Droplet: Decentralized Authorization and Access Control for Encrypted Data Streams

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Rise of Real-Time Data

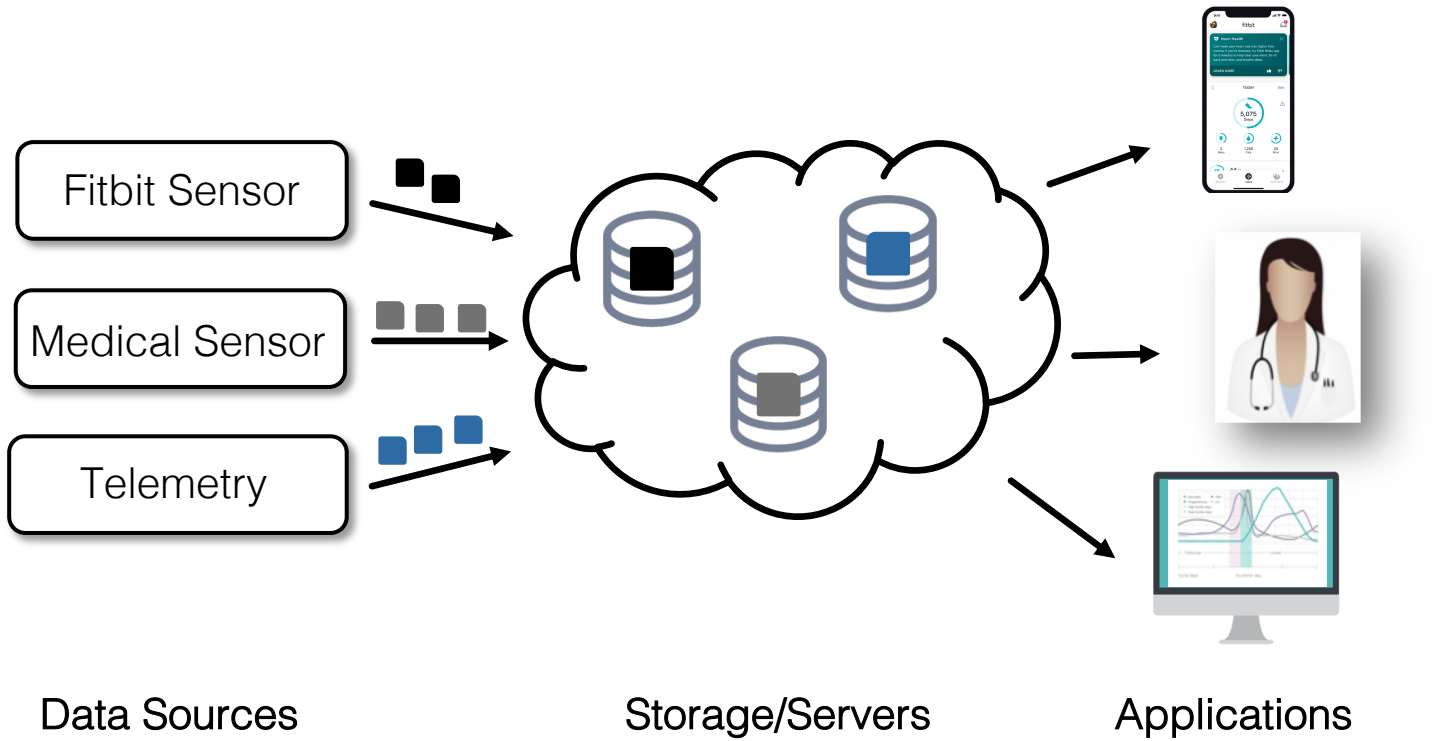
Autonomous Driving

Internet of Things

Health Care

Telemetry/DevOps

Monolithic Applications



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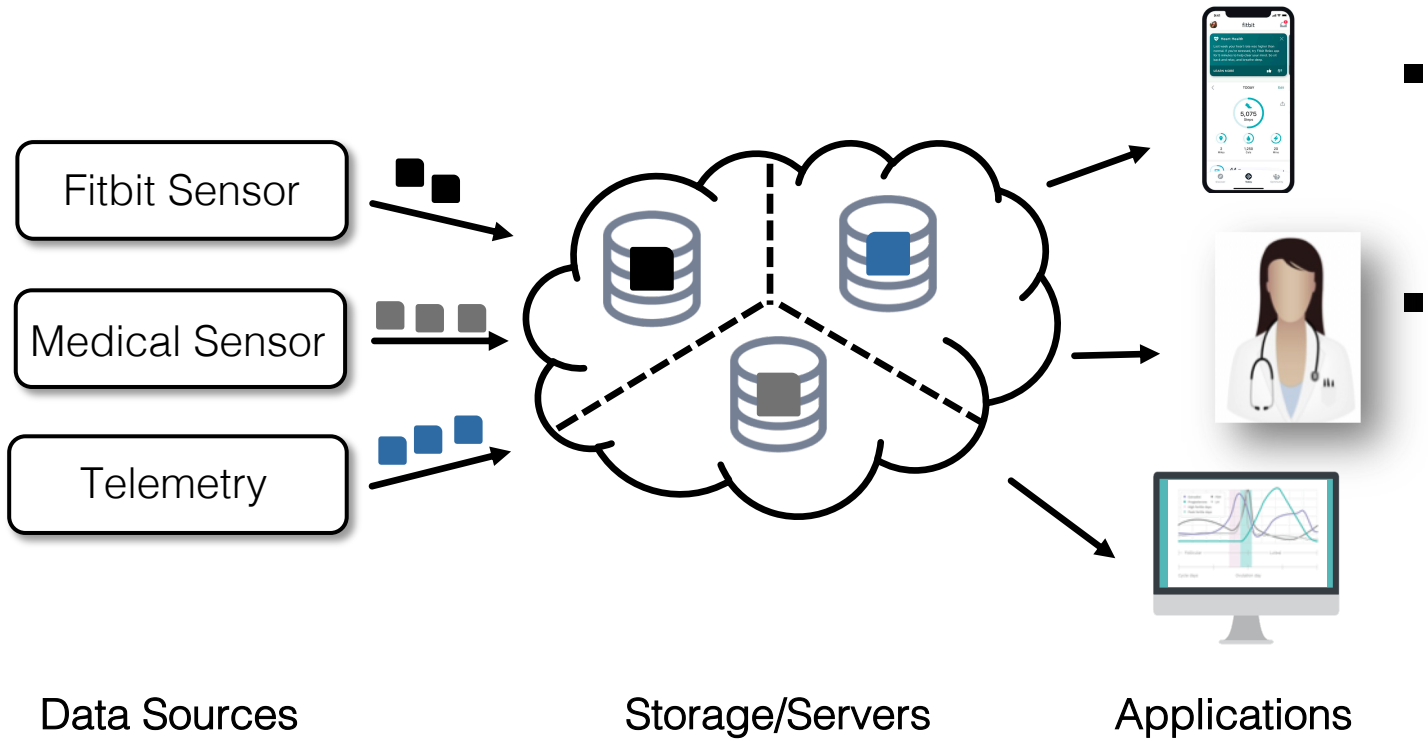

- data is governed and controlled by application providers
- data lives in narrow and disjoint silos → hindering fusing data from multiple sources

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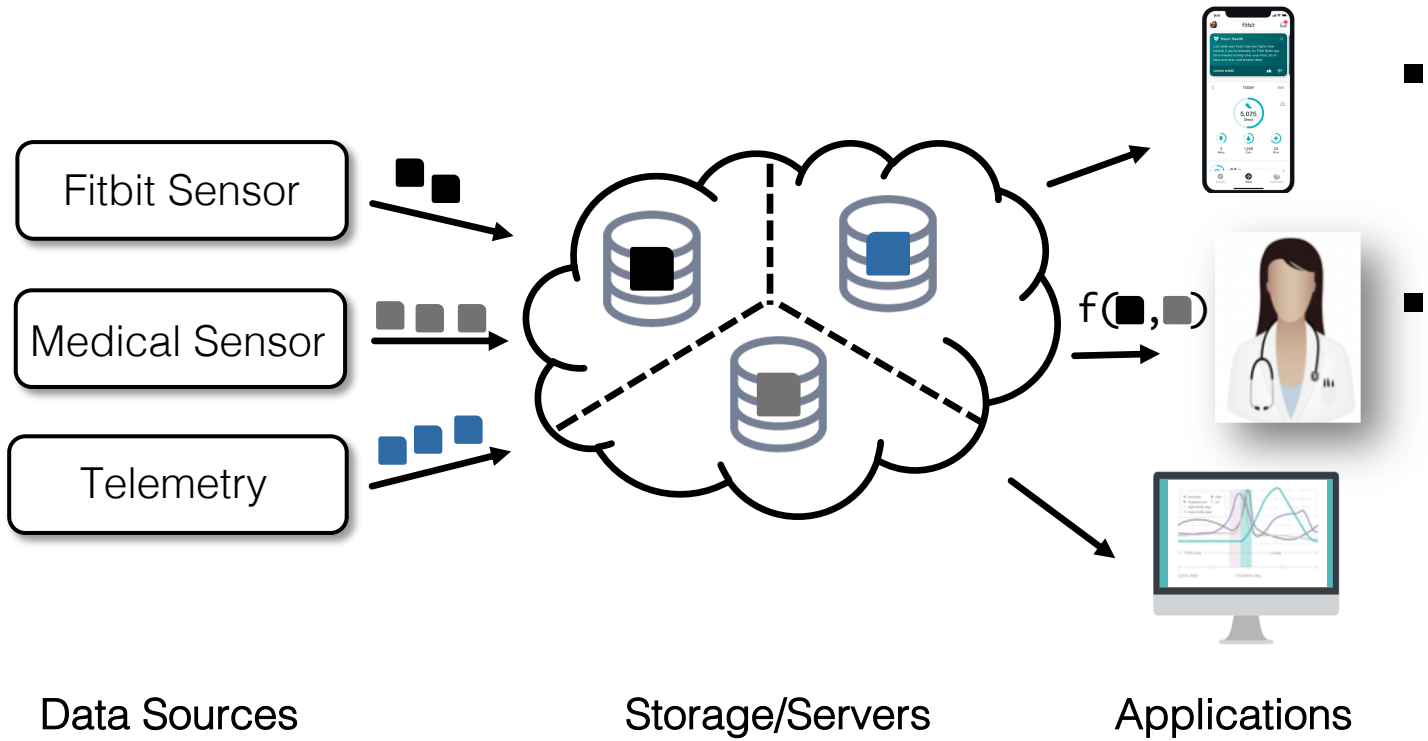

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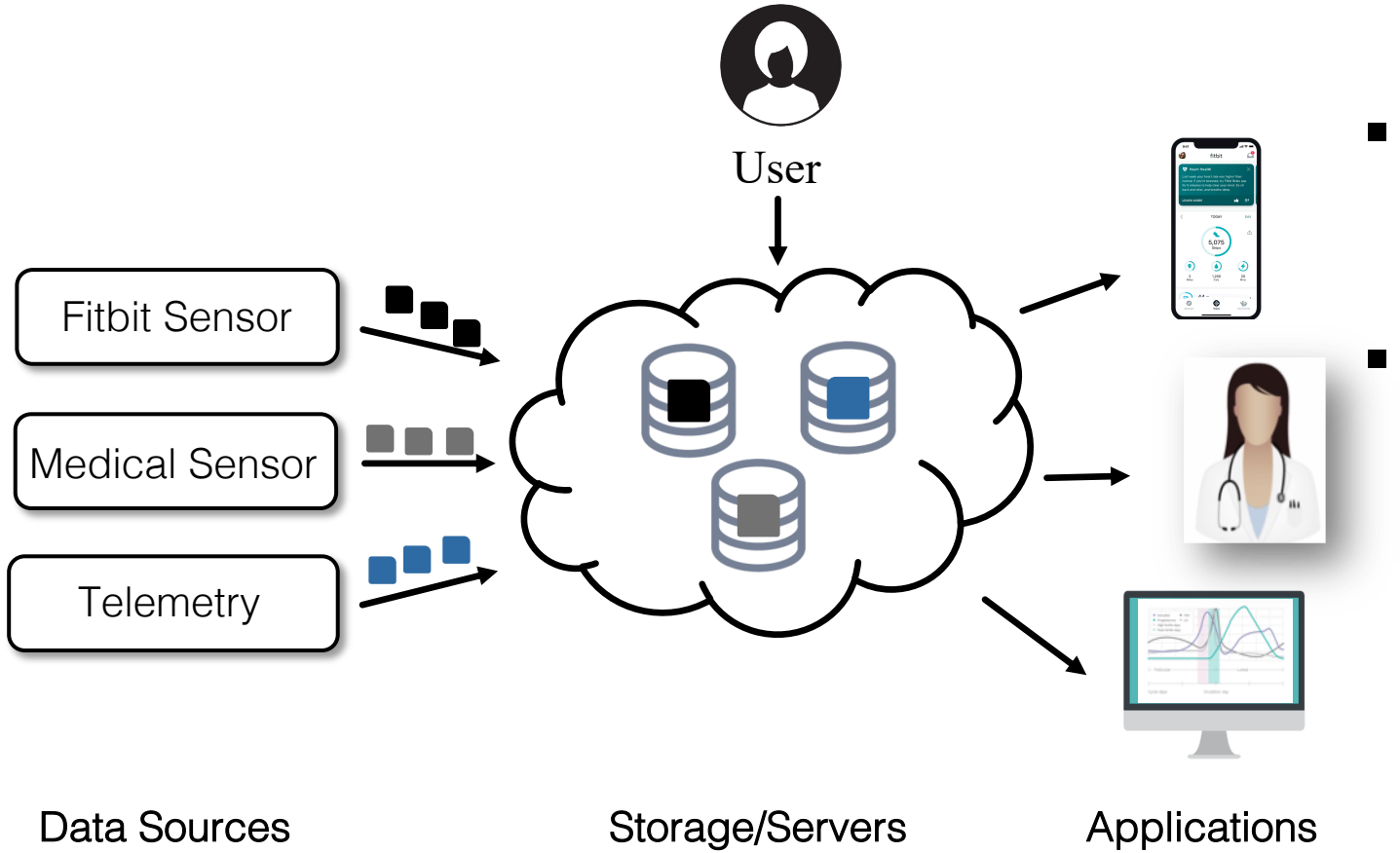
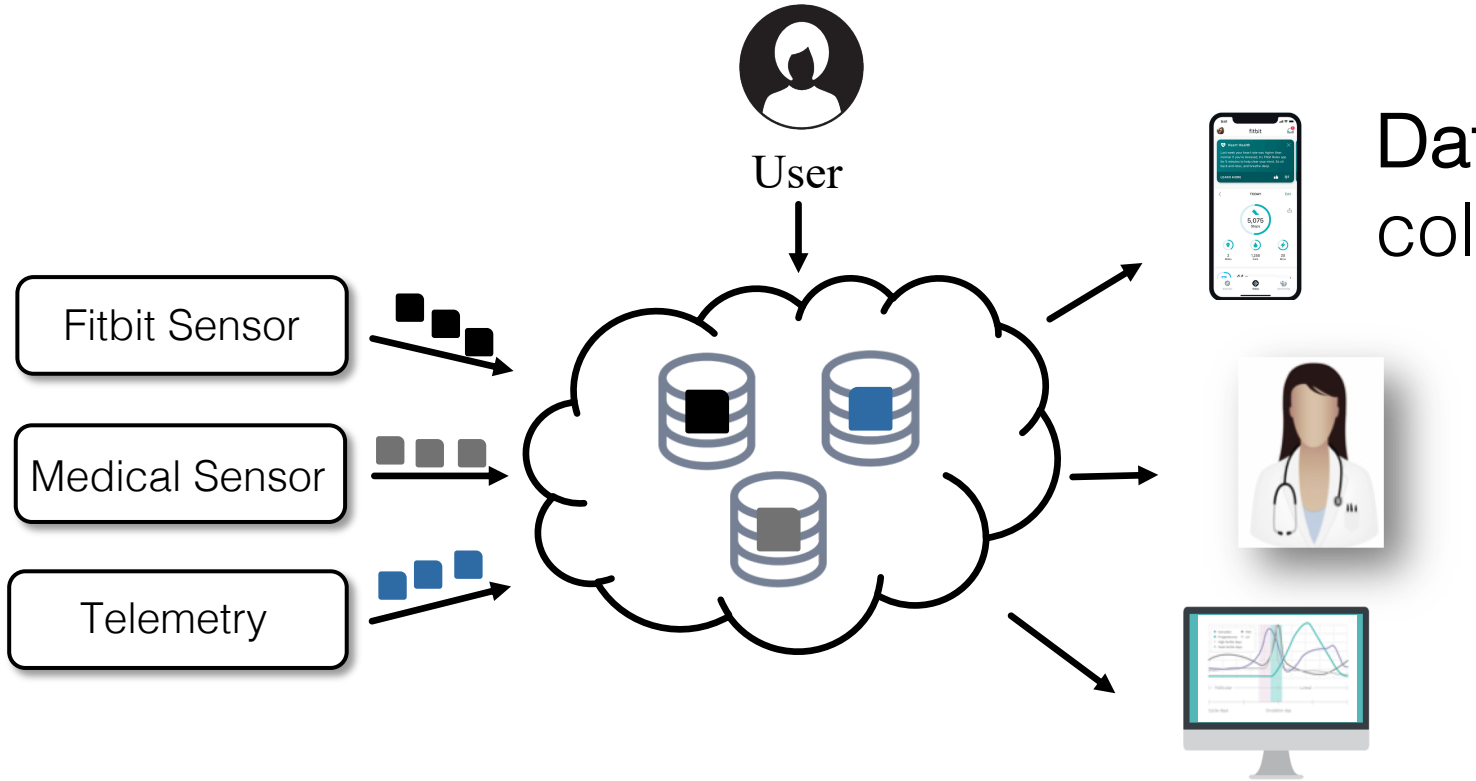
User-centric Model



- decouple user-data from application's logic
- users in full control of their data

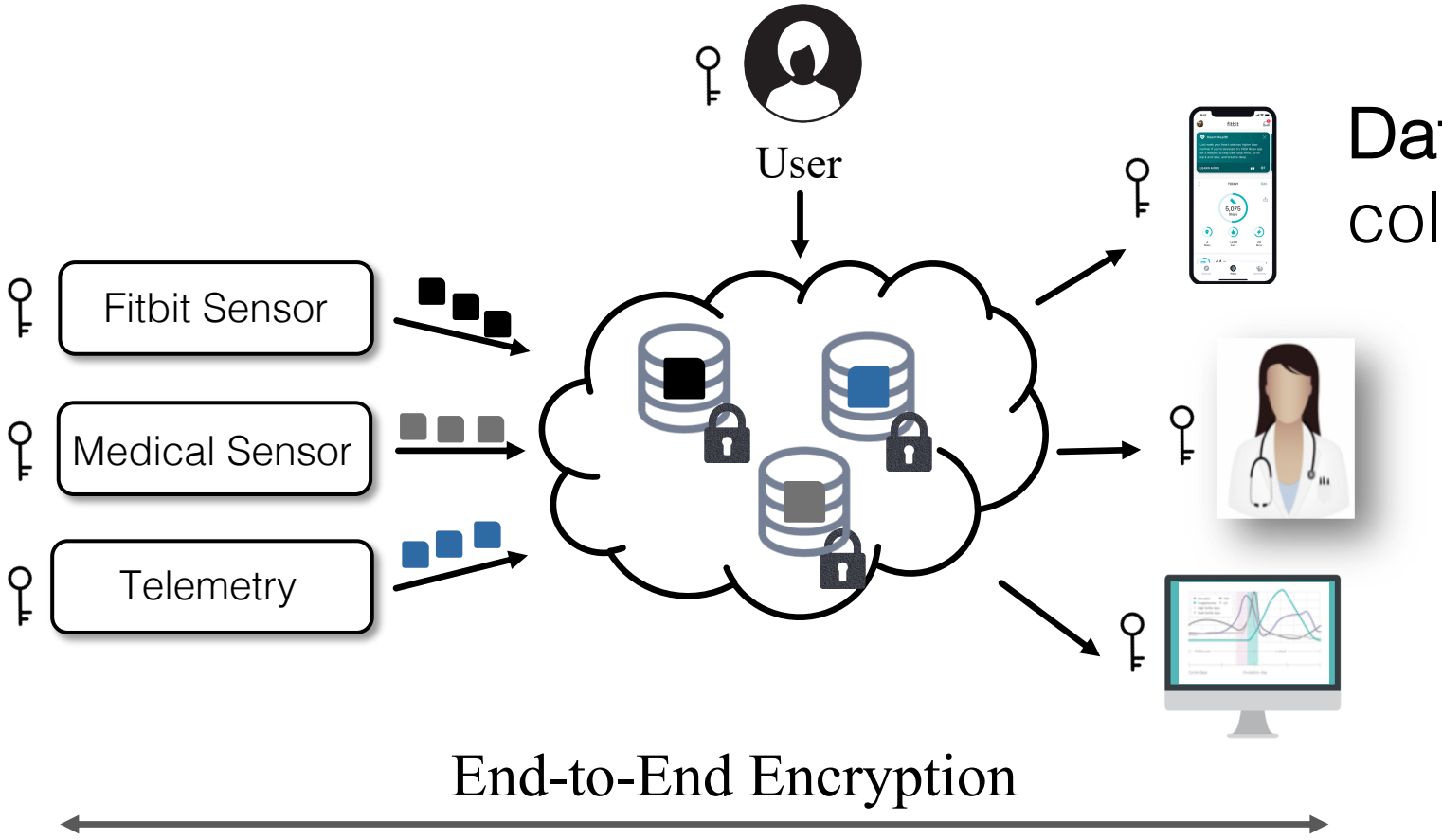
How to realize **secure** and **decentralized** access control in a user-centric architecture?

Privacy-sensitive Data



Data protection: IoT devices collect privacy-sensitive data

Privacy-sensitive Data: End-to-End Encryption



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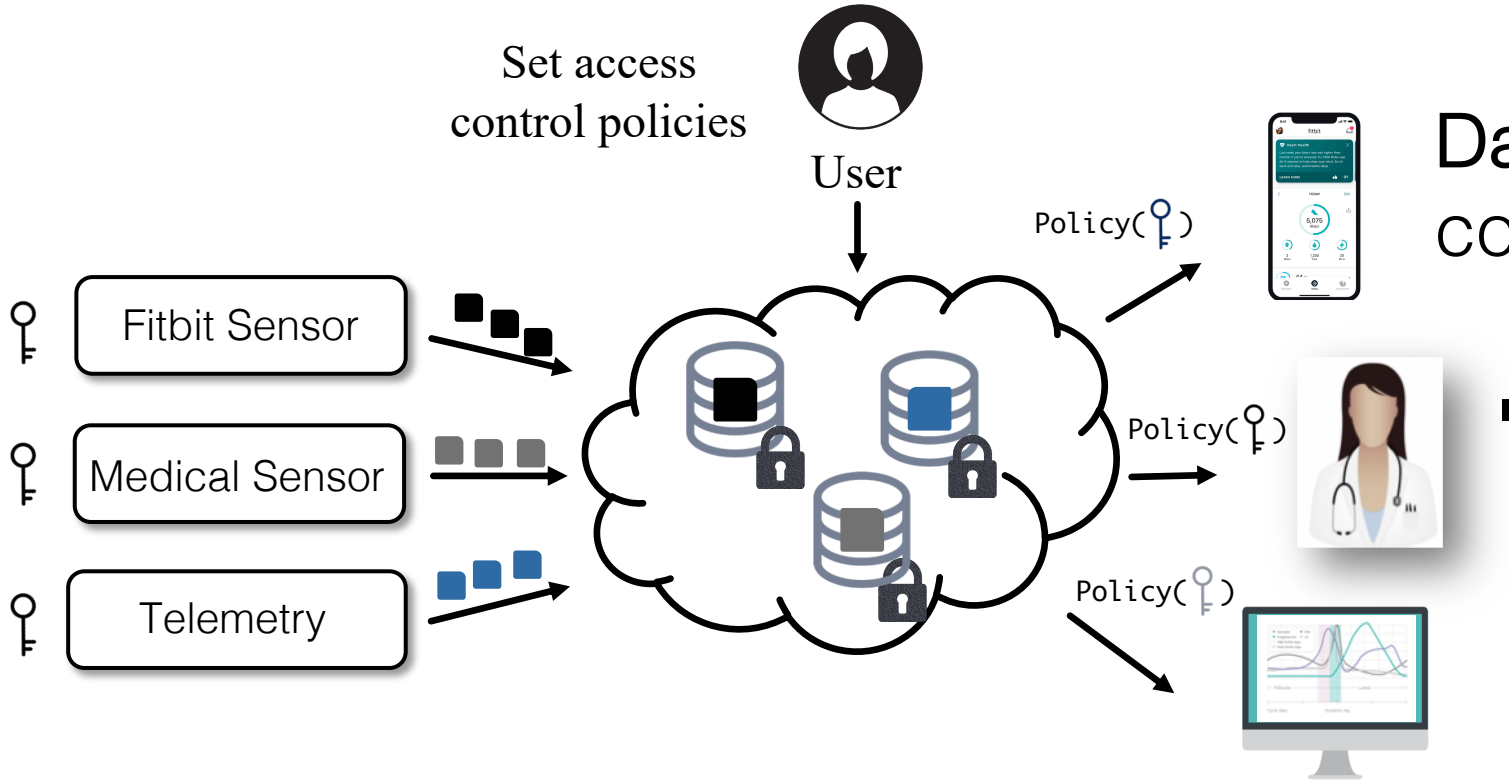
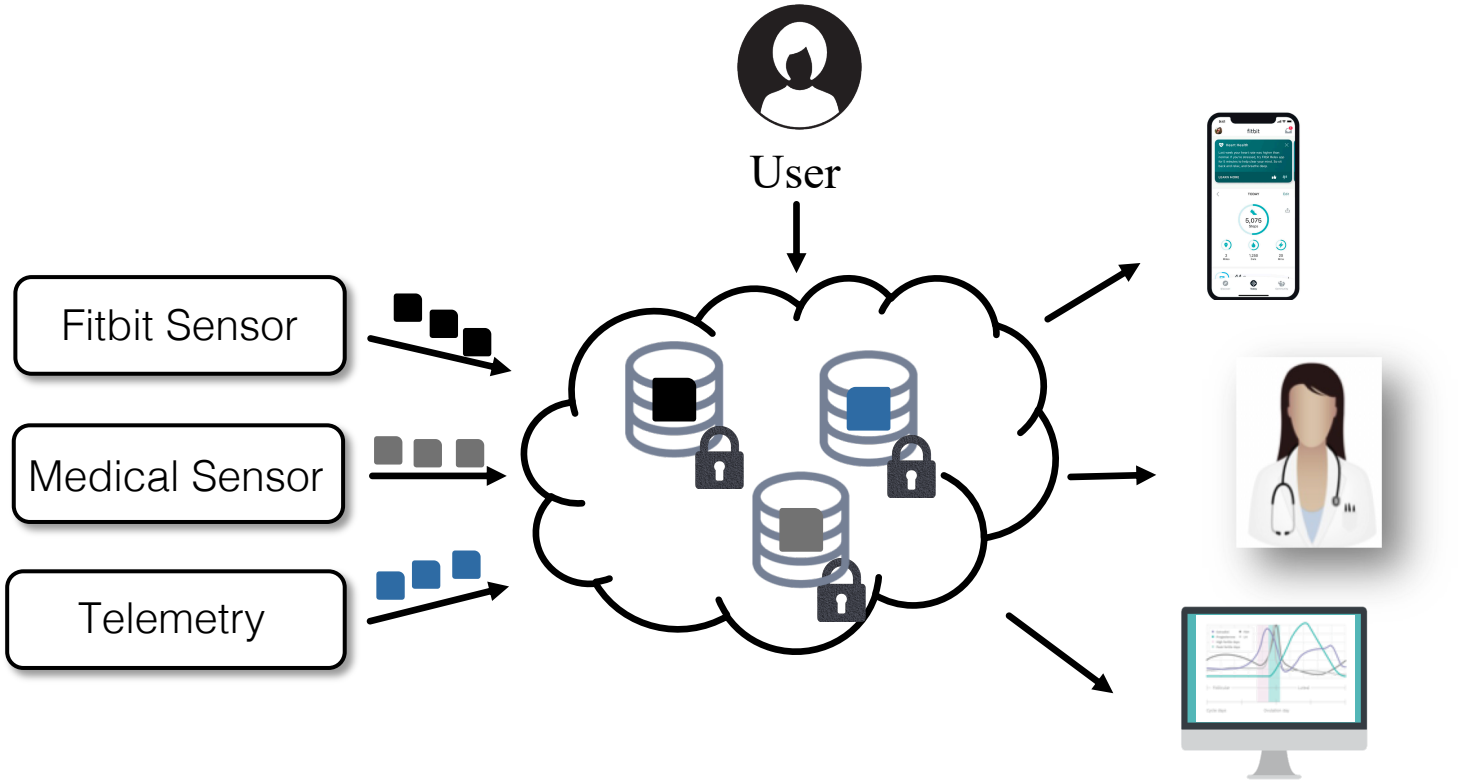


Data protection: IoT devices collect privacy-sensitive data

- **Challenge 1 :** fine grained data protection that is consistent with stream sharing semantics

Access Authorization



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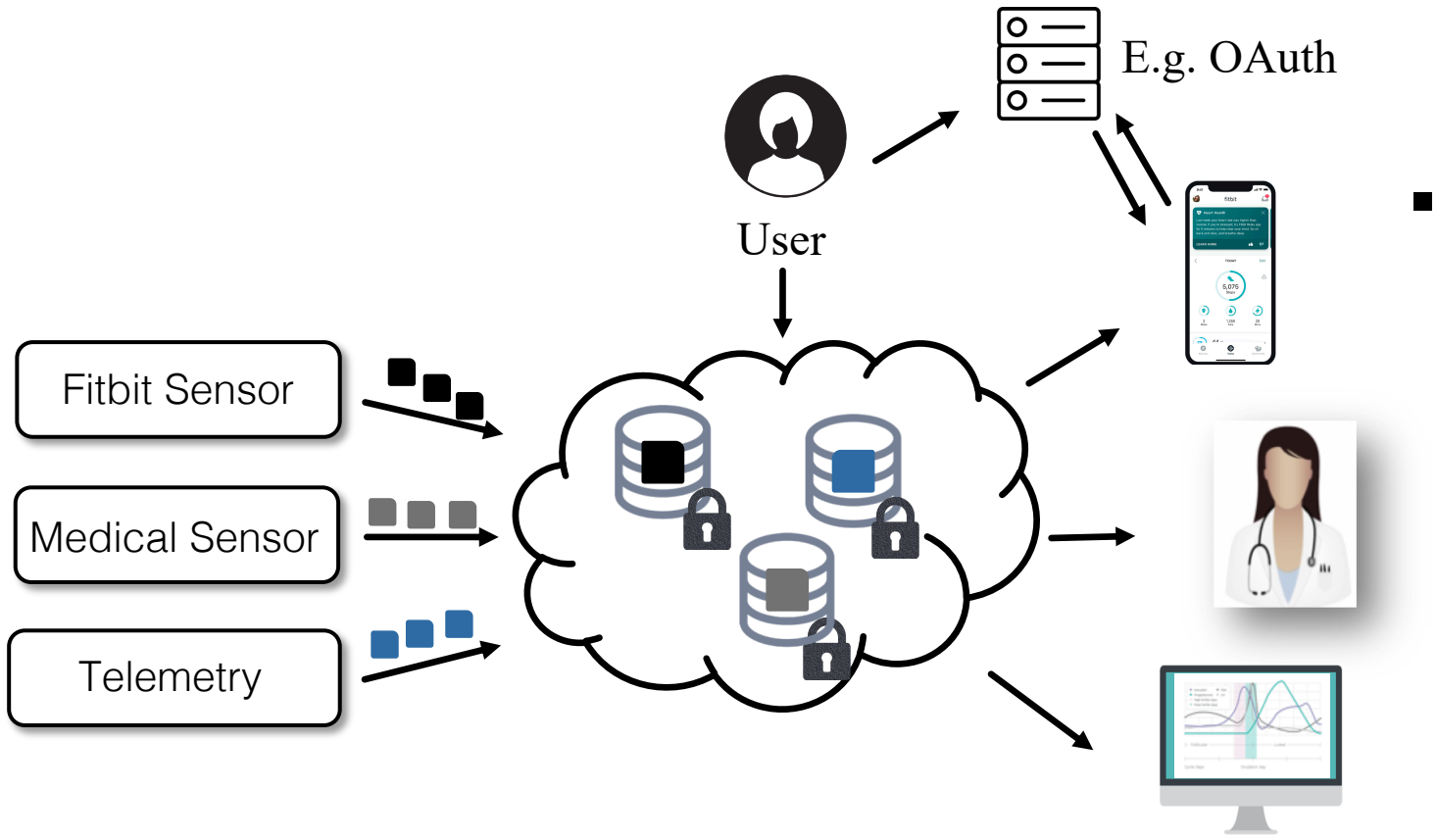

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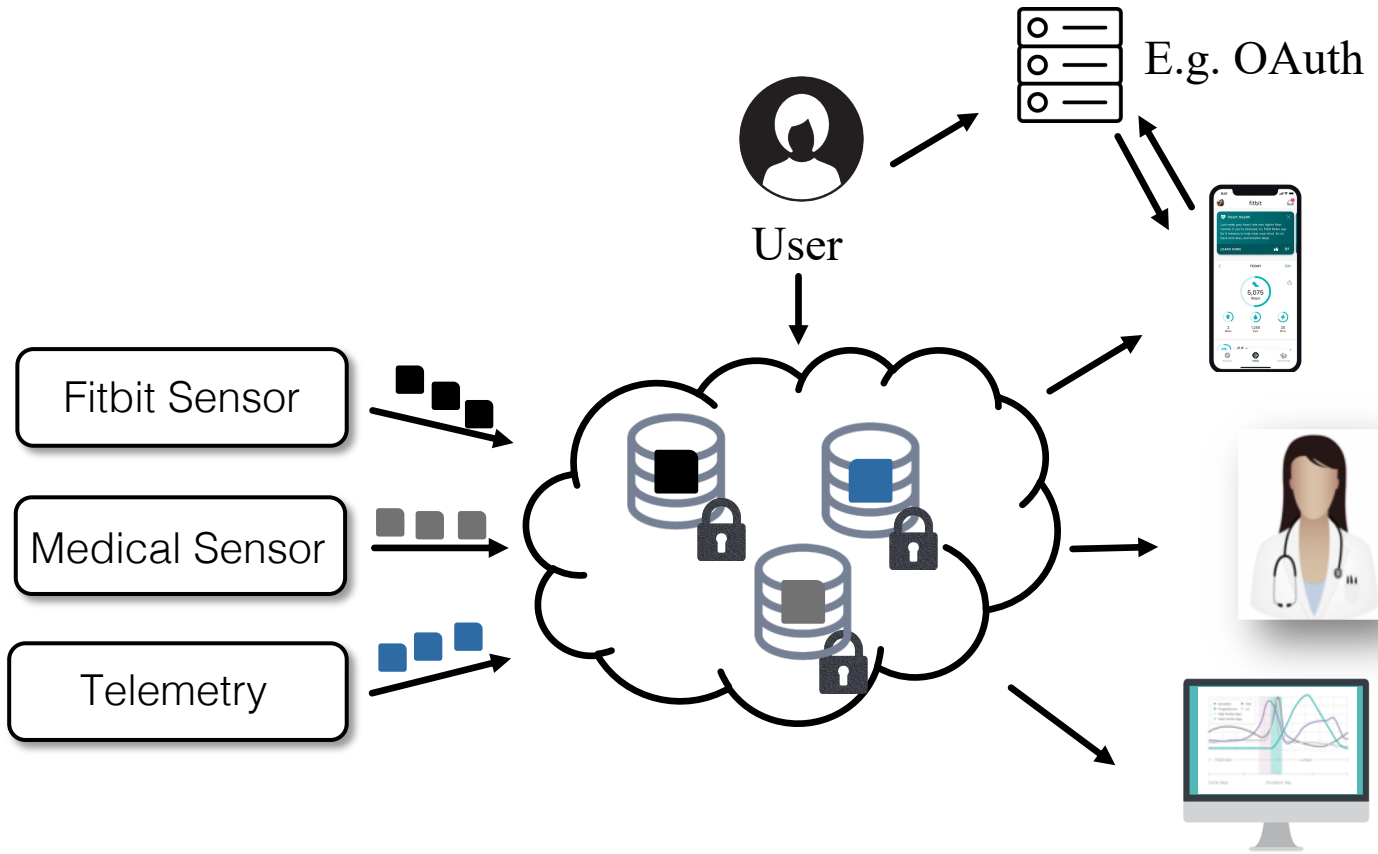

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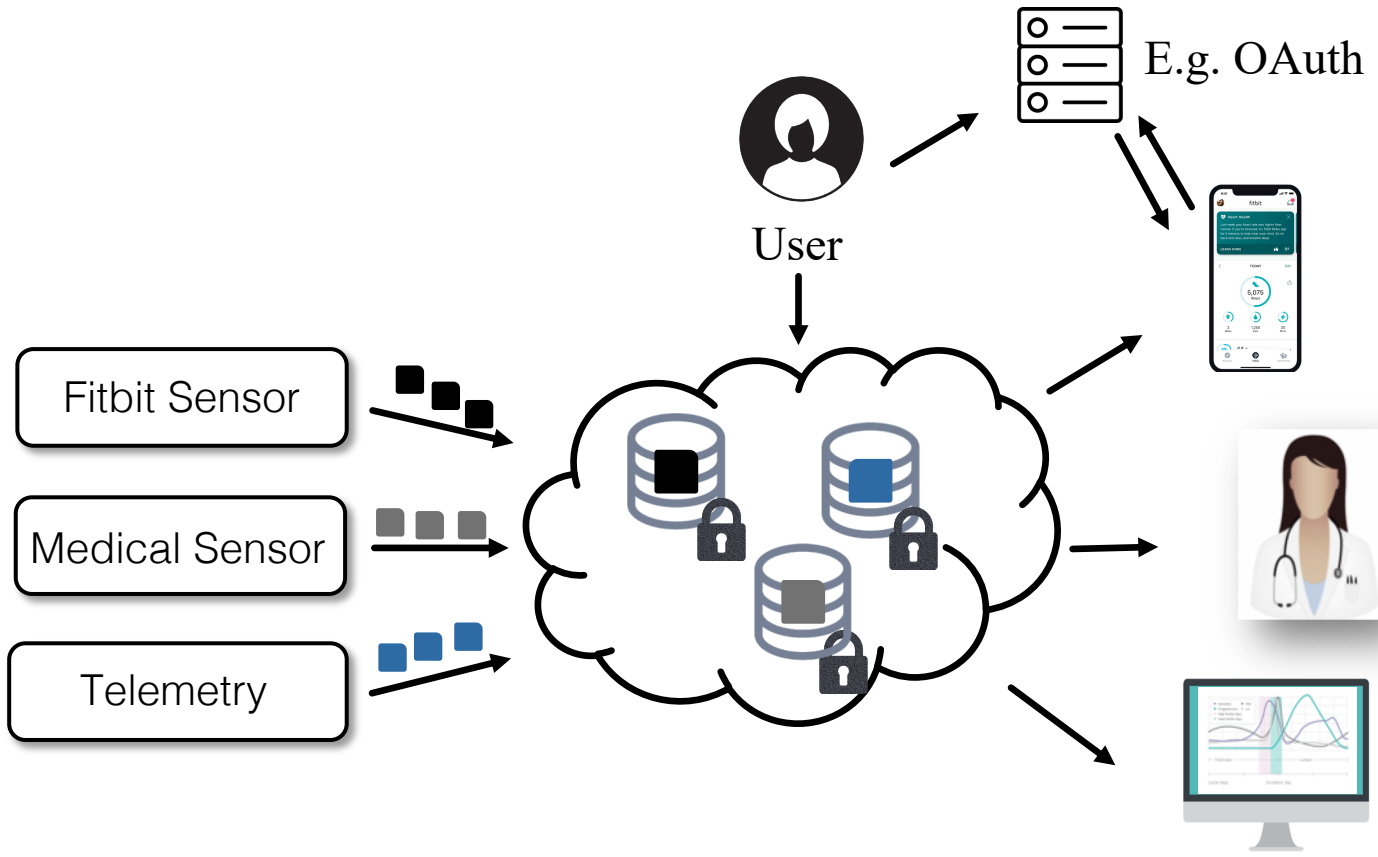

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- no cryptographic guarantees / decoupled from data protection
- **Challenge ❷: d**ecentralized authorization that adheres to end-to-end encryption

Droplet in a Nutshell

a new decentralized data access control service

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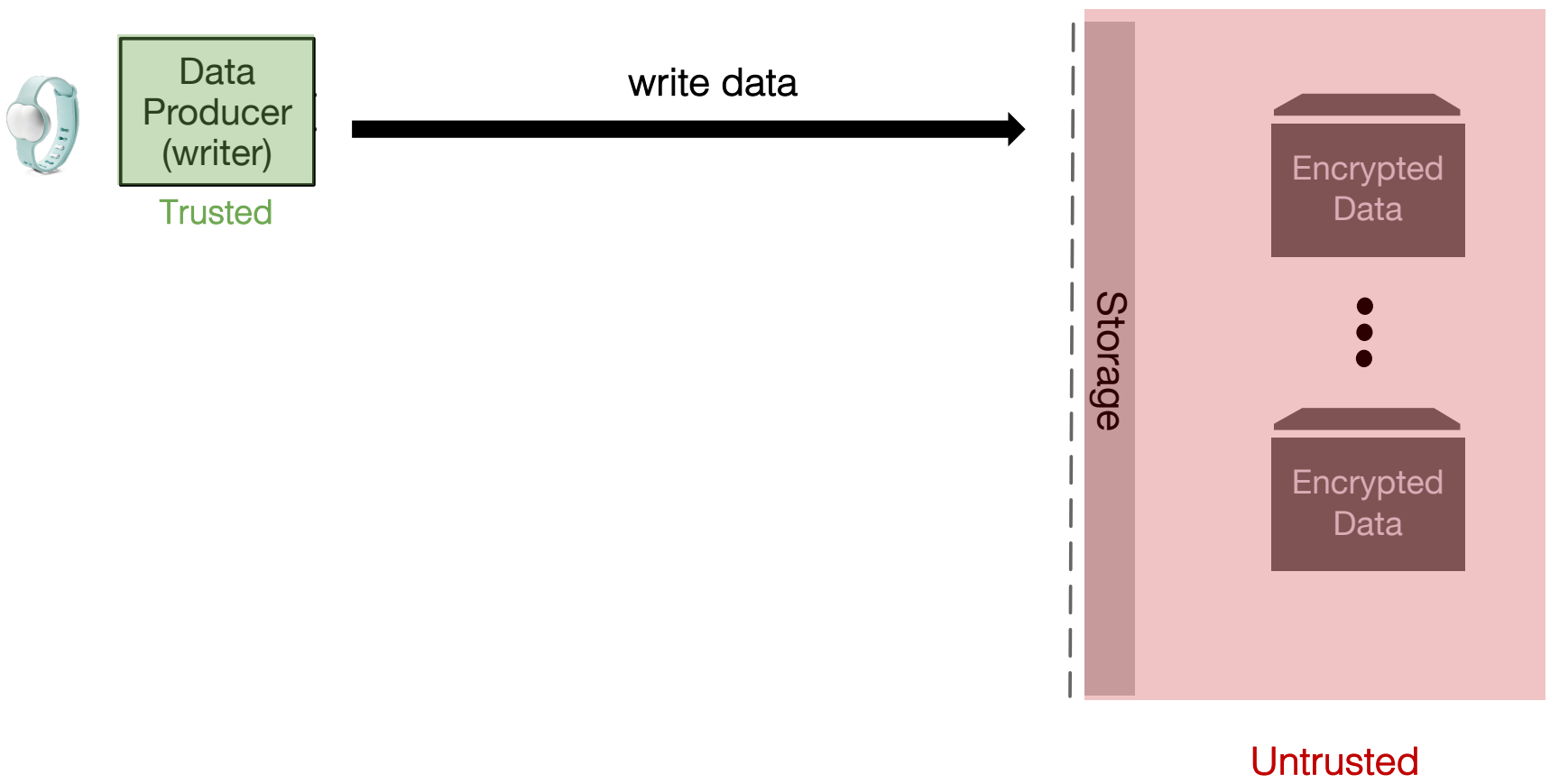
- co-design: access control & authorization for end-to-end encryption
- a new cryptographic access control construction tailored for stream data
- a new decentralization authorization service
  - operates without central authority
  - protects the privacy/integrity of access permissions
  - permission discovery

Overview and Threat Model



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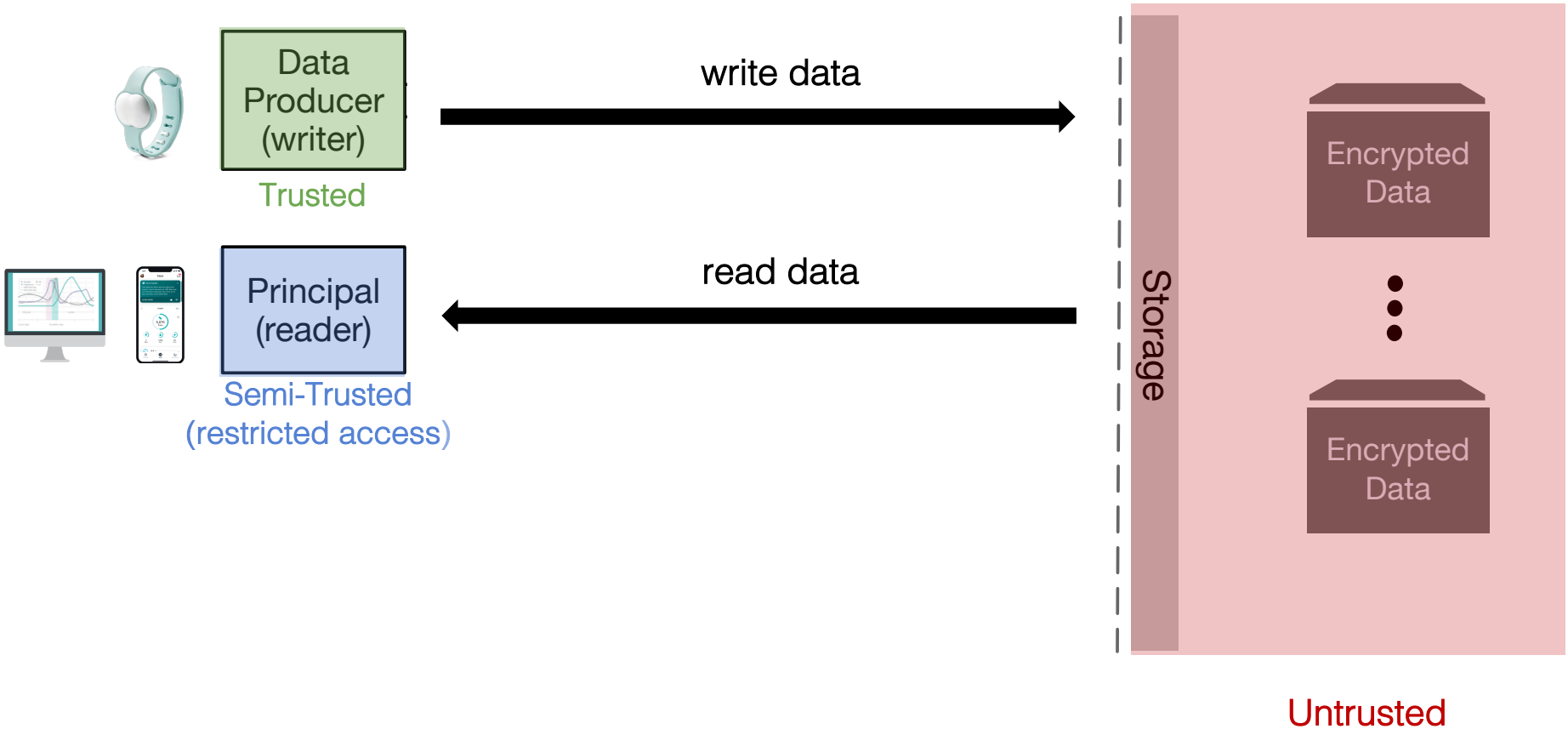

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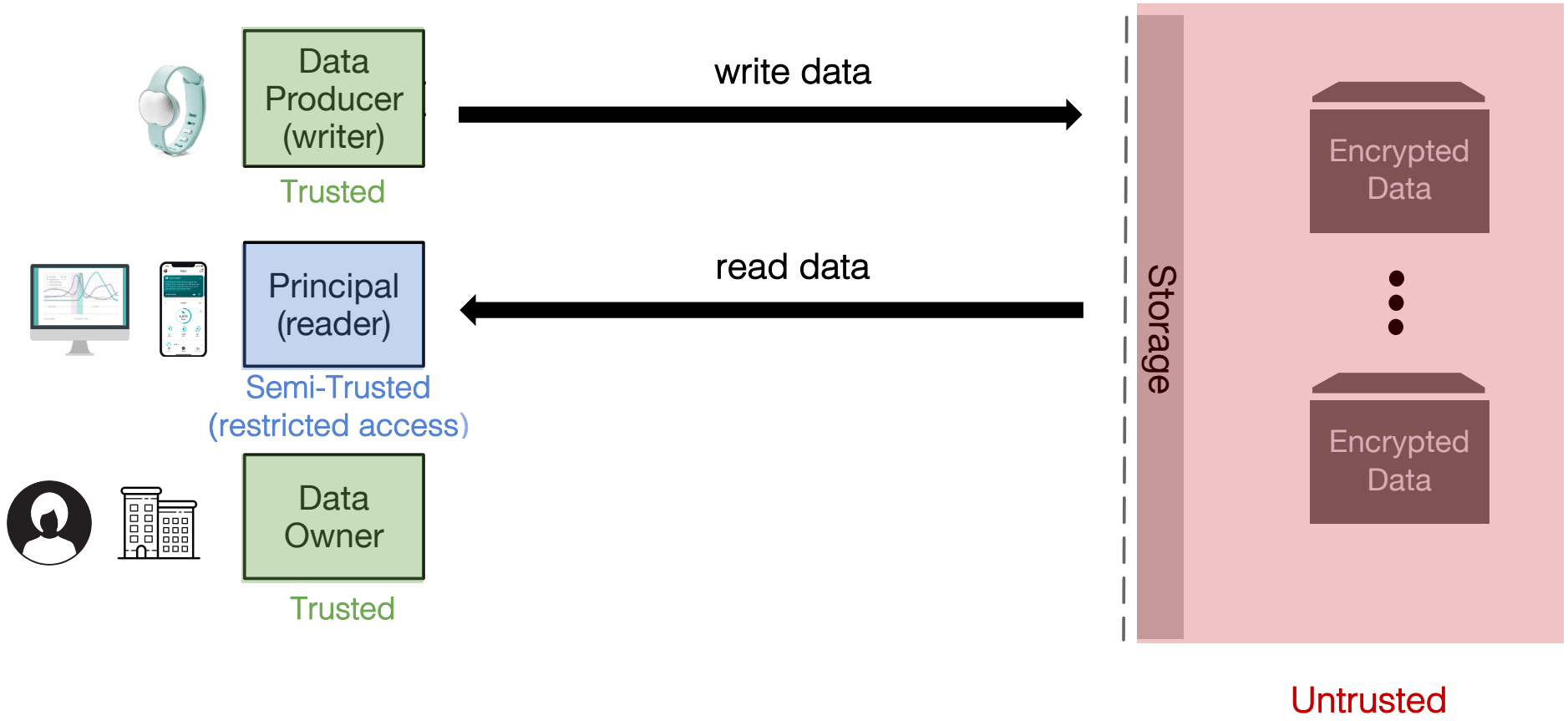

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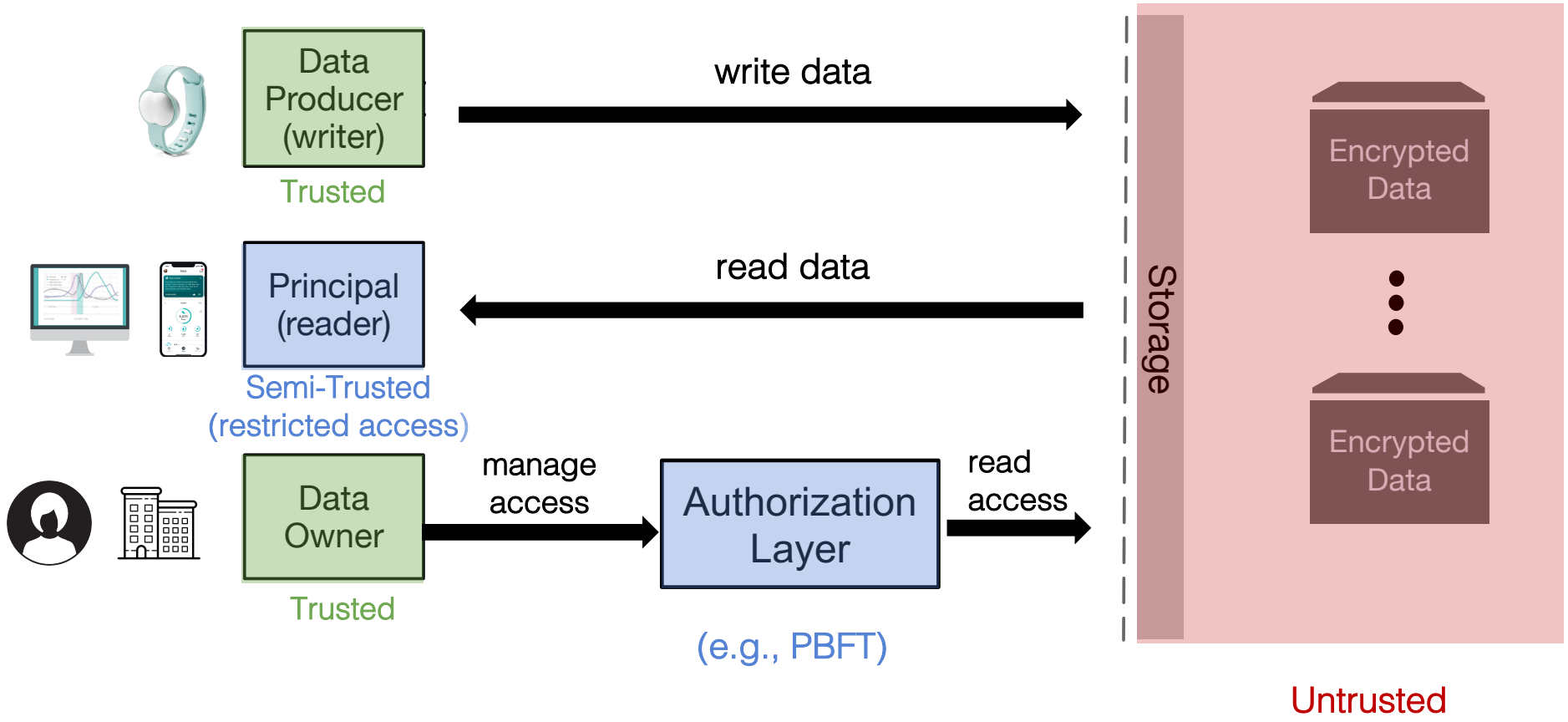
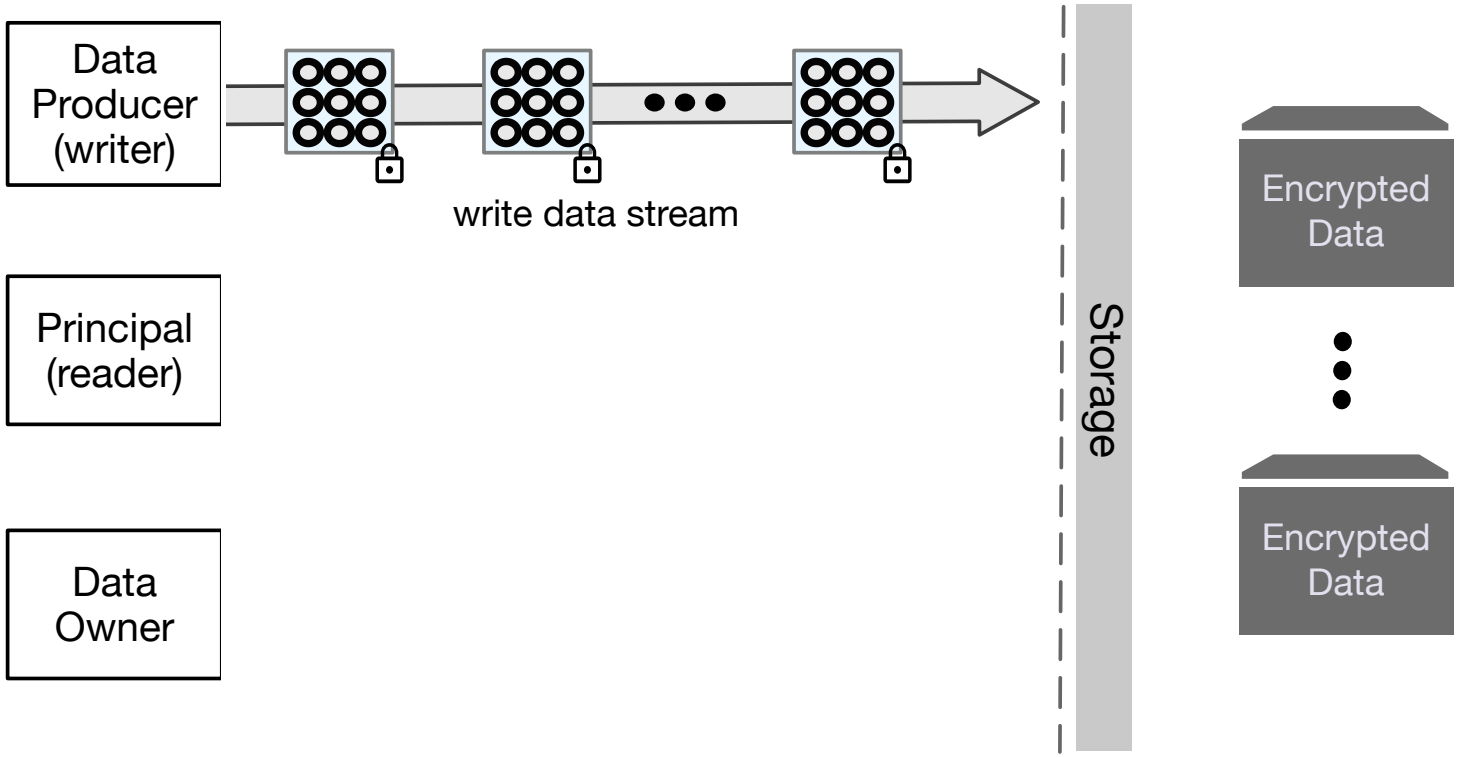


Droplet: Encryption-based Access Control



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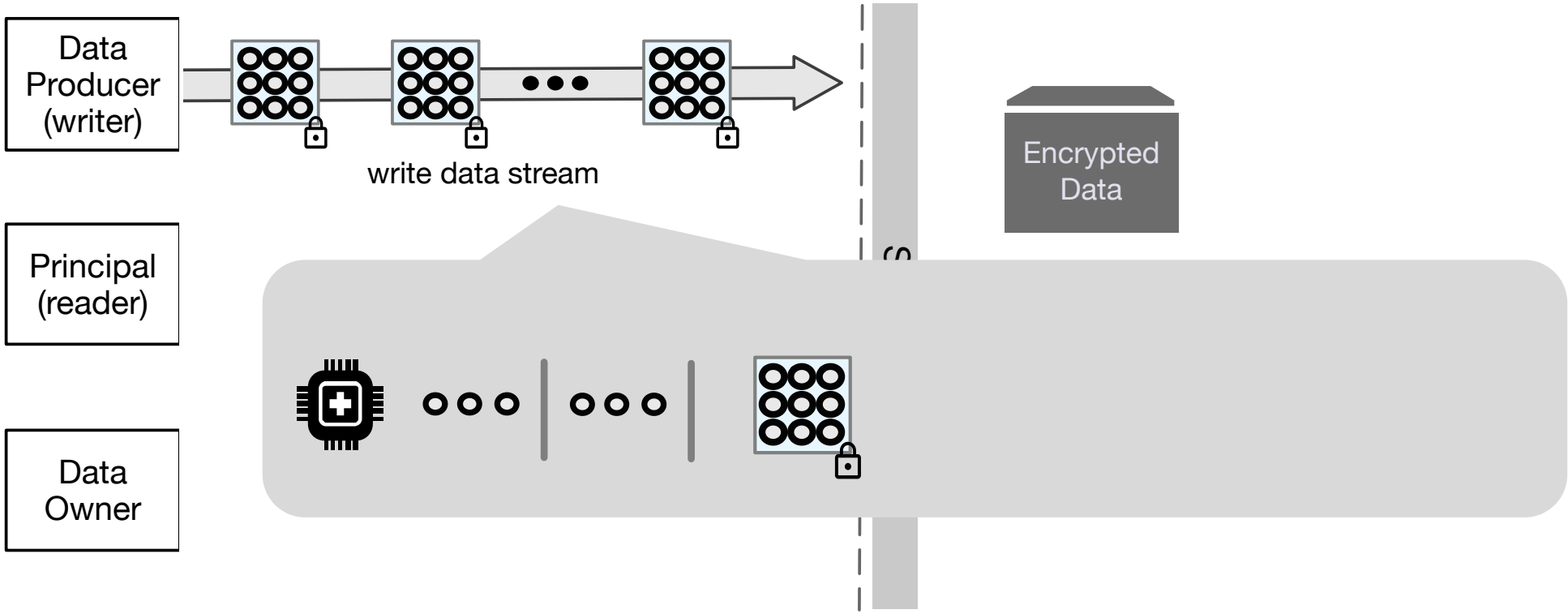

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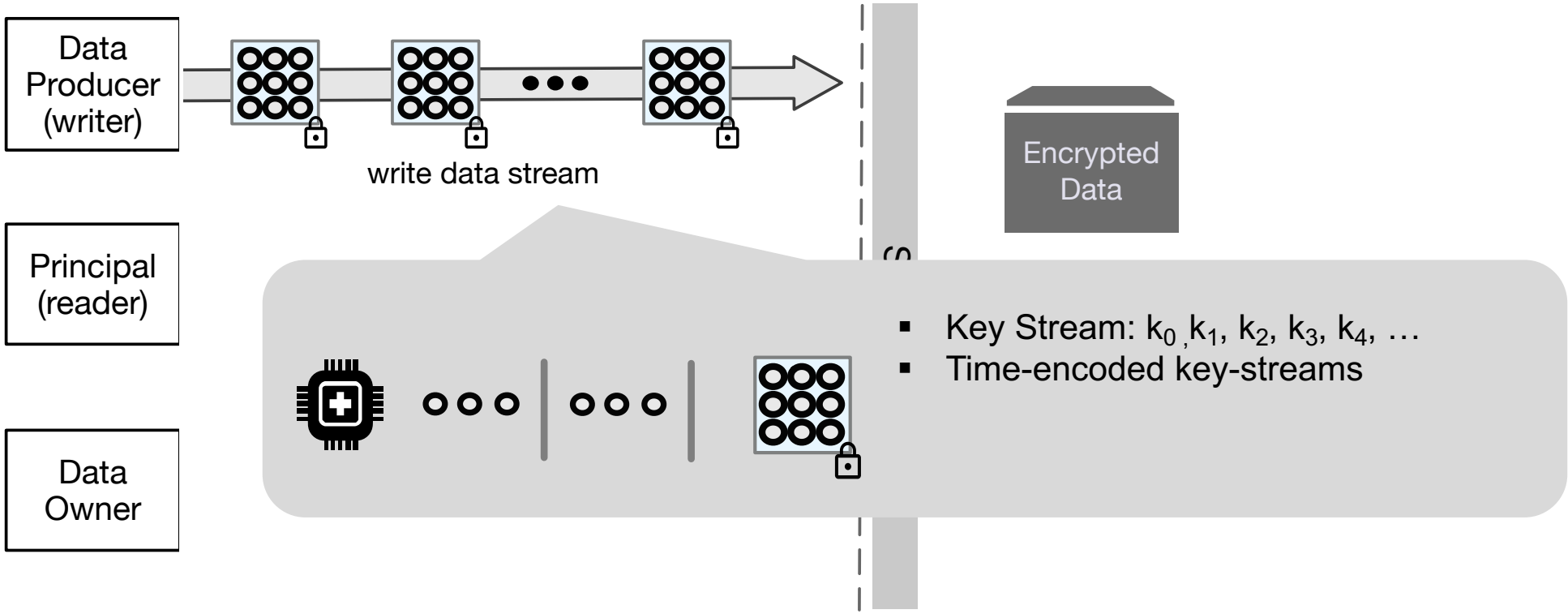

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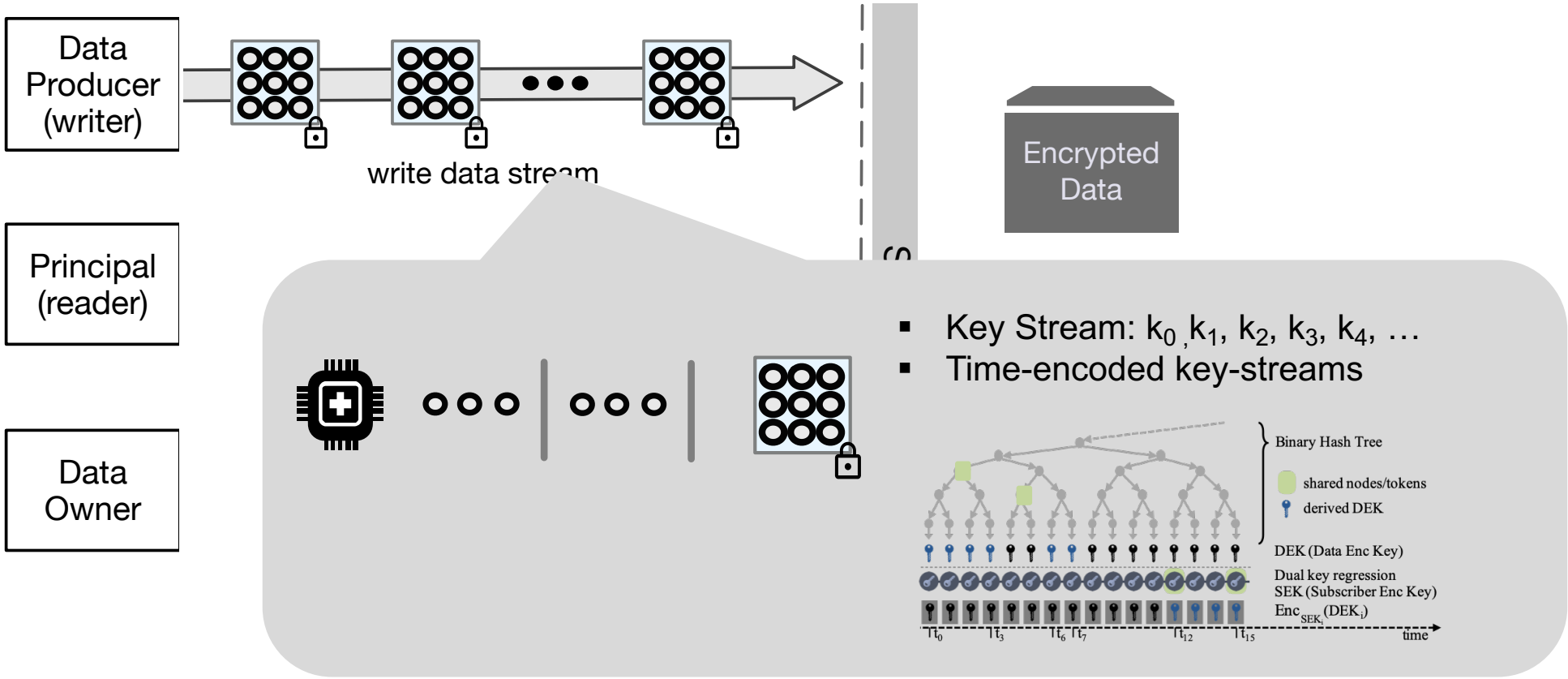

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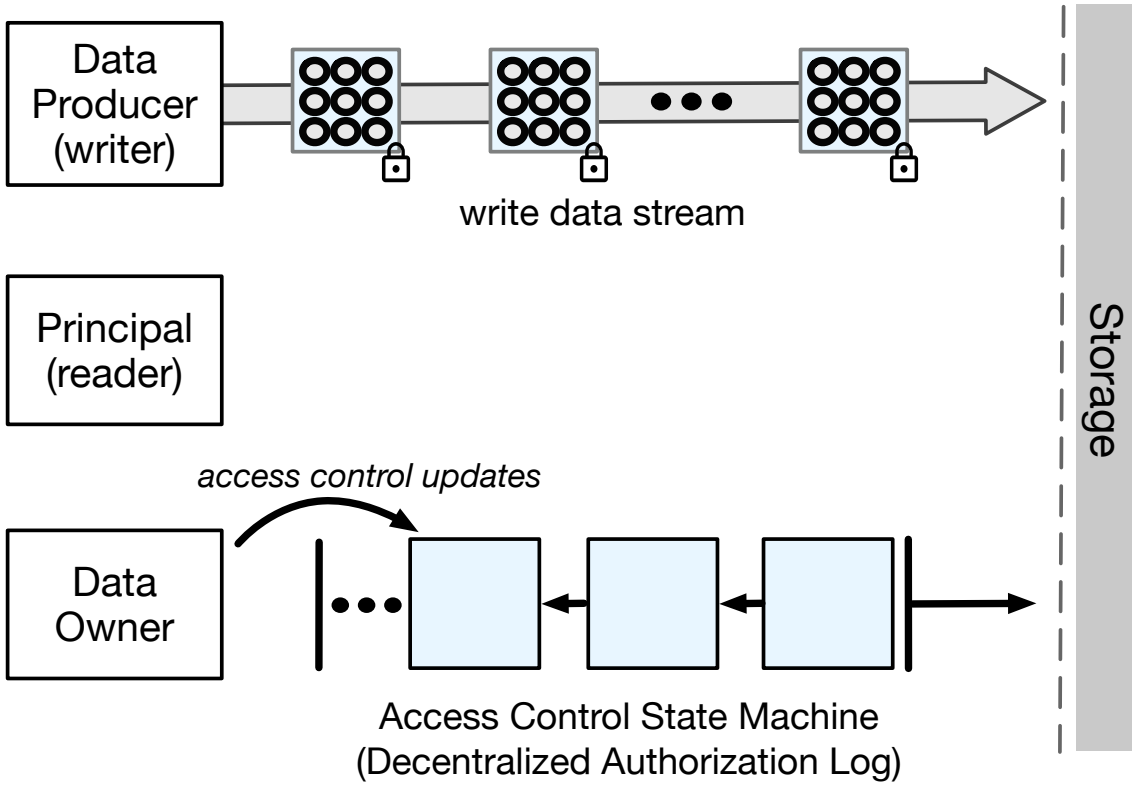

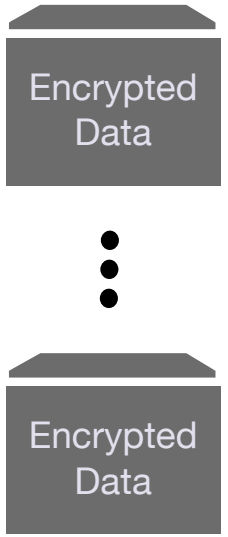

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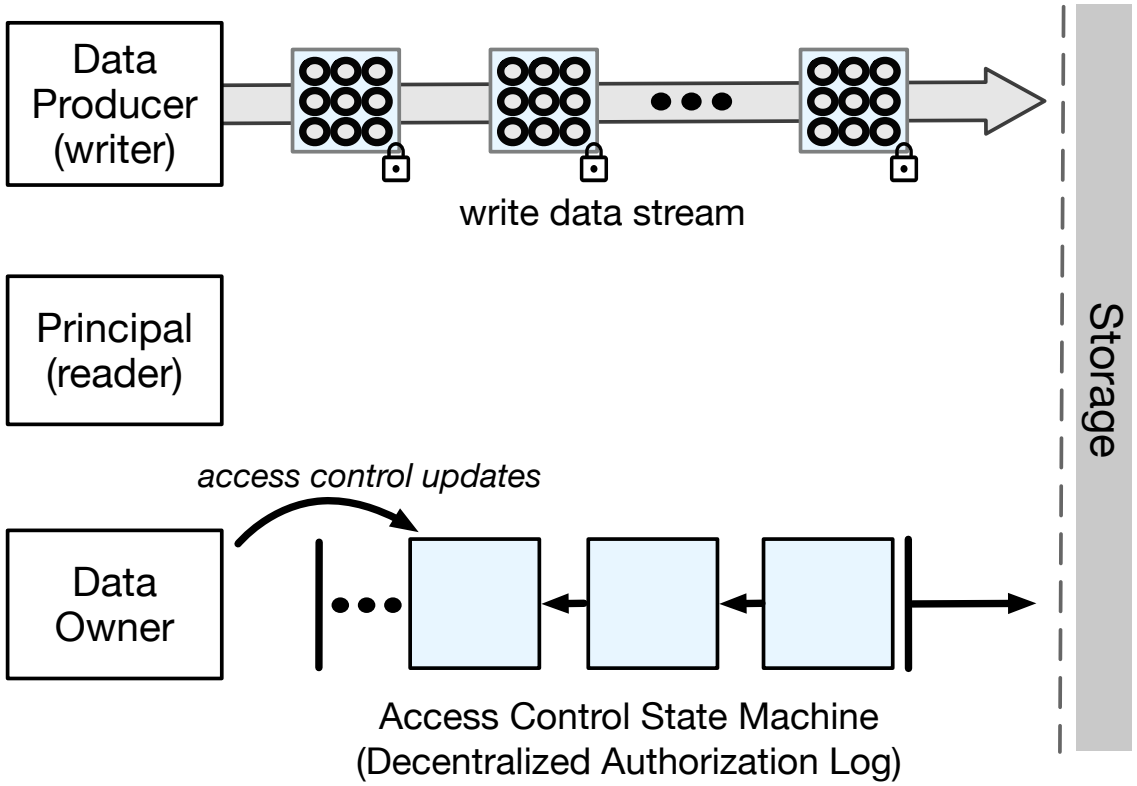

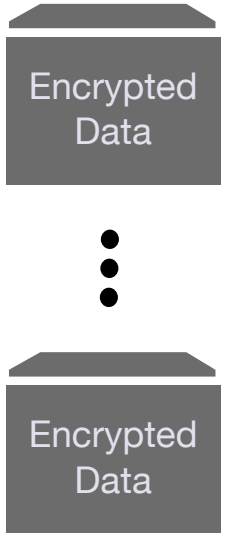

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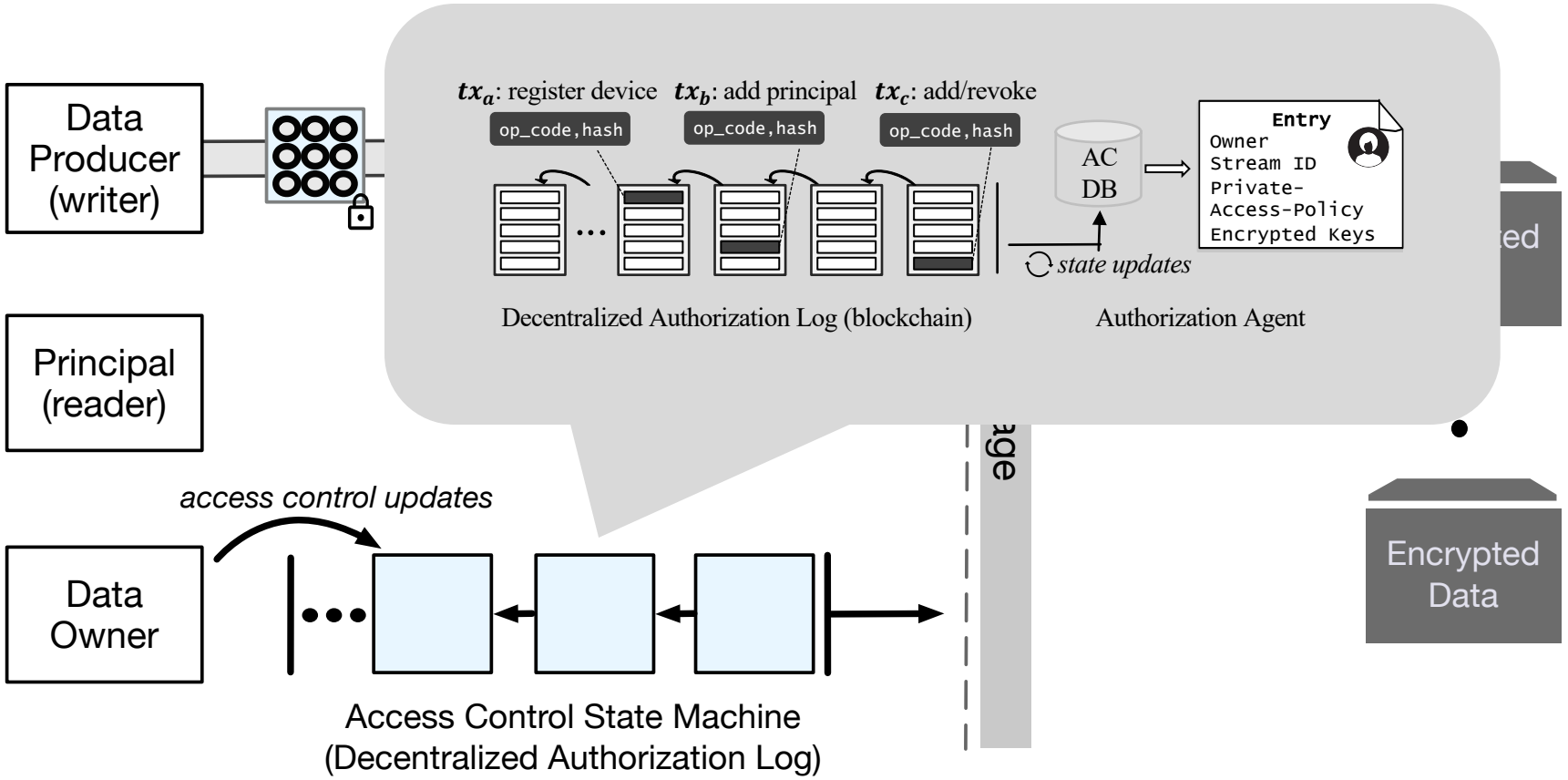

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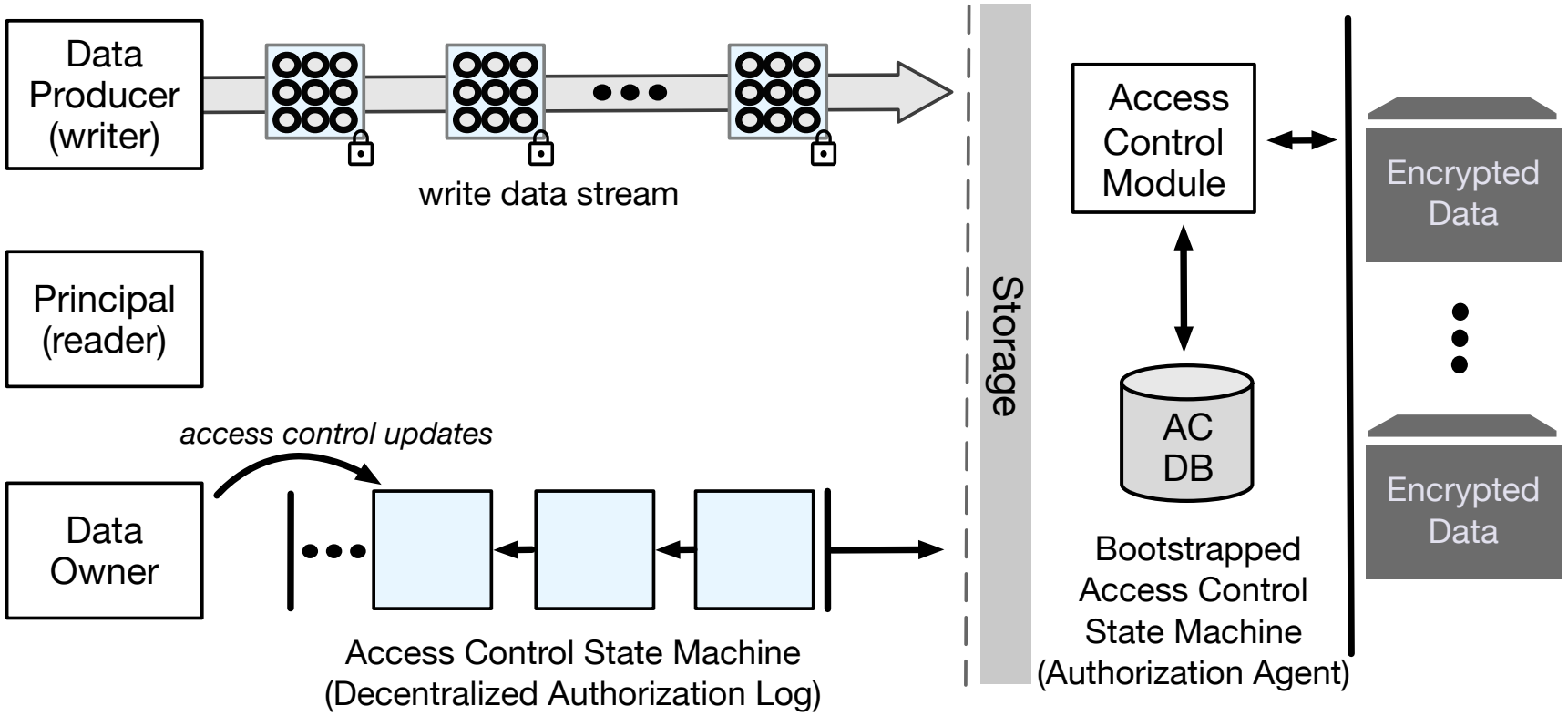

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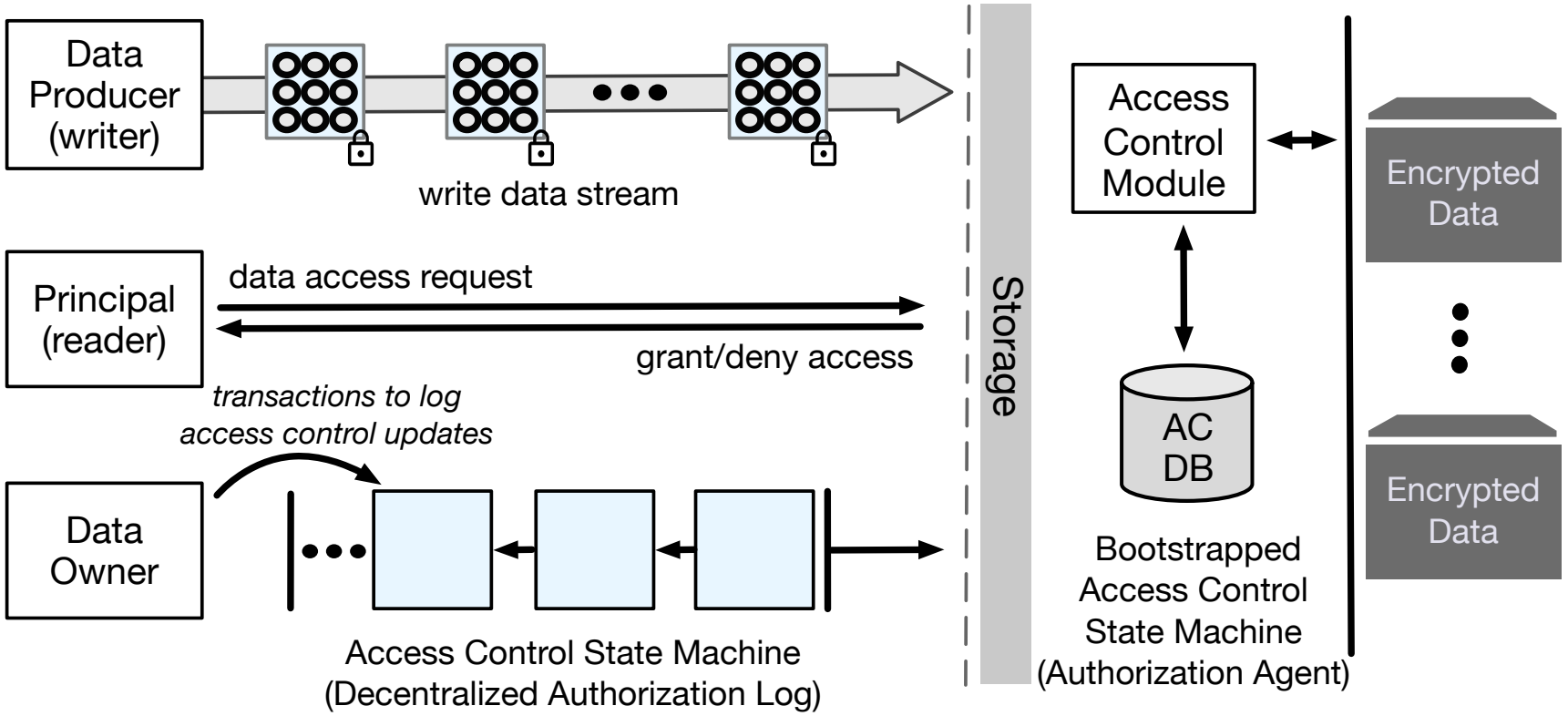
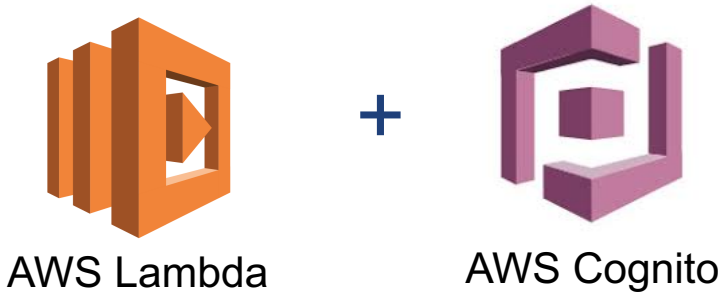


Implementation

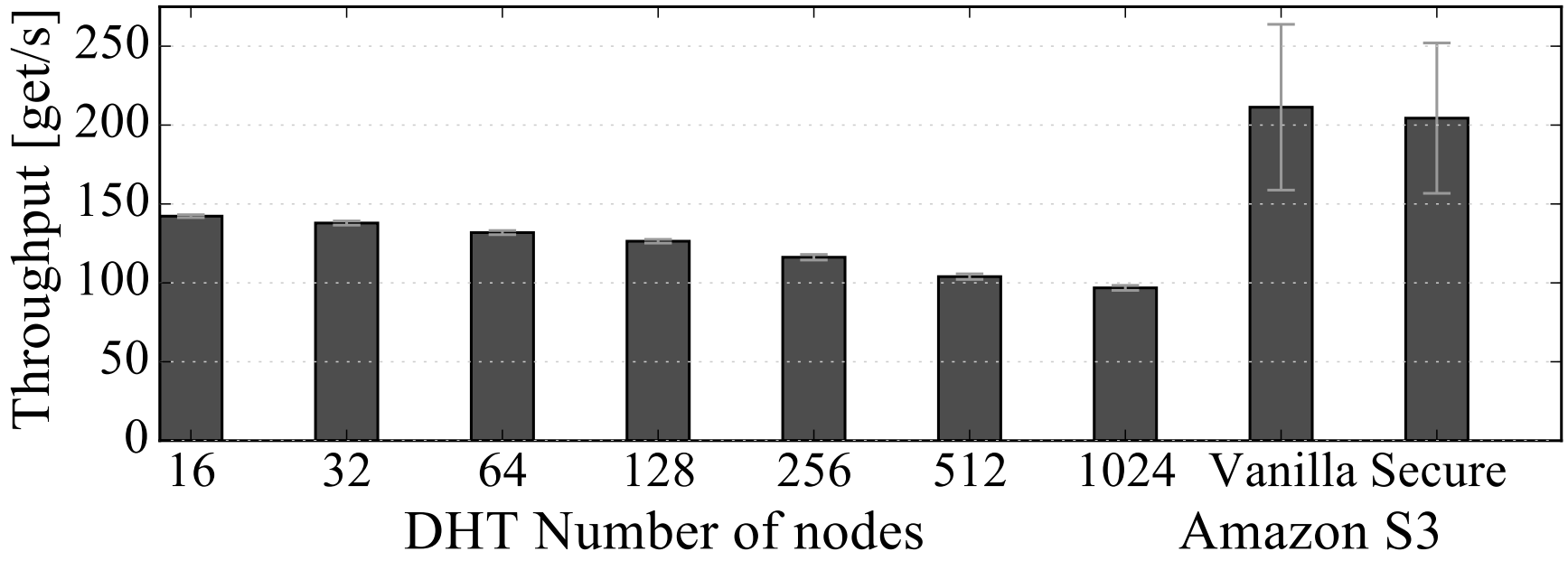
- Droplet Reference Implantation (https://dropletchain.github.io/)
  - Actors: client engine, storage-node engine, authorization agent (virtualchain)
  - Storage: Cloud (AWS S3), p2p storage (S/Kademlia)
  - Platforms: IoT (ARM Cortex), smartphone (Nexus 5), cloud (Amazon t2.micro)

Case Study: Serverless Computing

- Long-lived and more broadly-scoped access tokens for OAuth2
- Lookup latency 0.4% longer with Droplet



Read Throughput



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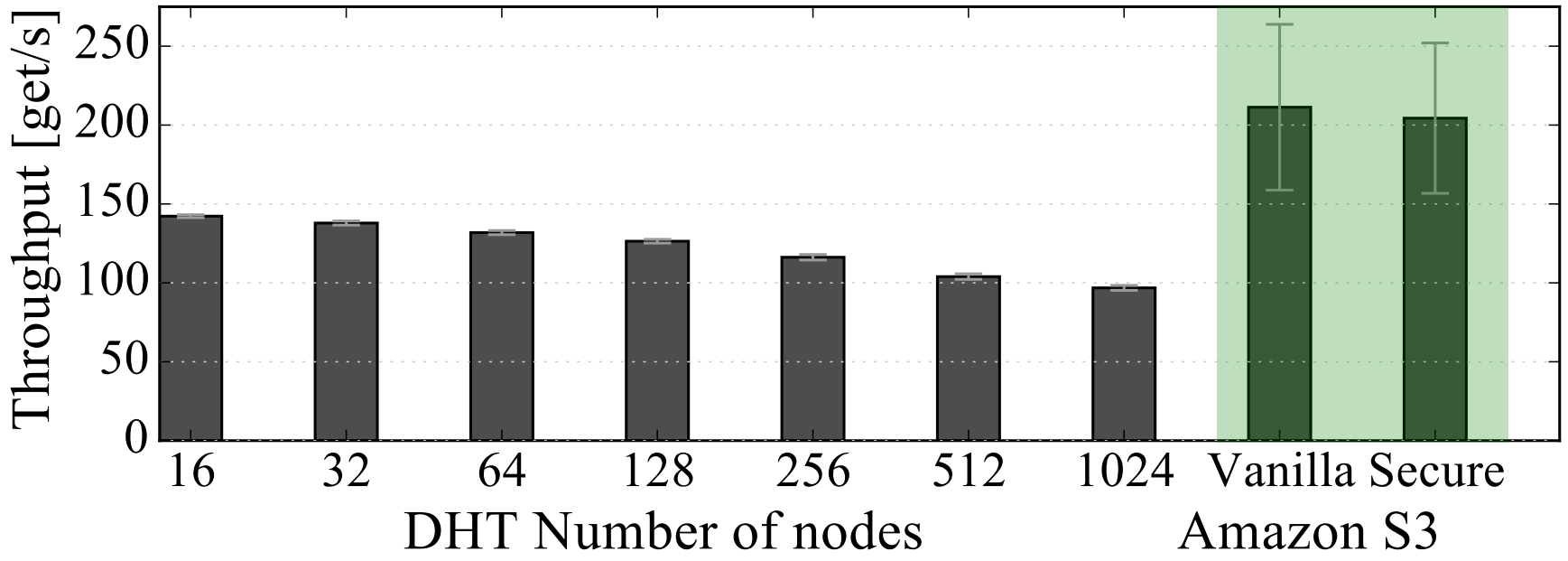

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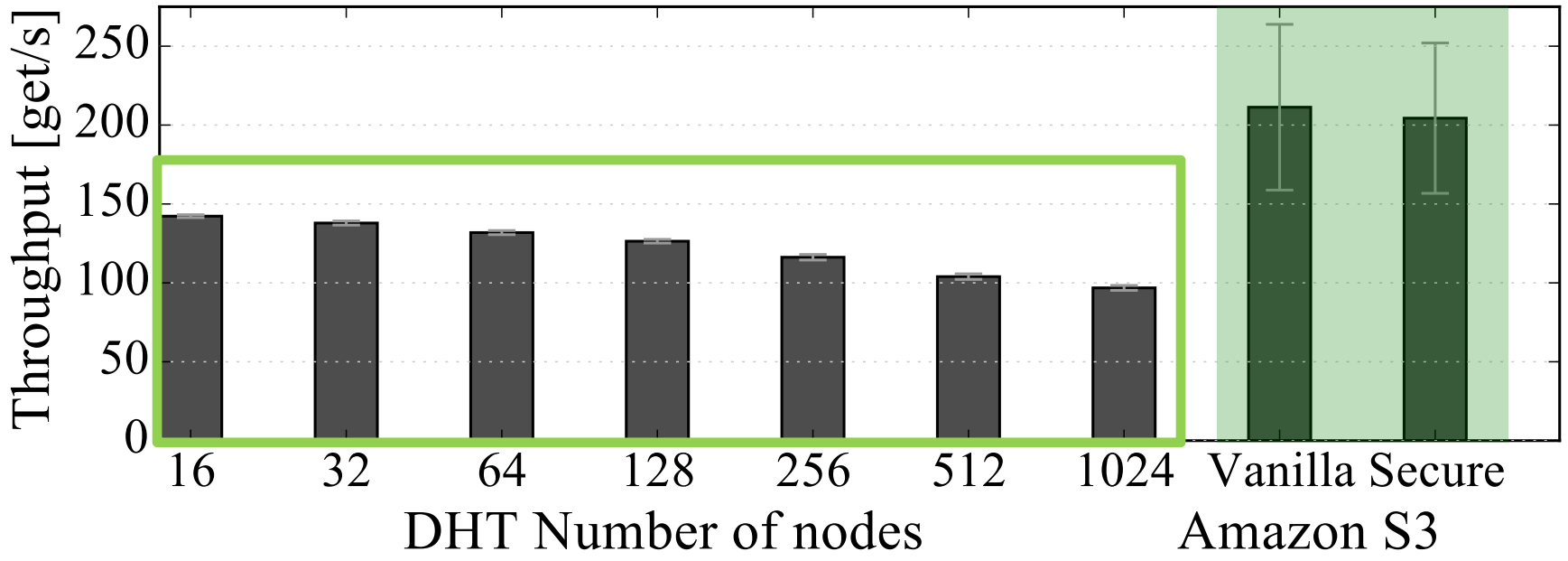

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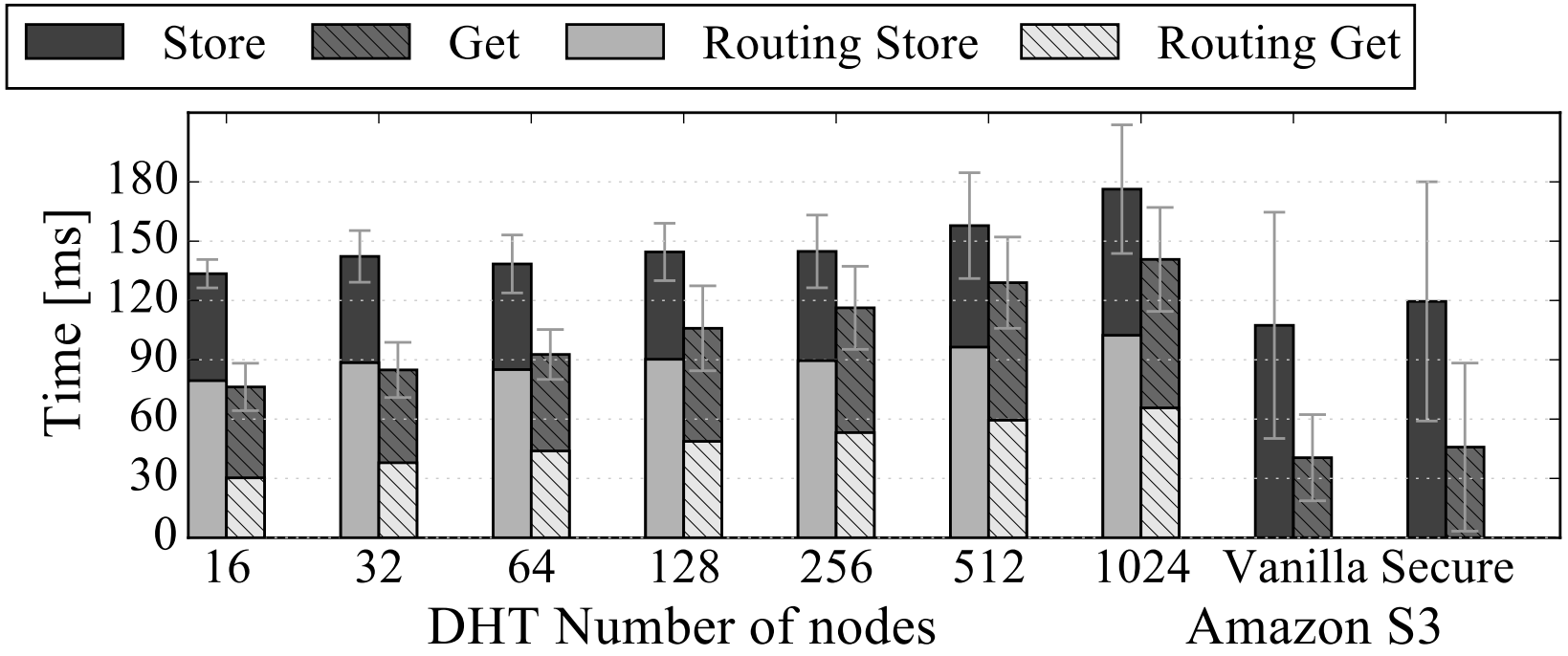

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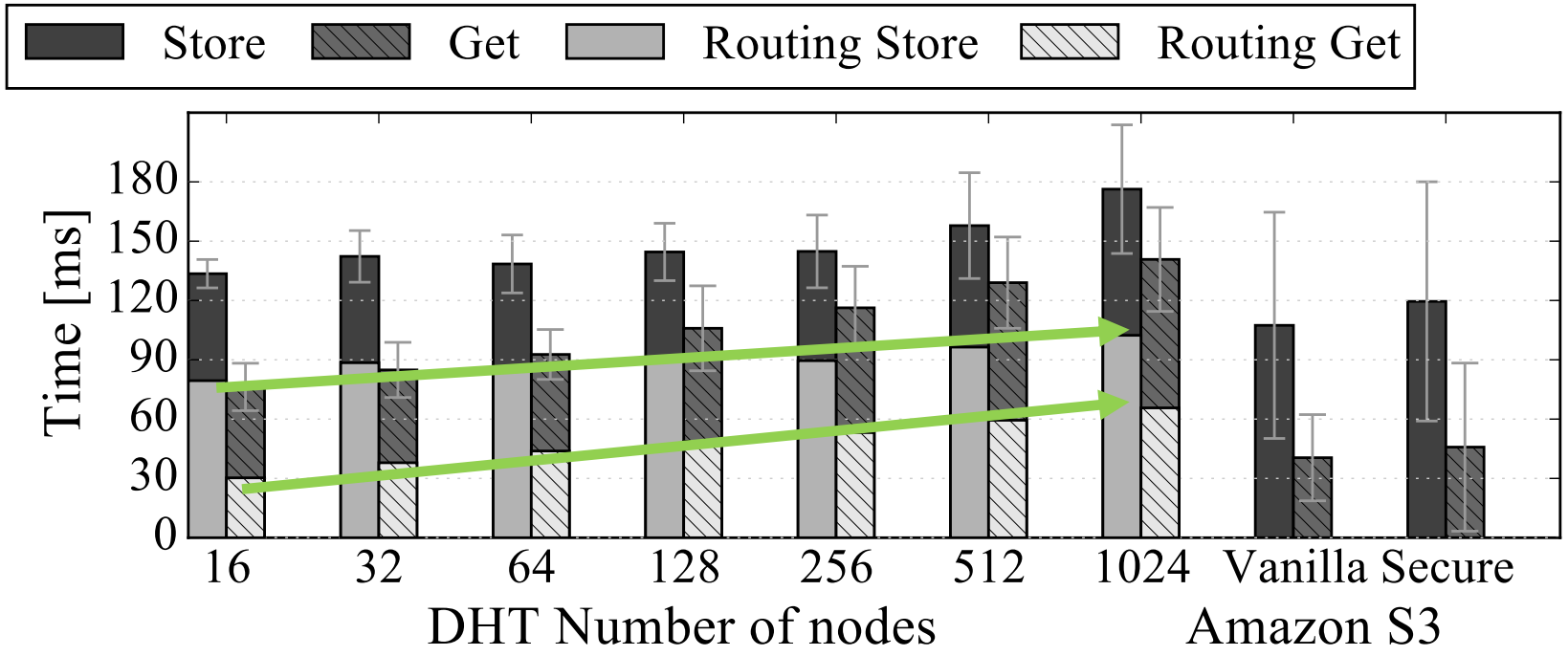

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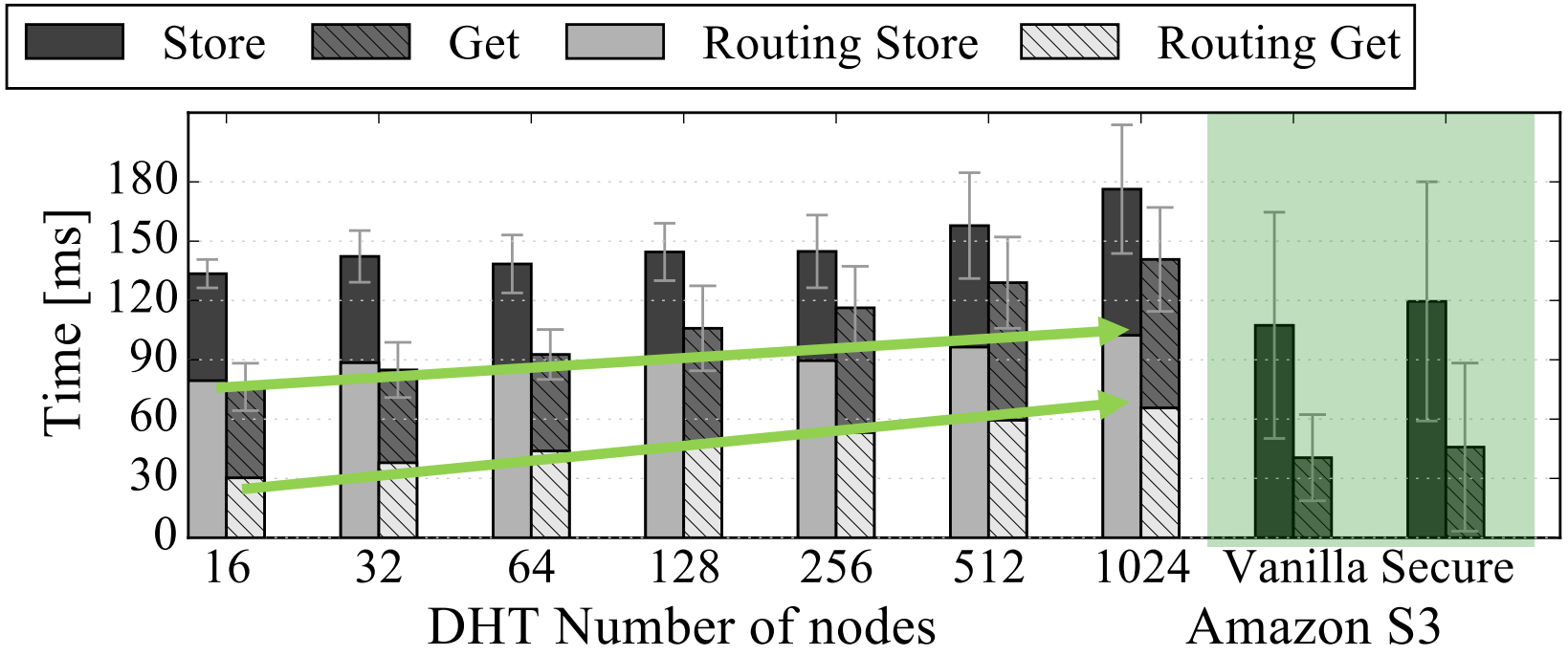
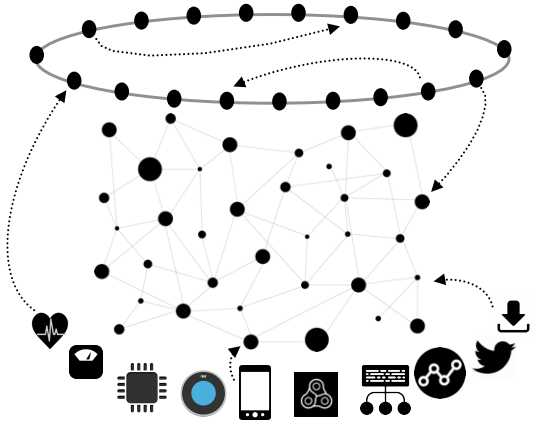


Conclusion

Droplet is a new decentralized authorization and data access control service:

- a new cryptographic access control construction tailored for stream data
- a new decentralization authorization service
- ensures data owner's sovereignty and ownership over their data



dropletchain.github.io