OAuth 2.0 meets verifiable credentials and blockchain-based tokens

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About this presentation

- Partially based on:

“N. Fotiou, I. Pitarras, V.A. Siris, S. Voulgaris, G.C. Polyzos, "OAuth 2.0 authorization using blockchain-based tokens," Proceedings of the NDSS 2020 Workshop on Decentralized IoT Systems and Security (DISS), San Diego, CA, USA, 2020”

- On going work in the context of H2020-SOFIE

About SOFIE*

- SOFIE enables interoperability between existing IoT platforms
  - Utilizes distributed ledger technologies
  - 3-year EU Horizon 2020 project, will end in December 2020
- SOFIE functionality will be provided through its framework**
  - “Privacy and Data Sovereignty,” and “Identity, Authentication, and Authorization” are two key components of the SOFIE framework

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emotion
ROVIO
ENGINEERING
ERICSSON
guardtime
VELTION OPTIMUM
SYNELIXIS

* Secure Open Federation for Internet Everywhere https://www.sofie-iot.eu/

** https://github.com/SOFIE-project/Framework

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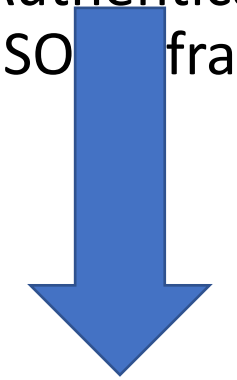
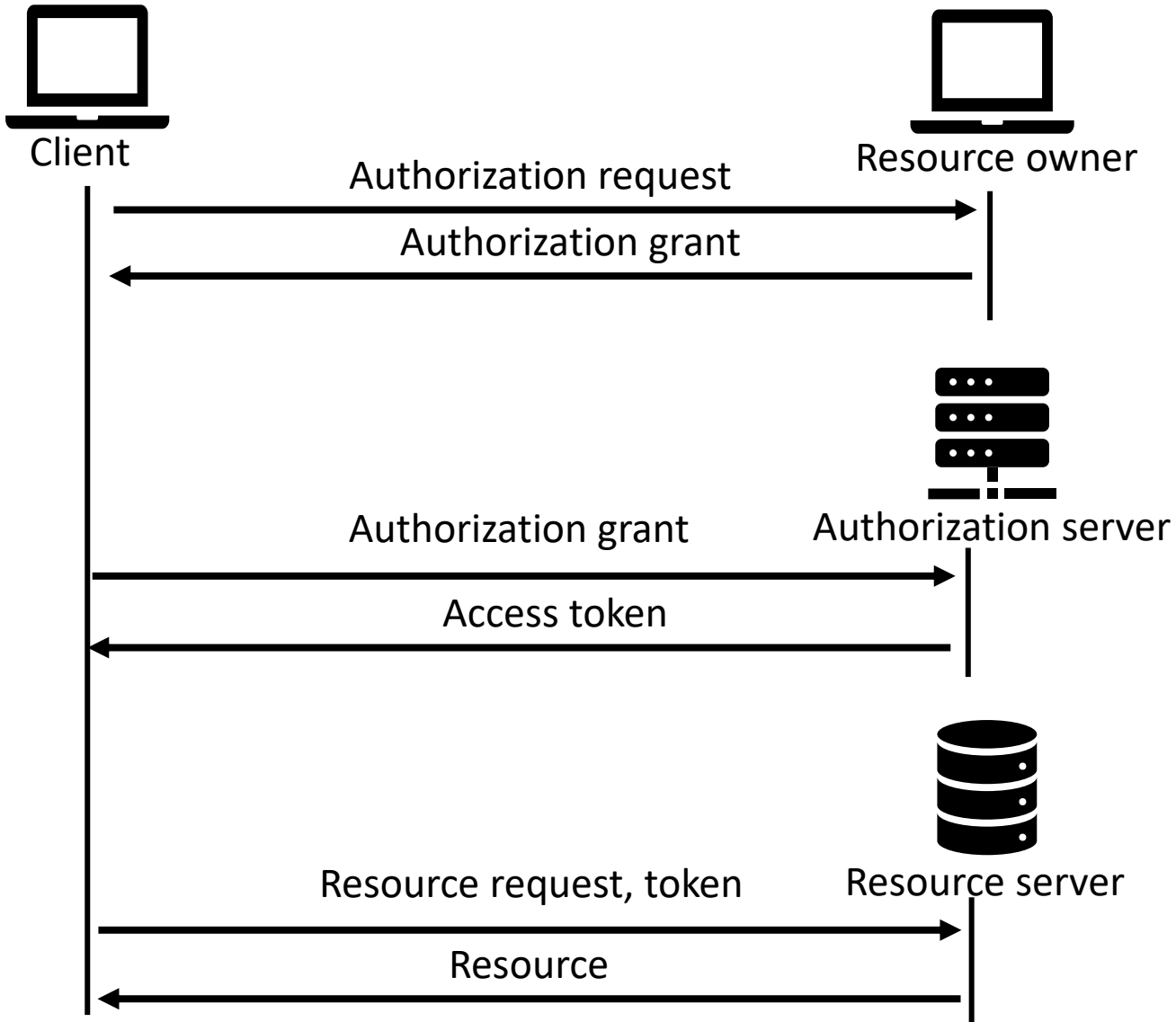
OAuth 2.0



JWT

OAuth 2.0-based authorization



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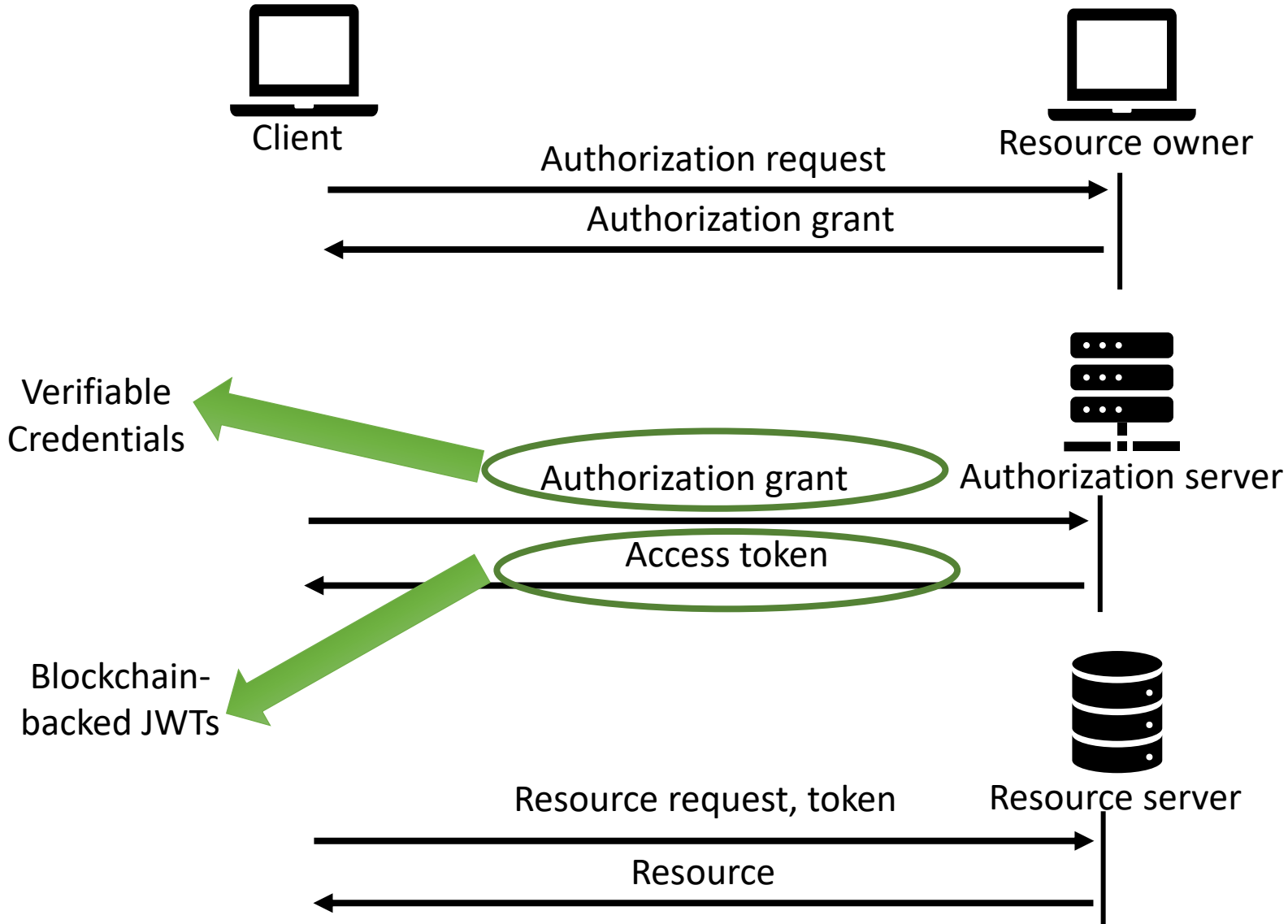


SOFIE Clients

- Resource owners do not interact with clients
- Clients may not evan have UI (e.g., IoT device)

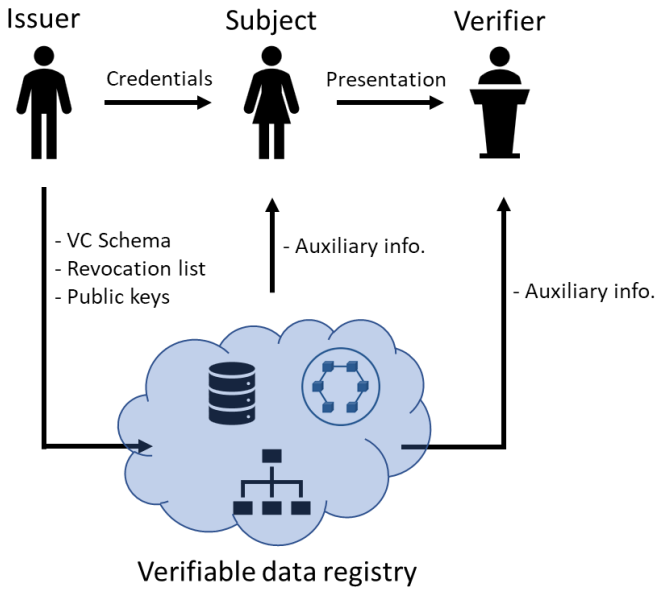
  → Client credentials are the “recommended” authorization grant for this case
- But we want to avoid long, hard to manage ACLs in the authorization server

Client Identifier	Resource Identifier
Client 1	[Resource 1, Resource 2, Resource 3]
Client 2	[Resource K, Resouce L]

→ Verifiable Credentials can solve this problem

VC in a nutshell

- A standard* way to express credentials on the Web



* W3C, Verifiable Credentials Data Model 1.0, https://www.w3.org/TR/vc-data-model/

VC in a nutshell

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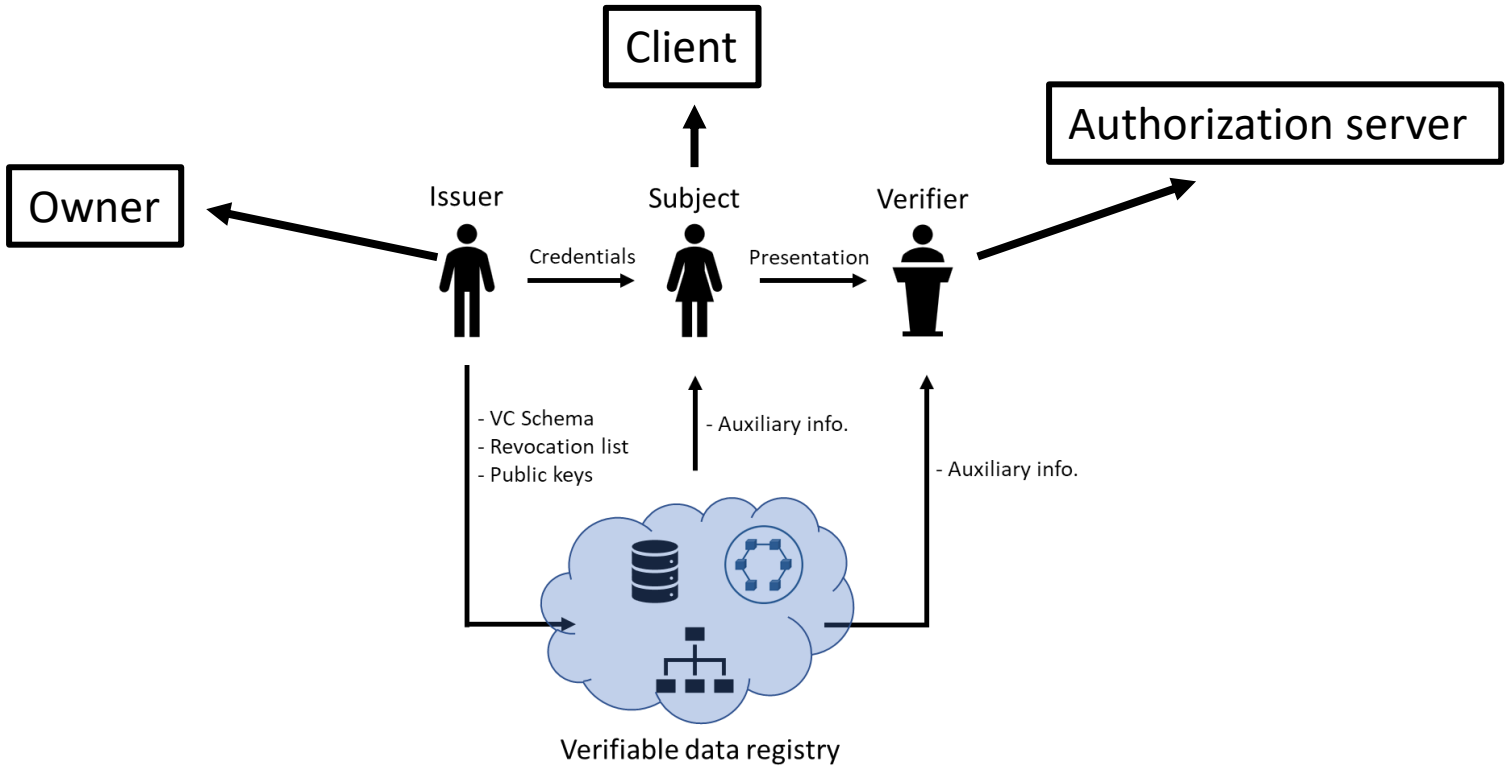

* W3C, Verifiable Credentials Data Model 1.0, https://www.w3.org/TR/vc-data-model/

VC Structure

Context
Issuer Id
Credential • Type • Subject Id • Claims
Proof

An example credential

```
sofie_credential = {
  "@context": [
    "https://www.w3.org/2018/credentials/v1",
    "https://mm.aueb.gr/contexts/access_control/v1"
  ],
  "id": "https://www.sofie-iot.eu/credentials/examples/1",
  "type": ["VerifiableCredential"],
  "issuer": "did:nacl:E390CF3B5B93E921C45ED978737D89F61B8CAFF9DE76BFA5F63DA20386BCCA3B",
  "issuanceDate": "2010-01-01T19:23:24Z",
  "credentialSubject": {
    "id": "did:nacl:A490CF3B5B93E921C45ED978737D89F61B8CAFF9DE76BFA5F63DA20386BCCA62",
    "type": ["AllowedURLs"],
    "acl": [
      {
        "url": "http://sofie-iot.eu/device1",
        "methods": ["GET","POST"]
      },
      {
        "url": "http://sofie-iot.eu/device2",
        "methods": ["GET"]
      }
    ]
  }
}
```

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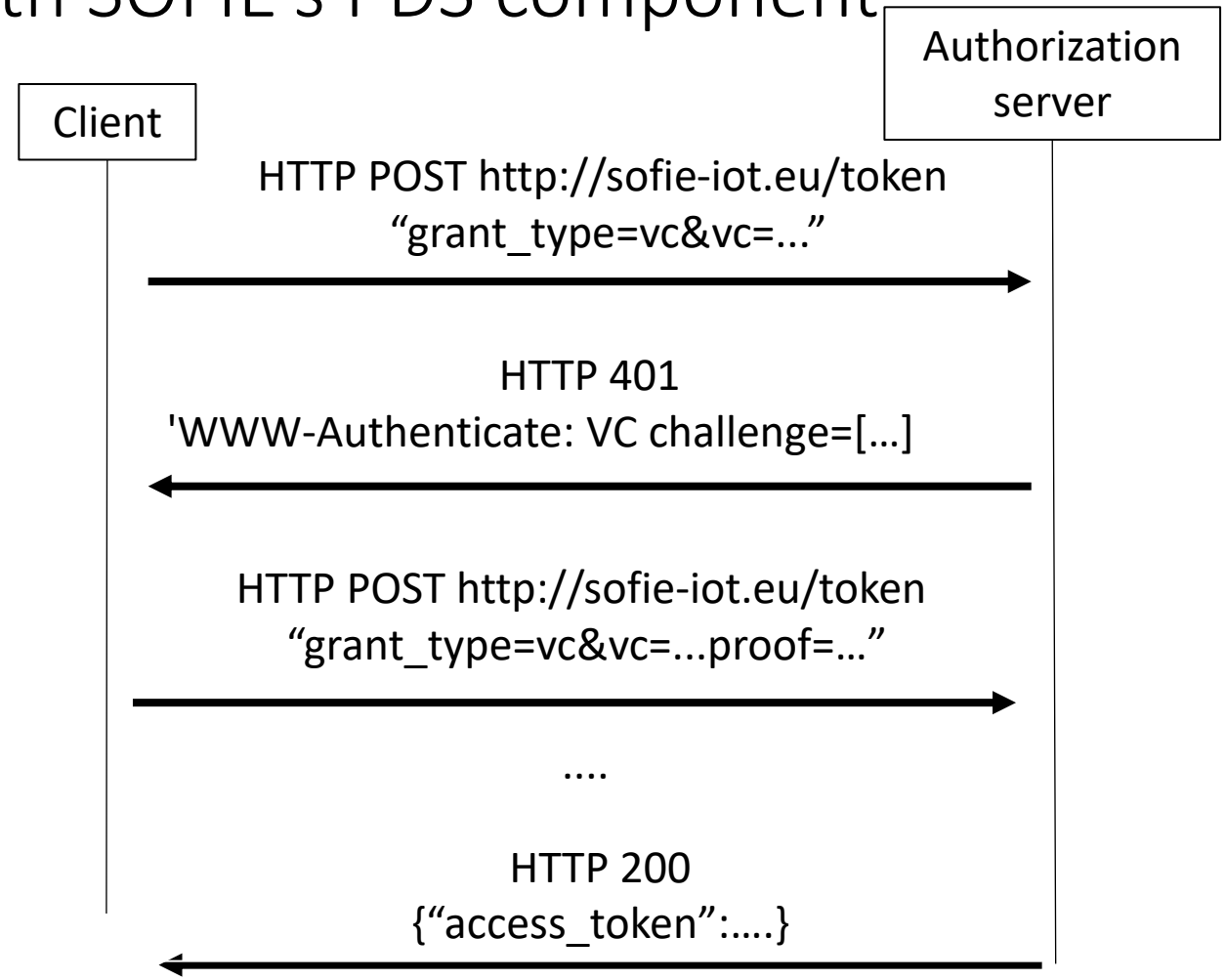
      }
    ]
  }
}
```

Interacting with SOFIE's PDS component



PDS configuration

```
filters = [
    ["$.@context[*]", "https://mm.aueb.gr/contexts/access_control/v1"],
    ["$.issuer", ["did:nacl:…","another issuer", "or this issuer"]],
    ["$.credentialSubject.acl[?@.url='http://sofie-iot.eu/device1'].methods[*]","GET"]
  ]
```

The use of JWT in SOFIE

- JWT is a standard mean for tranfering claims, used in may authorization systems
- Usually they are used as Bearer tokens
- We leverage blockchain to provide
  - Proof-of-possession
  - Revocation
  - Delagation

The Ethereum blockchain

- Decentrilized “smart contract” executed by untrusted nodes
- Smart contract code and state are public
- Smart contract execution is deterministic
- State modification are permantly recorded in the blockchain
- Users identified by a public key. The hash of the public key is used as the “address” of the user. The private key is used for singing “transactions”

ERC-721

ERC-721 tokens

- Token Id
- Owner Id
- Metadata

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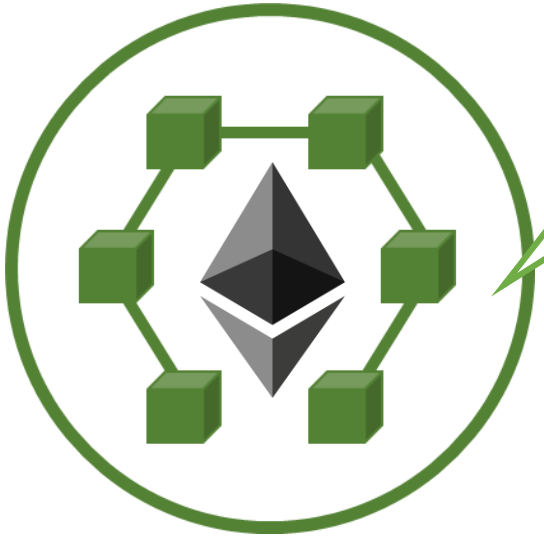
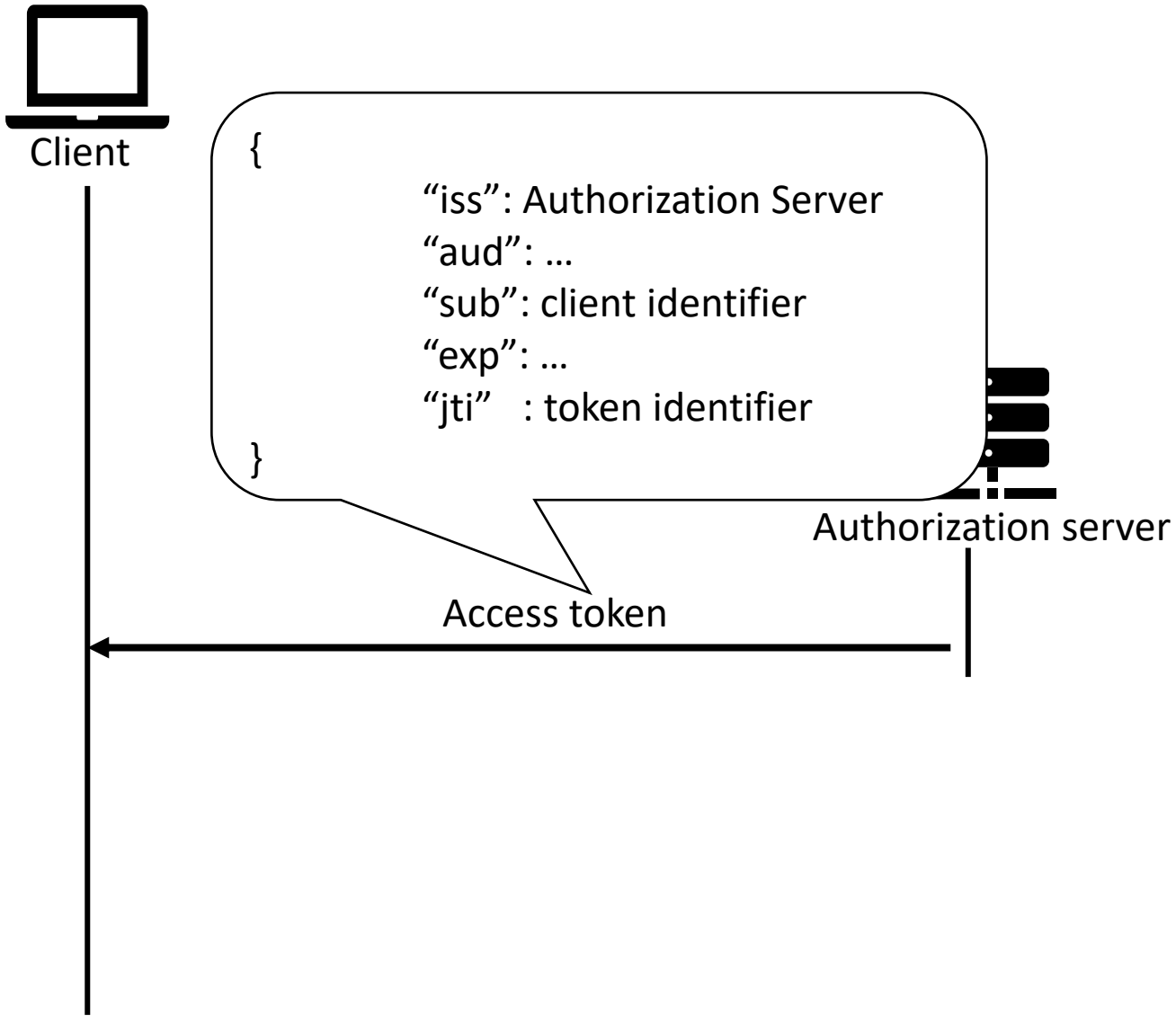


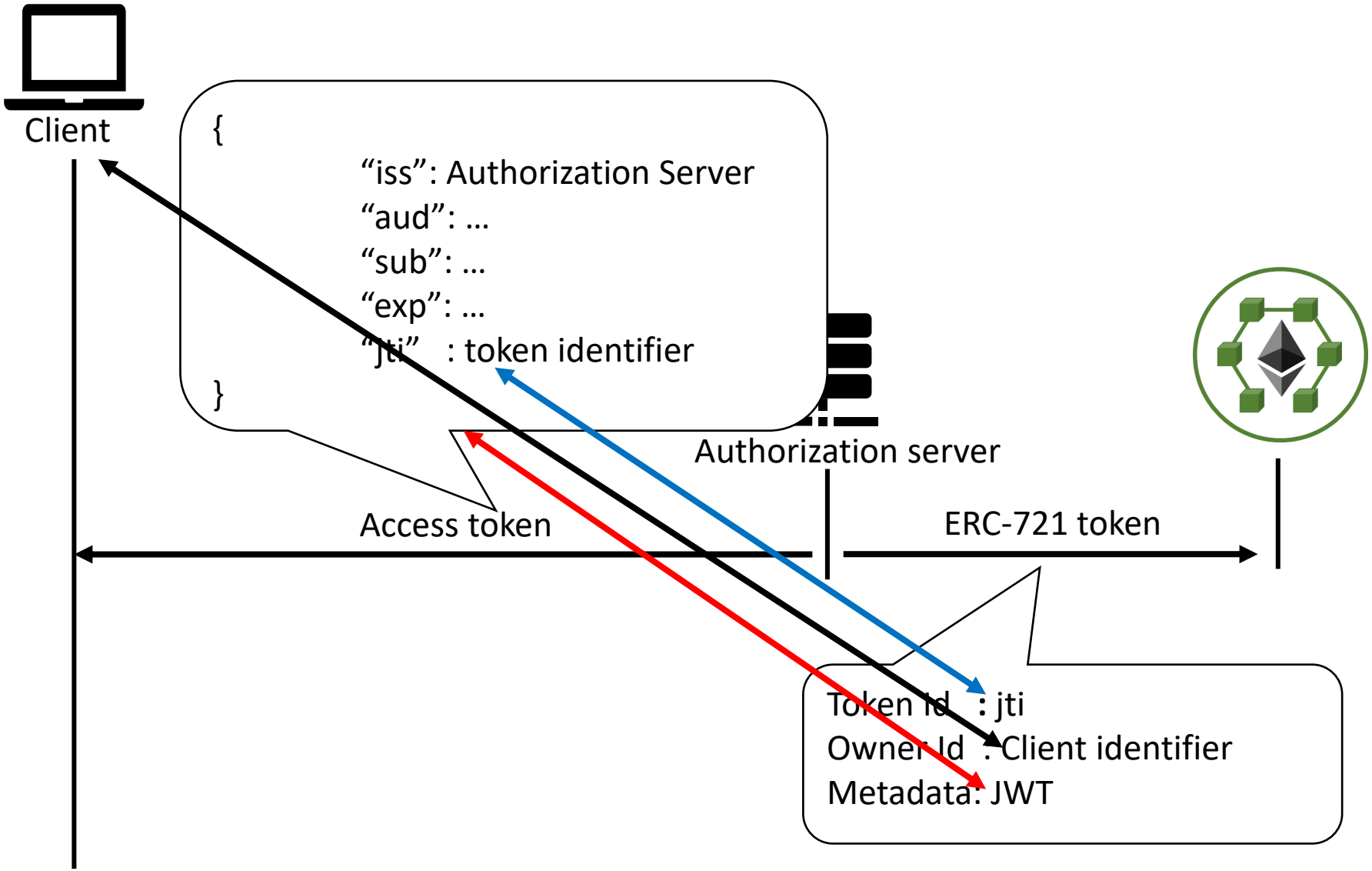
ERC-721 token management contract

- ownerOf()
- transferFrom()
- approve()
- getApproved()
- tokenURI()

JWT


Client
{
“iss”: Authorization Server
“aud”: …
“sub”: client identifier
“exp”: …
“jti” : token identifier
}
Authorization server
Access token

JWT + ERC-721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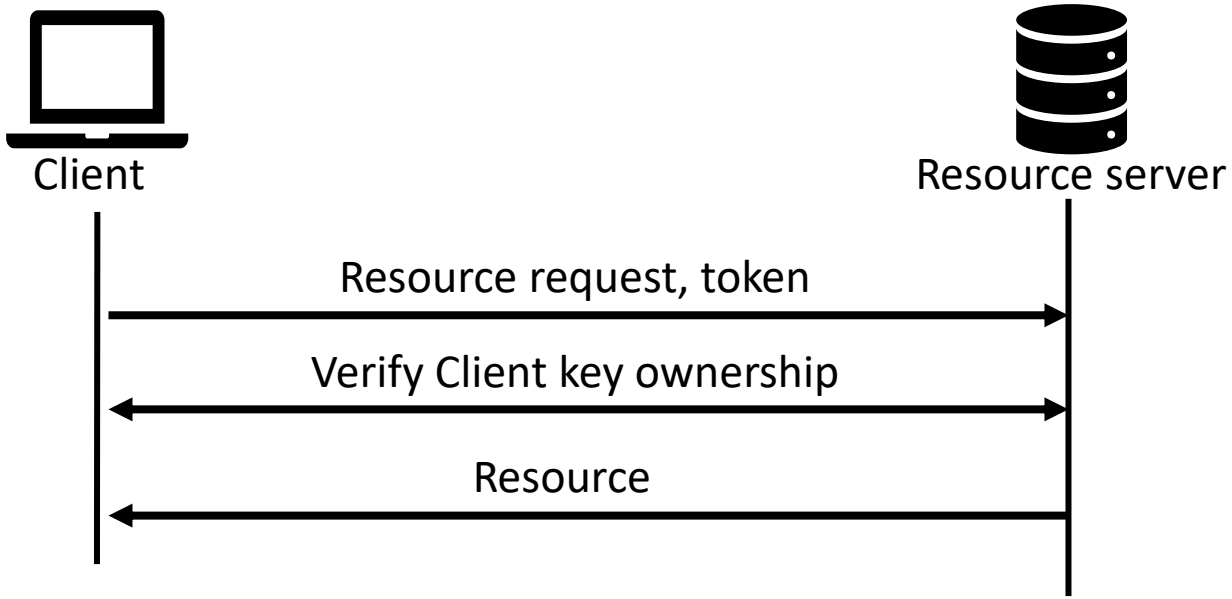
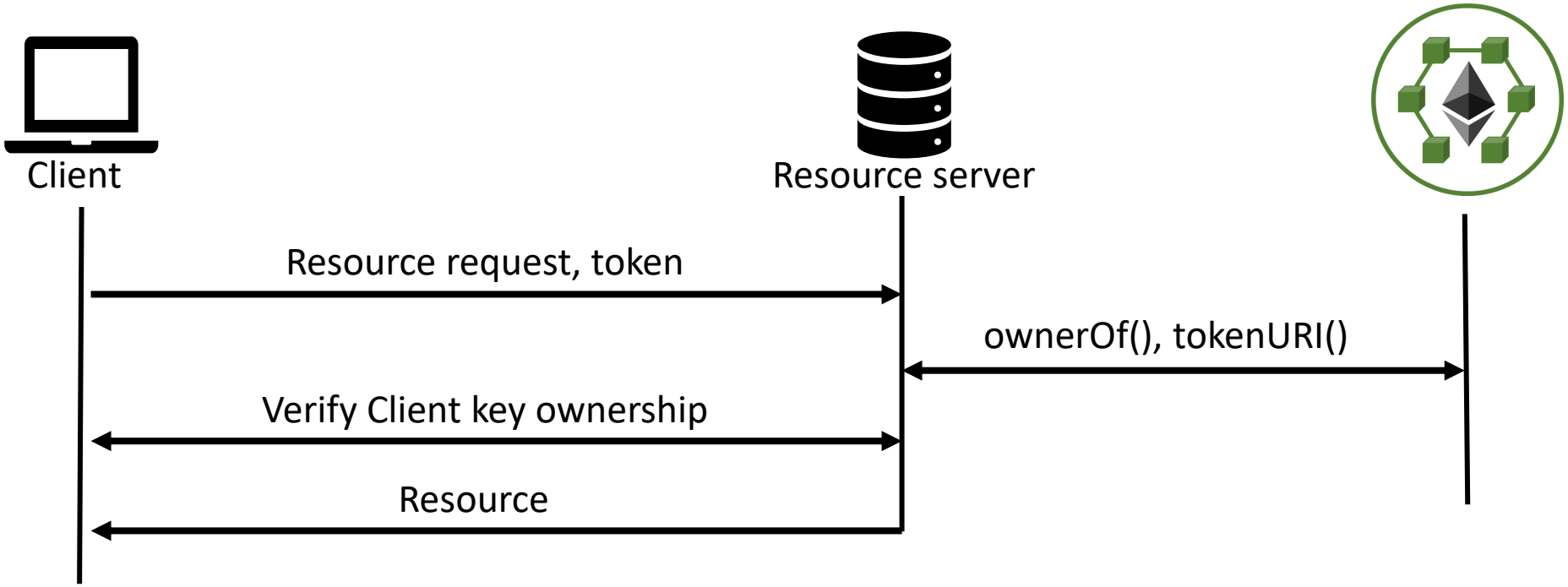
Authorization server
Access token
ERC-721 token
Token Id : jti
Owner Id : Client identifier
Metadata: JWT

Accessing legacy resource servers

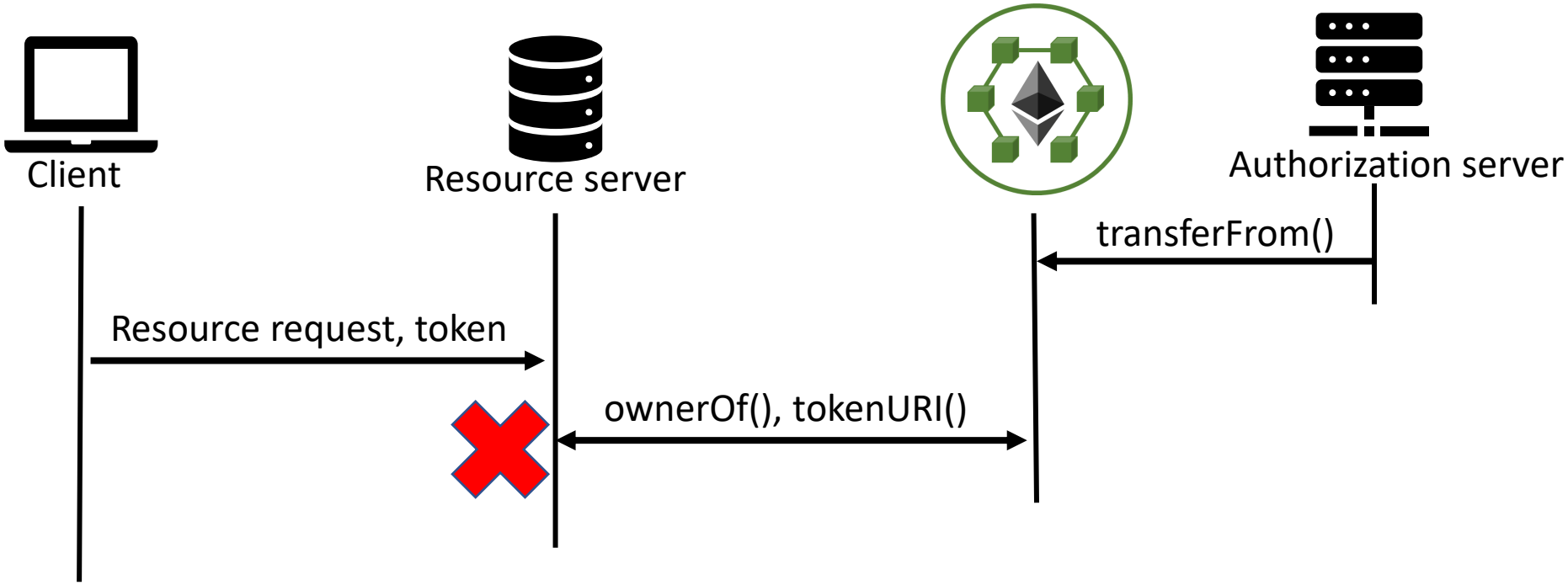


- It facilitates logging and auditing services

Accessing resource servers with BC read access

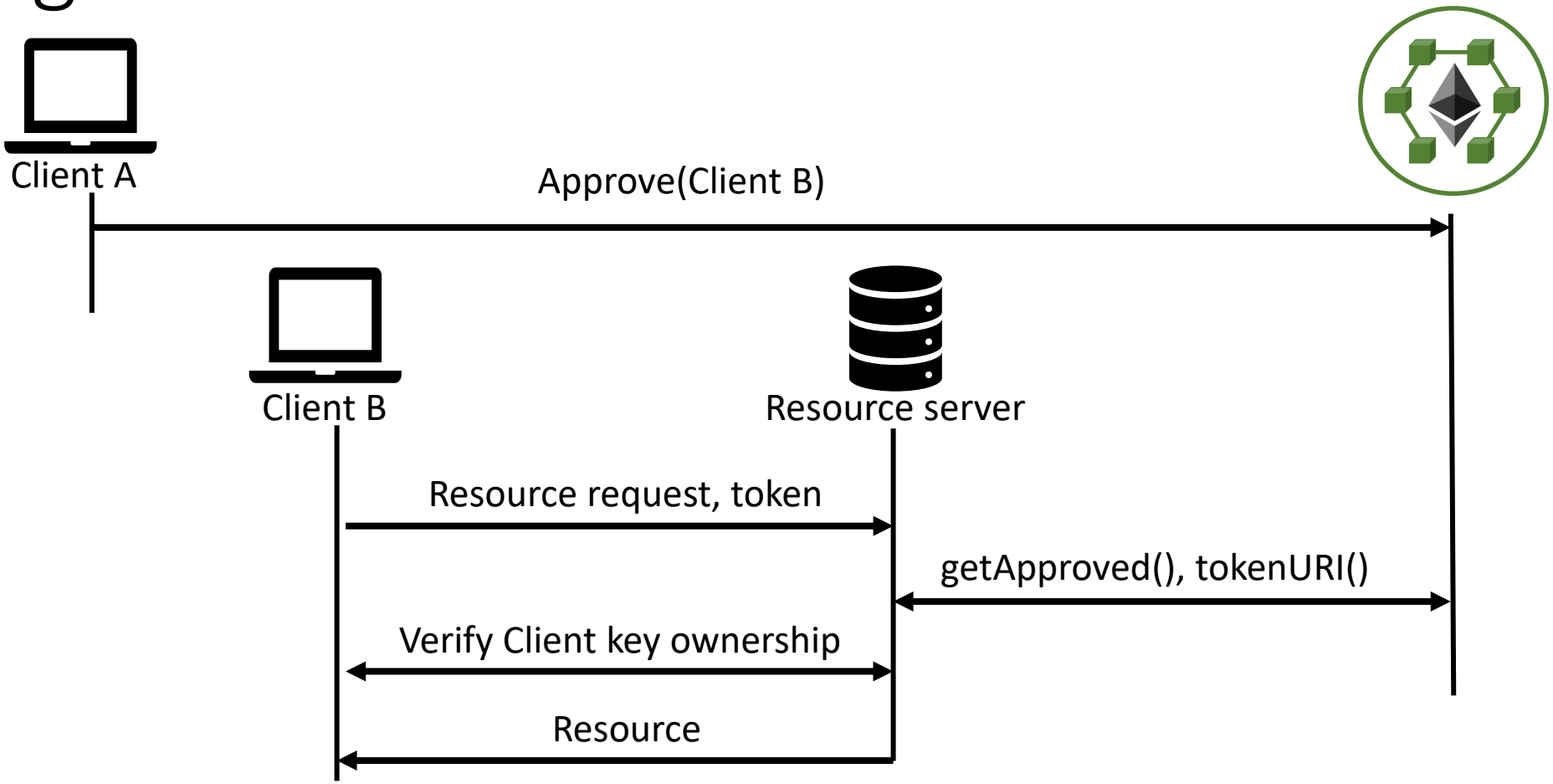


Revocation



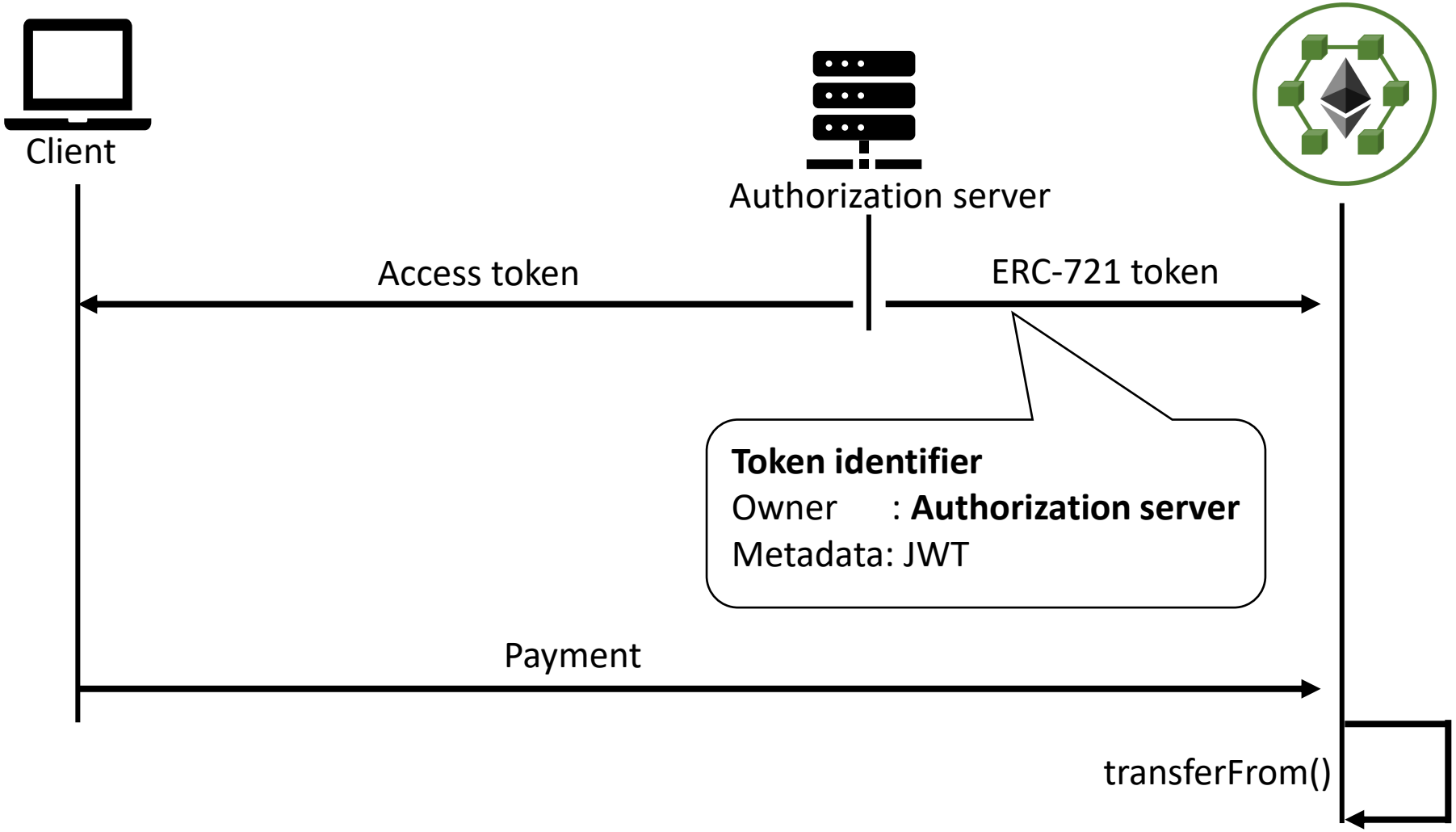
- Revocation is asynchronous
- Authorization server does not have to be online

Delegation



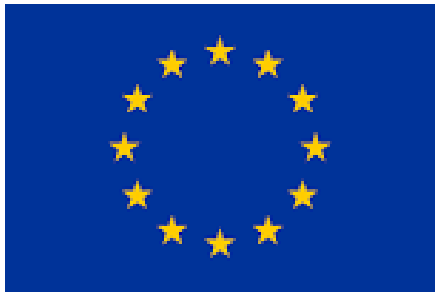
- Delegation is not transitive
- Revocation is not affected

Fair exchange



A note about blockchains

- (Public) blockchains have privacy issues, introduce delays (~13sec per transaction) and monetary costs (~$0.10 to create a token, $0.02 to revoke or delegate)
  - In no payments are involved then private, or testing chains can be used.



Thank you

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https://www.sofie-iot.eu/

https://github.com/SOFIE-project/Framework

https://www.sofie-iot.eu/news/integrating-verifiable-credentials-and-decentralized-identifiers-for-identification-and-author