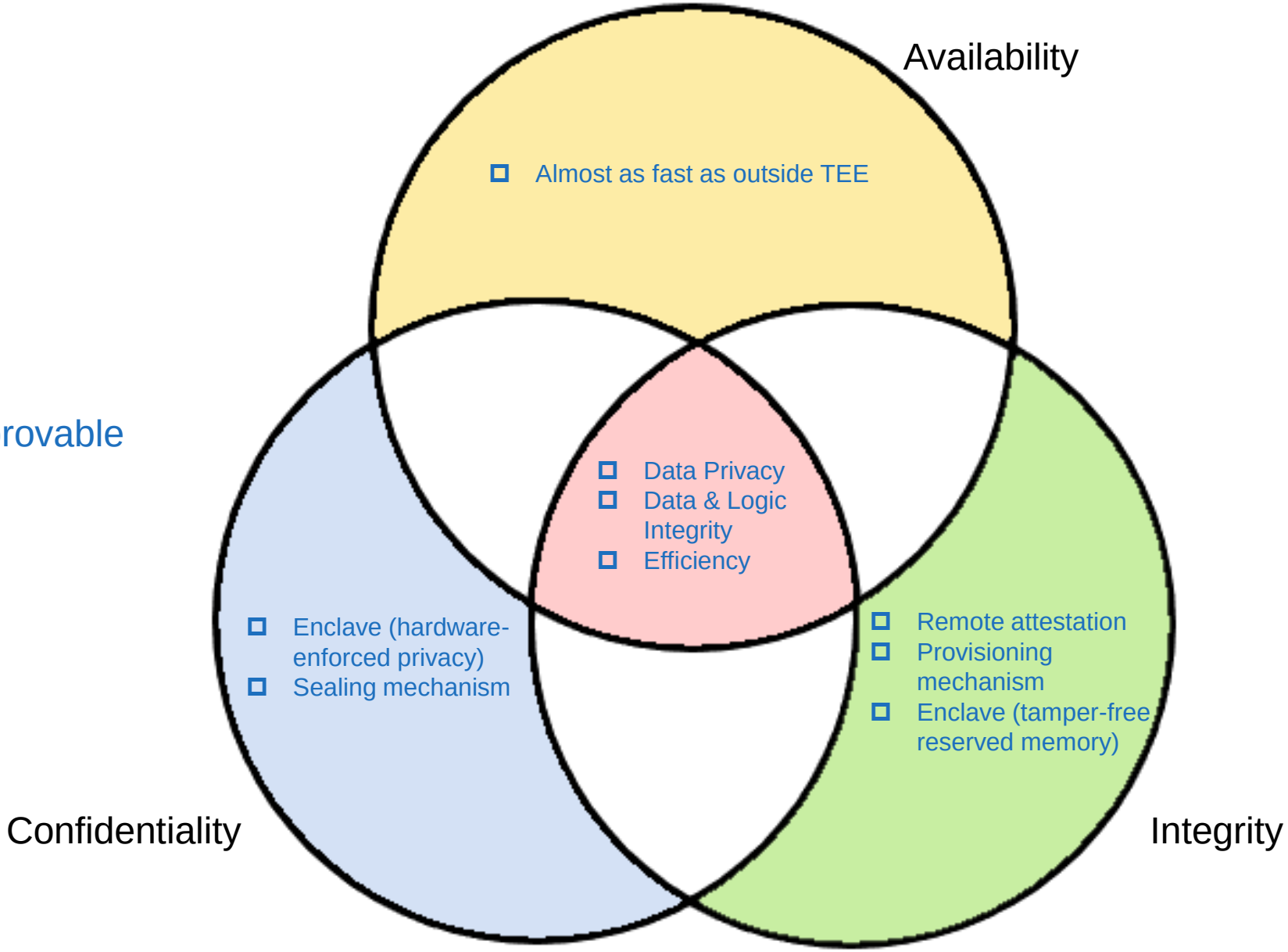
- Minimum Data Privacy
  - Data on the chain is public to chain participants
- Data & Logic Integrity
  - Chaincodes are public
  - Consensus
  - Blockchain data structure
- Efficiency
  - Crypto algorithms are resource-consuming



TEE (SGX) for Privacy and Integrity

Tencent Cloud Blockchain

- Data Privacy
- Data & Logic Integrity
- Efficiency
- Hardware-enforced & Not provable



TEE-Enhanced Blockchain

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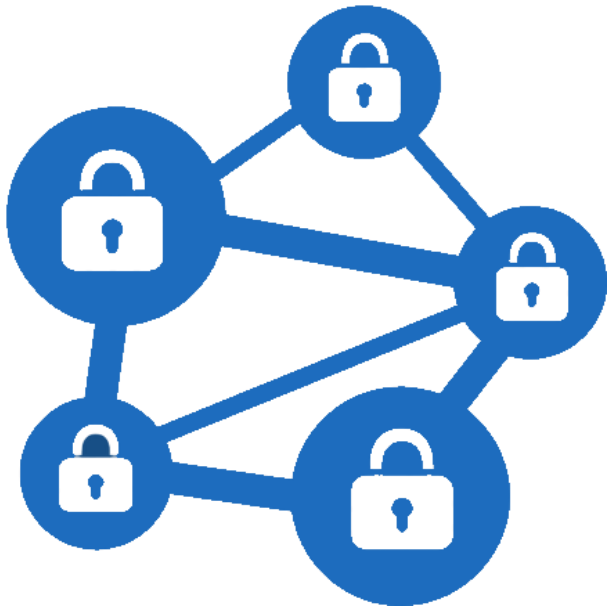
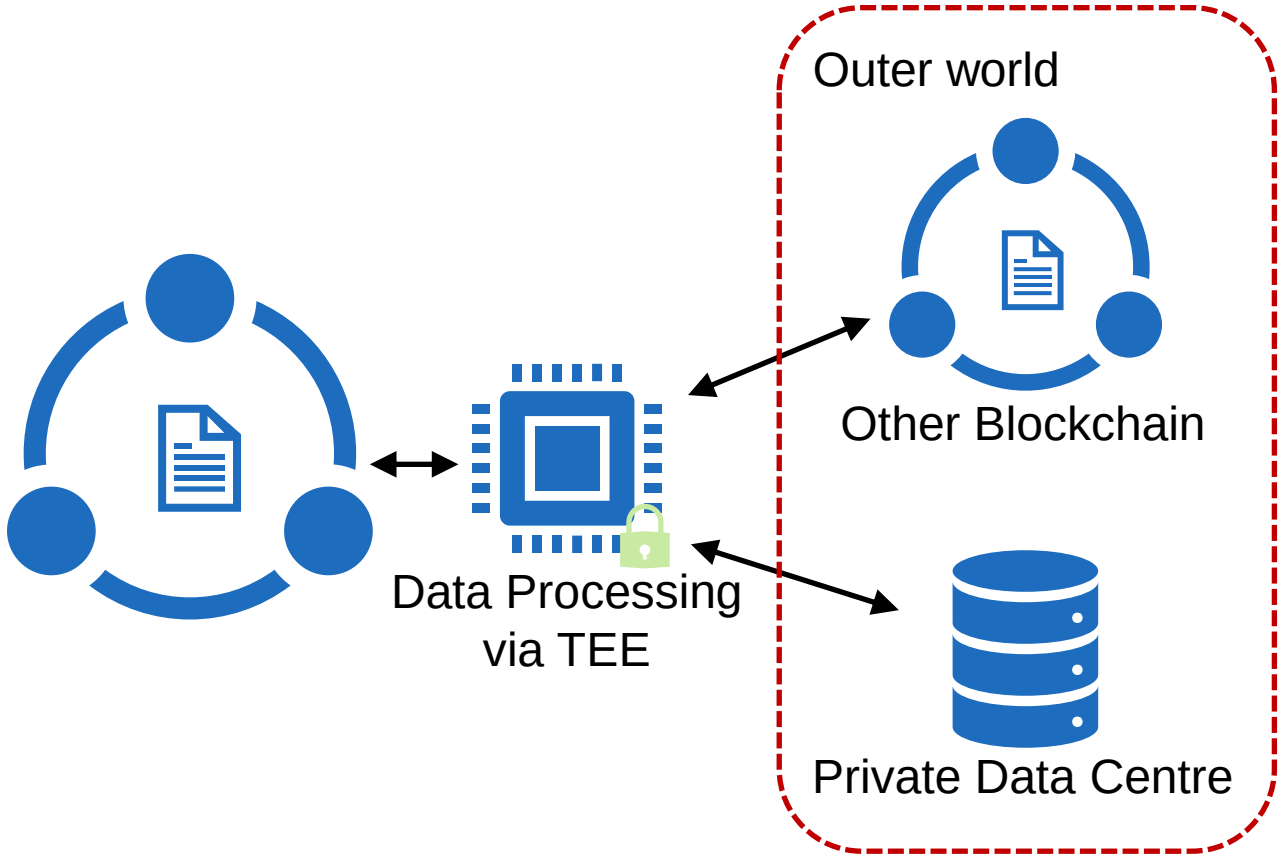
- Execute chaincode with TEE
  - Data is confidential
  - Processing procedure is publicly auditable



- Process private data from outer world



TEE-enhanced Chaincode

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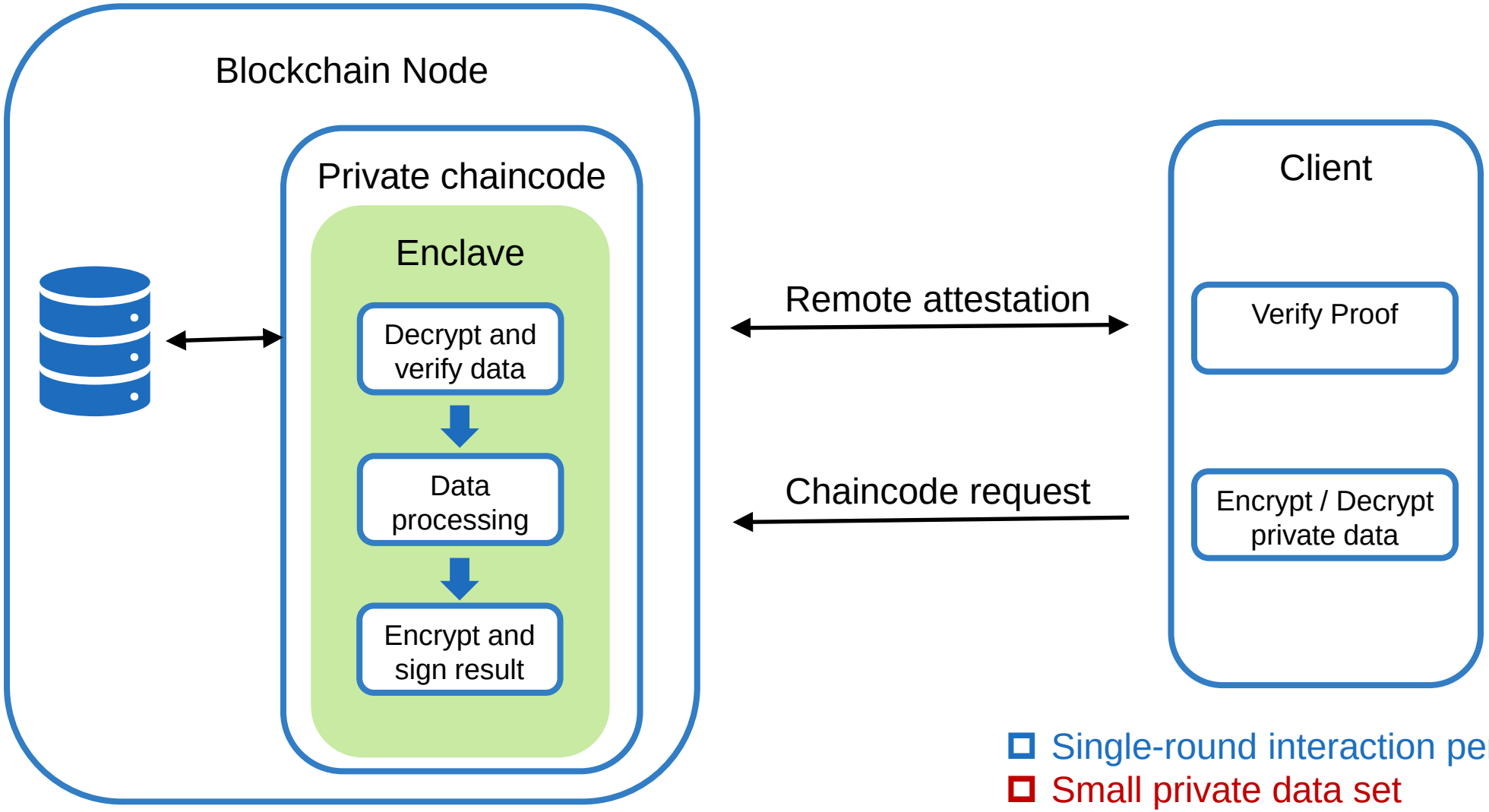

- Single-round interaction per task
- Small private data set
- Deterministic algorithm in TEE (Consensus-compatibility)

TEE as an Off-chain Service

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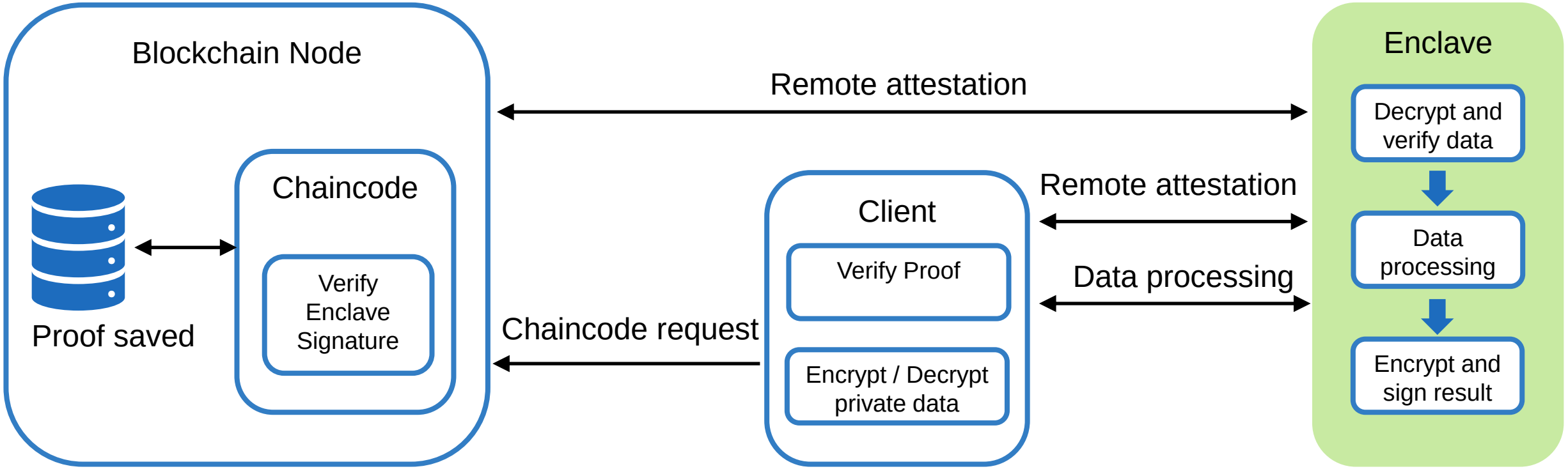

- Large private data set
- Randomized algorithm in TEE
- Multiple-round interactions per task

TEE Cluster

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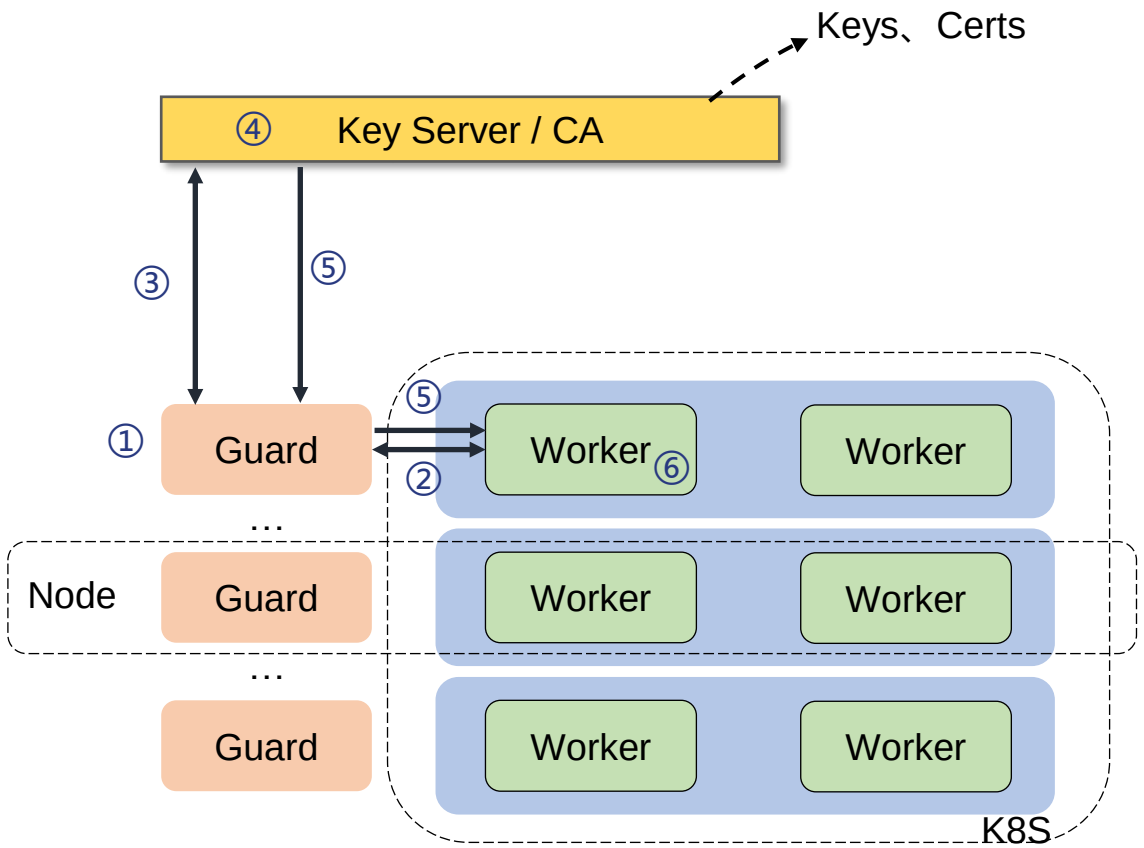

P.S. Key Server, Guards, and Workers are all SGX Enclaves

① Each node has a Guard enclave deployed.

② Guard and local Workers conduct local attestation. Worker sends its CSR to Guard.

③ Guard signs CSR, conducts bidirectional remote attestation with Key Server, and sends the signed CSR to Key Server.

④ Key Server verifies Guard's signature, and issues a certificate on CSR.

⑤ Key Server returns certificate and encryption / decryption key to Guard. Guard forwards these to Worker

⑥ Worker can manage application data with the key received from Key Server, and use its own Seal Key to manage this key.

Structure Diagram of Shuliantong

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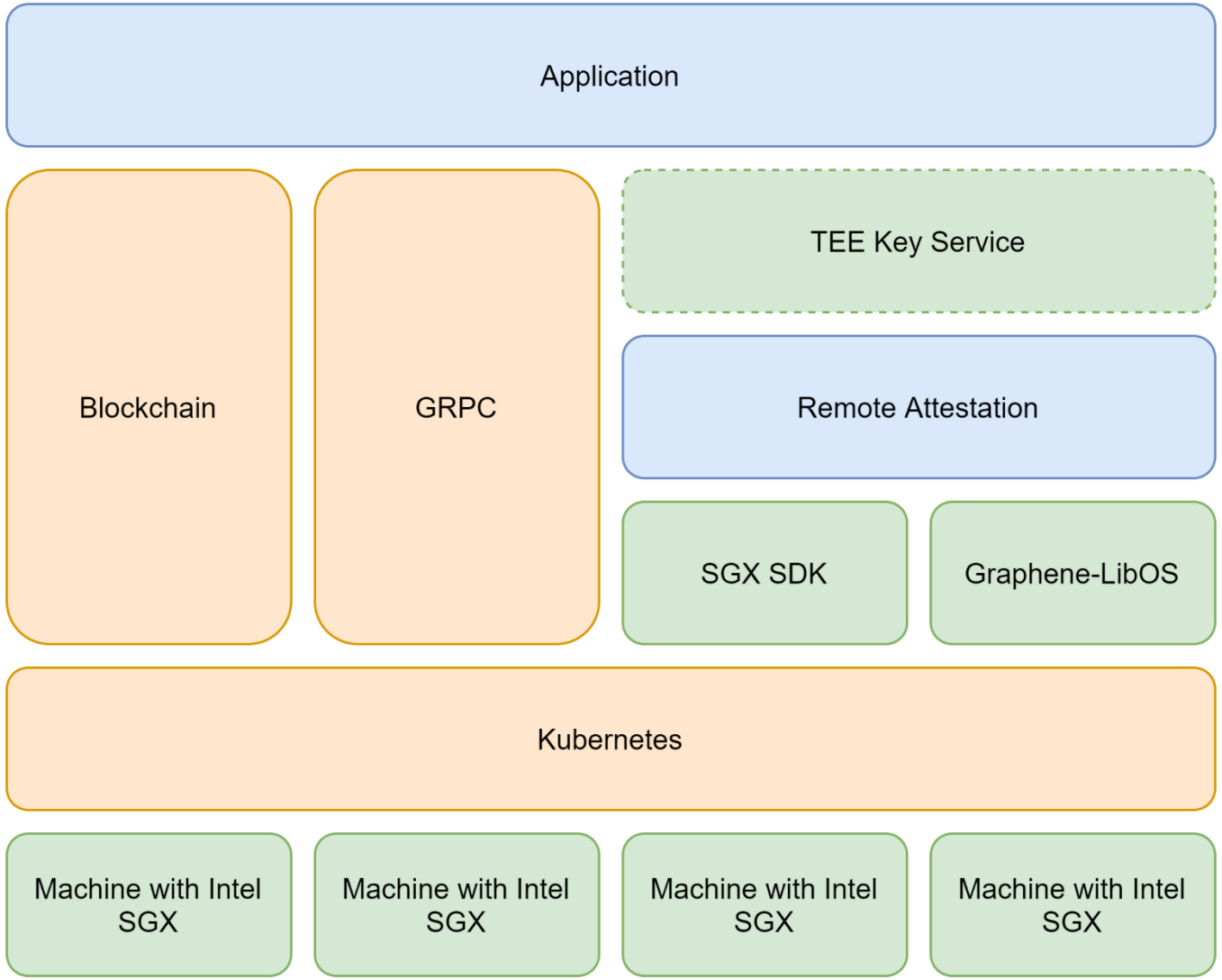

TEE as Oracle for Blockchain

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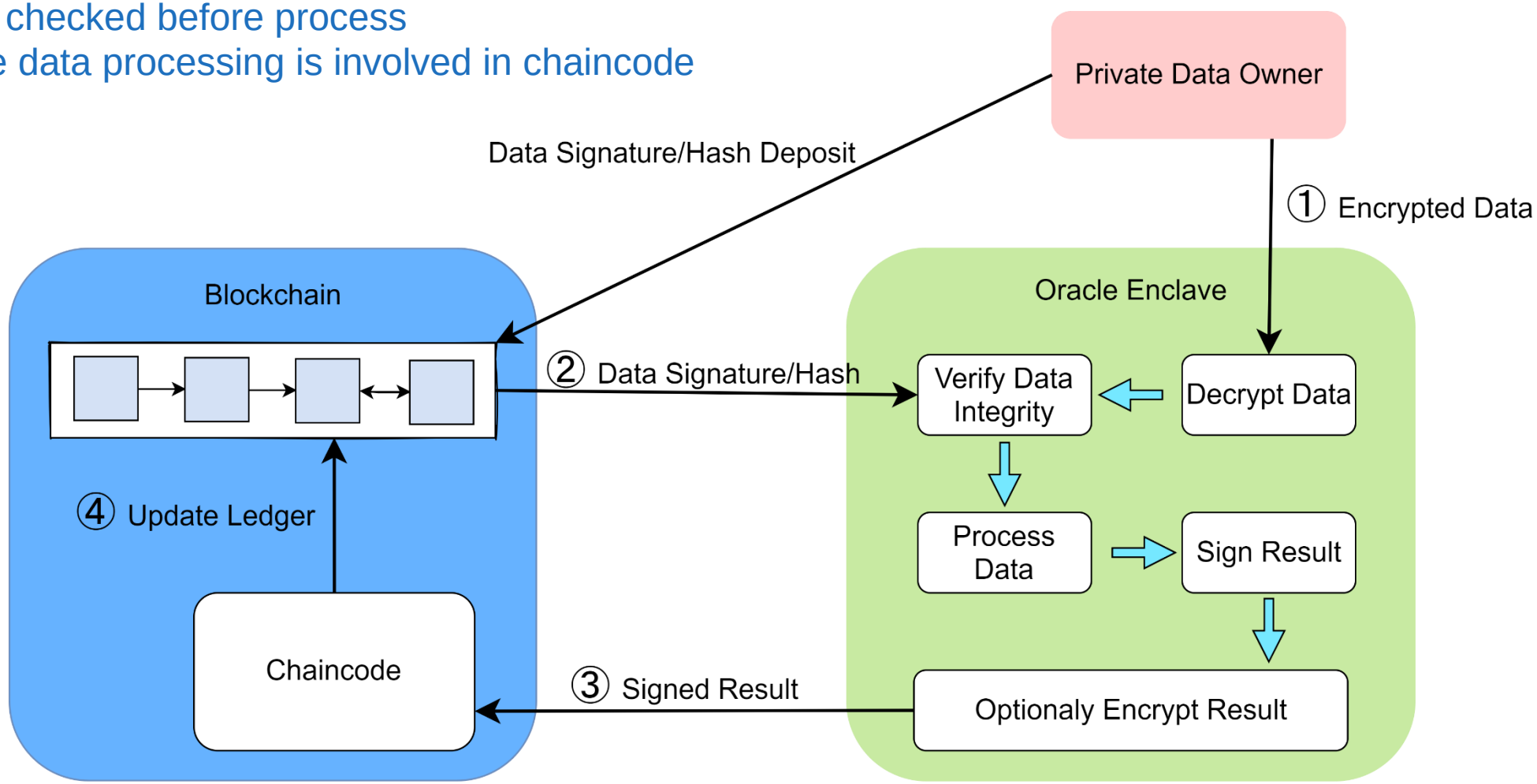
- Store sensitive data off-chain privately
- Deposit data signature/hash into the ledger when data is generated of updated
- Data integrity is checked before process
- Result of private data processing is involved in chaincode



Cross-Chain Interoperation

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1. Client send cross-chain request to Chain 1

2~4. Gateway send chaincode invocation request, subscribe events for this request

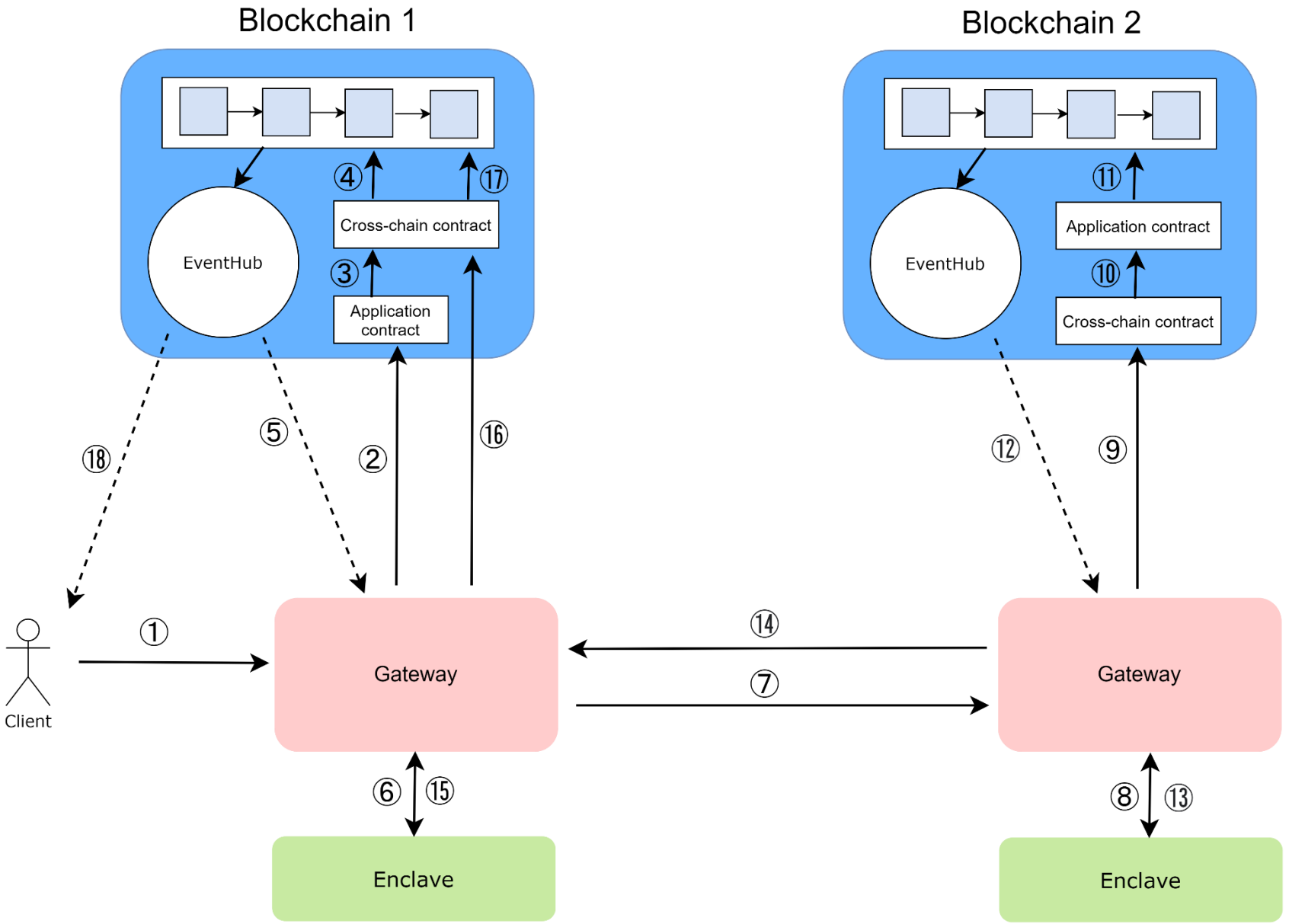
5. Gateway gets notification for completion of chaincode

6~8. Enclave verify the notification, and sends a corresponding request to Chain 2

9~11. Same as 2~4

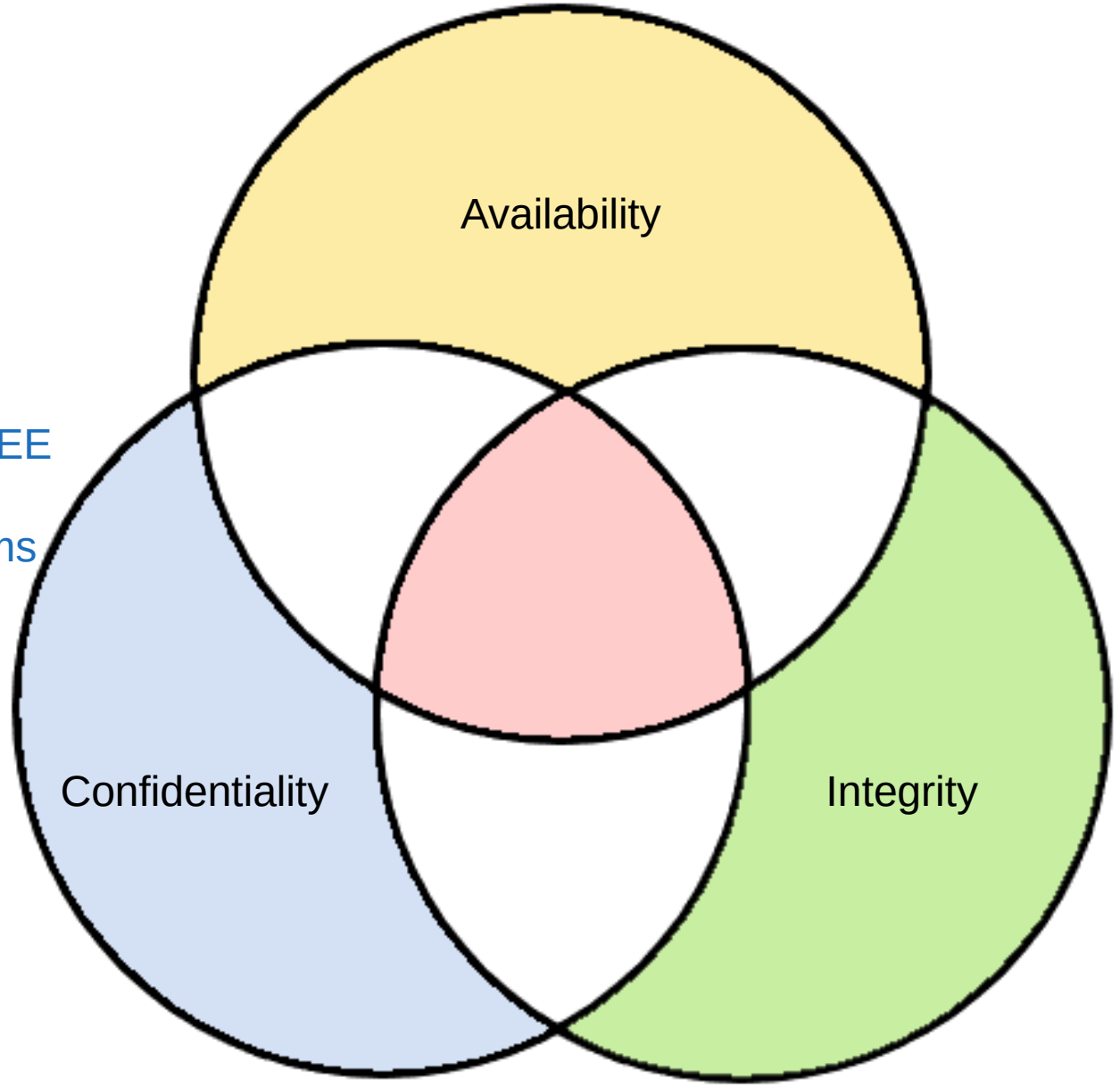
12~15. Same as 6~8

16~18. Finalize the state of cross-chain operation, and notify Client



Summary

- Balanced
  - Confidentiality:
    - Reserved memory by TEE
  - Integrity:
    - Blockchain mechanism
    - Tamper-free environment by TEE
  - Availability:
    - Avoid complex crypto algorithms



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Thank you!