Using Personal Portfolios to Manage Customer Data

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Aims and results

- Goals:
  - Transaction information **at the owner's control**.
  - **Customer data management** easier for companies.
  - Privacy-preserving **utilization** of transaction data.
- Results:
  - Designed a **Portfolio system** where individuals' transaction data are stored and managed by its owner.
  - **Privacy preserving, legitimate** way to access **accountable** transaction information.

Presentation outline

- Motivation
- Portfolio approach
  - Concepts and architecture
  - Building blocks
  - Functionality
  - Applications
- Conclusions
- Future work

Motivation

Transaction data handling today

- **Customer profiles** record transaction and personal information.
- **No option** to perform transactions anonymously.
- **Loyalty cards** offer privileges in exchange for **data recording**.
- Collected data can **compose an individual's detailed profile** revealing sensitive information about them.

$\Rightarrow$ Shopping profiles can be a significant source of private information leakages.

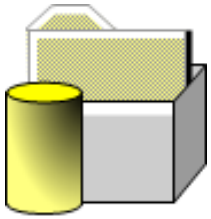
Economic aspects of privacy

- Companies **profit** out of using individuals' transaction information.
- Customer information processing is a **viable task** and brings important benefits to the marketplace.
- The **goal of privacy** protection is **not to lock** transaction information away from any possible use.
- A **privacy-preserving** and **accountable** way to access and **utilize** individuals' transaction information is needed.

The Portfolio Approach

Concepts and architecture

The concept



- Portfolio:
  - **Owned** by an individual.
  - Stored **locally** at their side.
  - Contains individual's **transaction history**.
  - Controlled access, under **owner's consent.**
- Desired attributes:
  - **Protect** transaction profile.
  - **Enable utilization** of transaction data.
  - **Ensure accountability** of revealed information.

Portfolio entities

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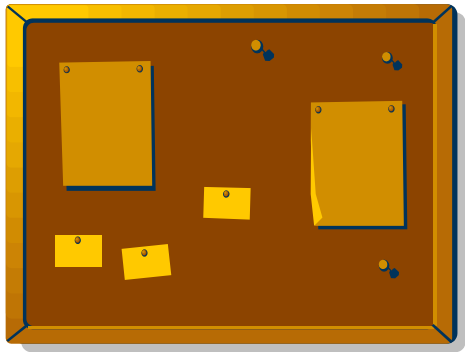
- A notice board.



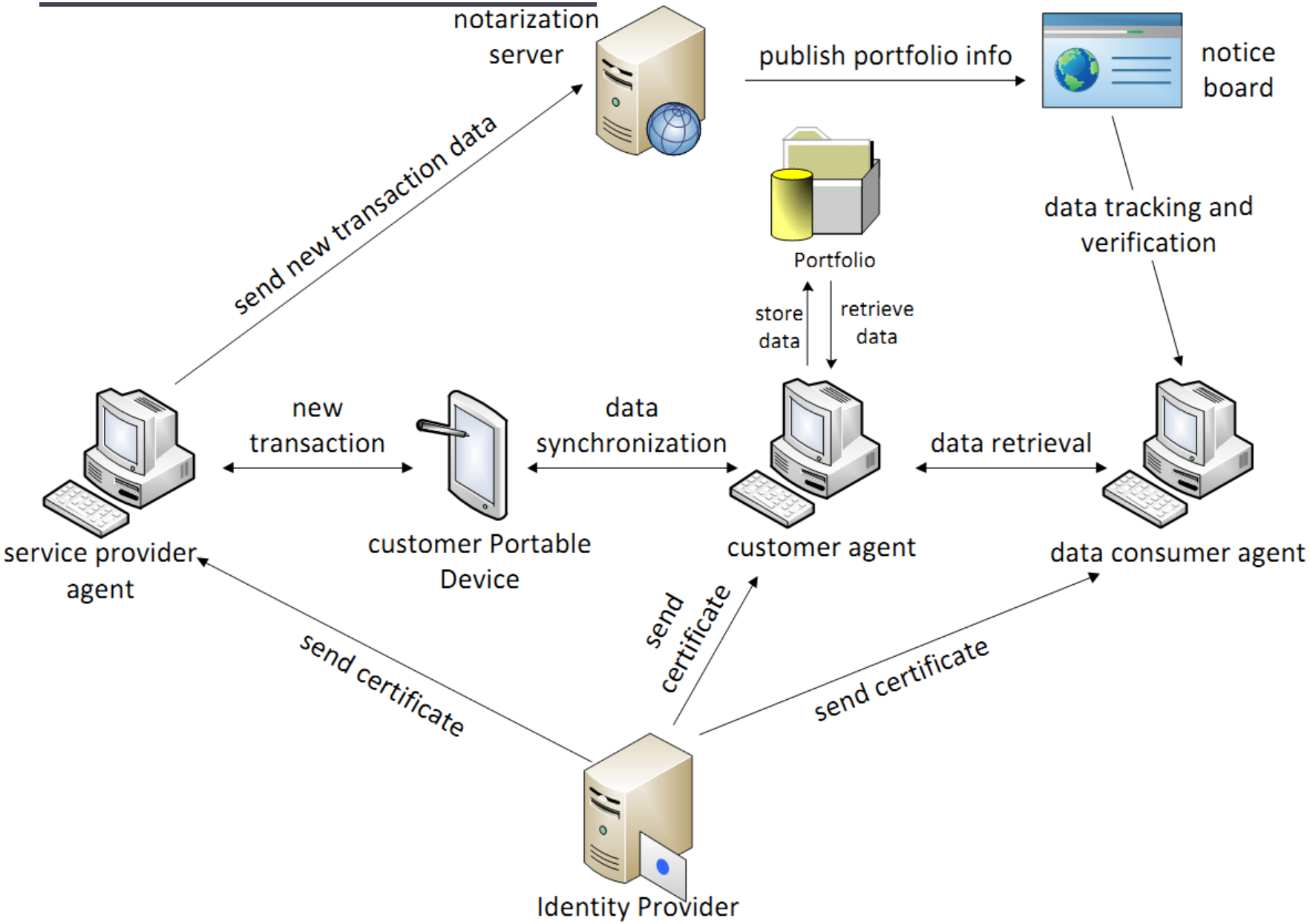
Portfolio entities

- The individual.
- Shops and service providers .
- Companies (data consumers).
- An identity provider.
- A notarization service.
- A notice board.

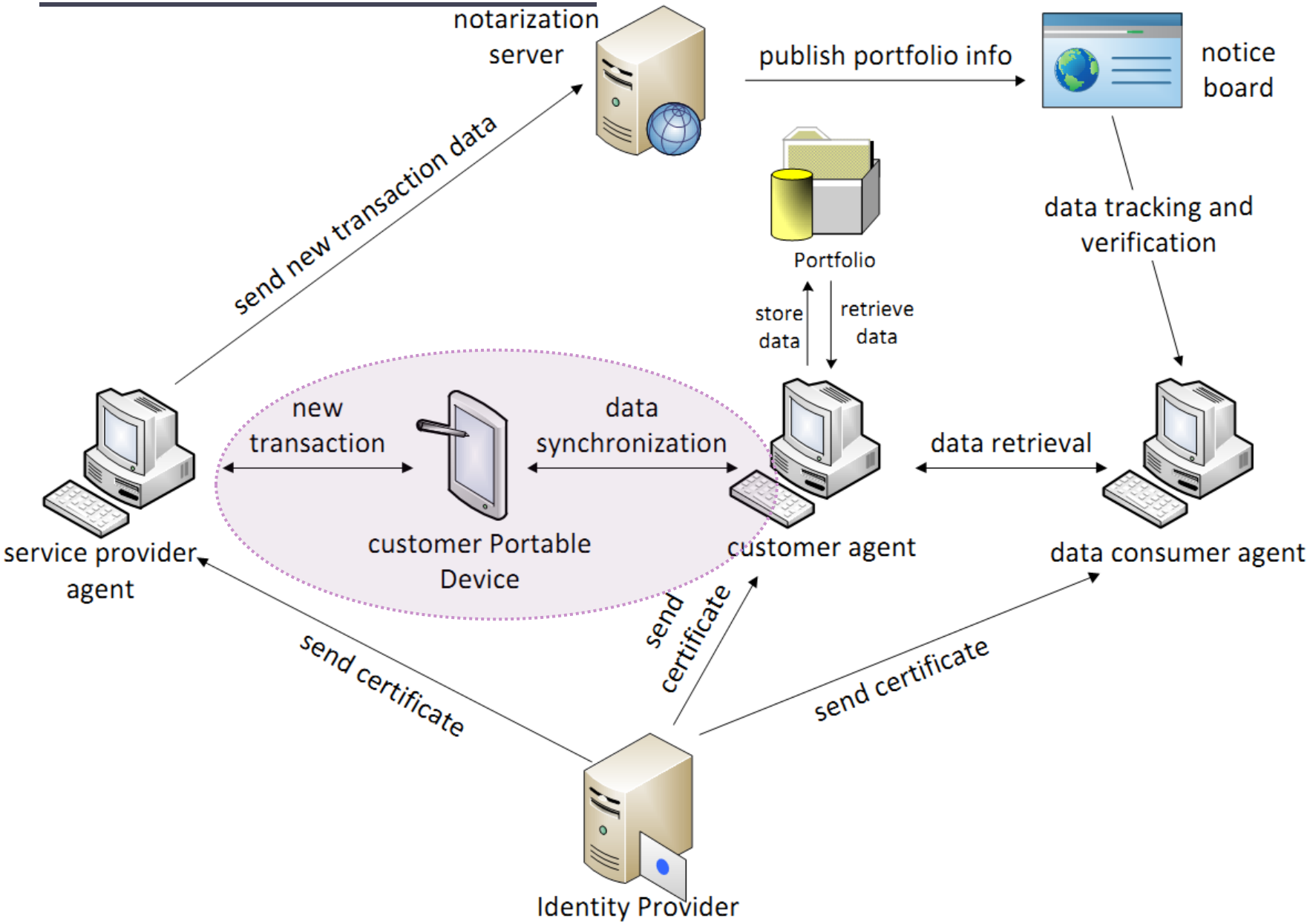
- Individuals, shops and companies are all Portfolio users.

- The main system components are the following:
  - The Portfolio that belongs to an individual.
  - The software agent (A_u) of user U.

Portfolio architecture



Portfolio architecture



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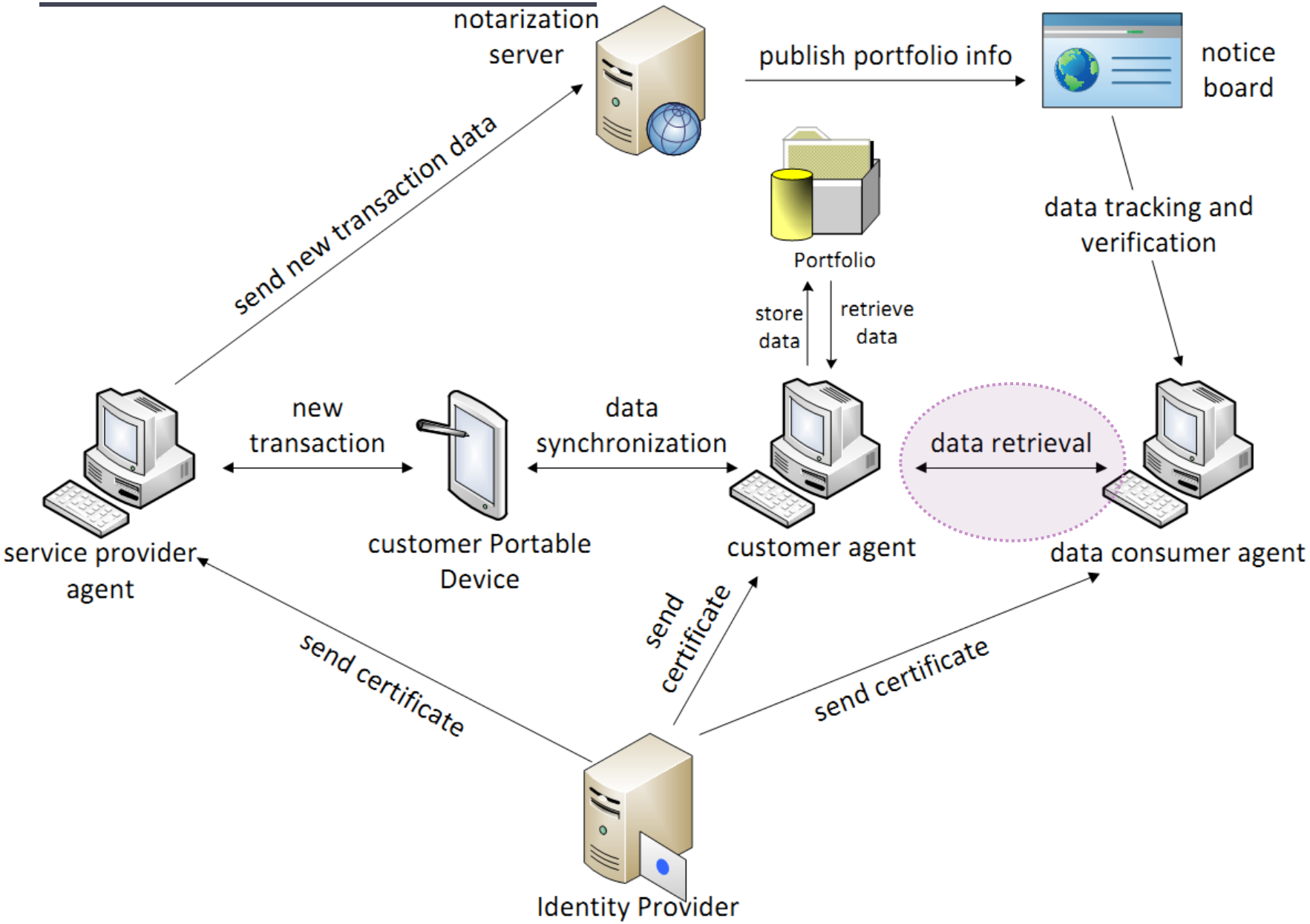

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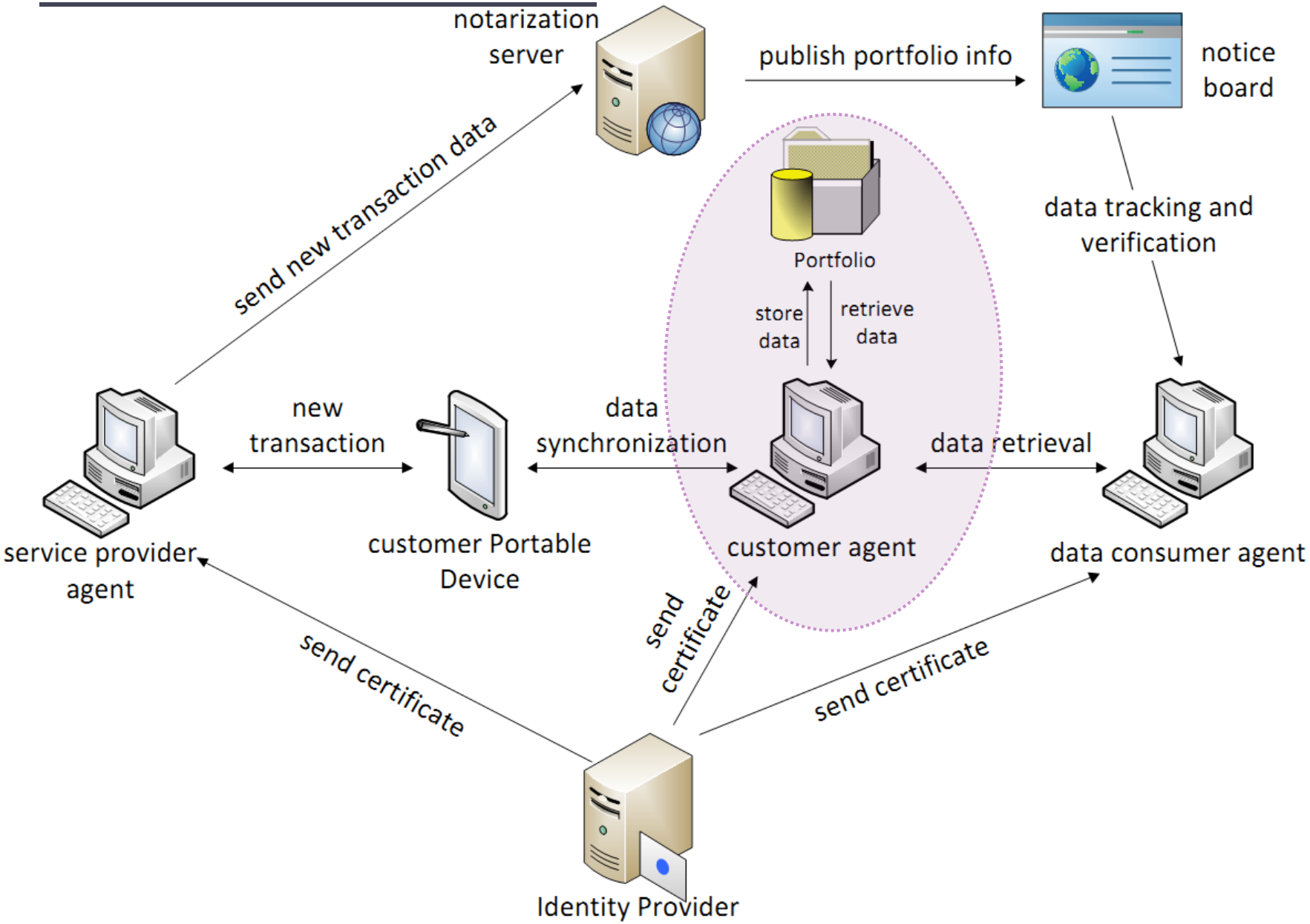

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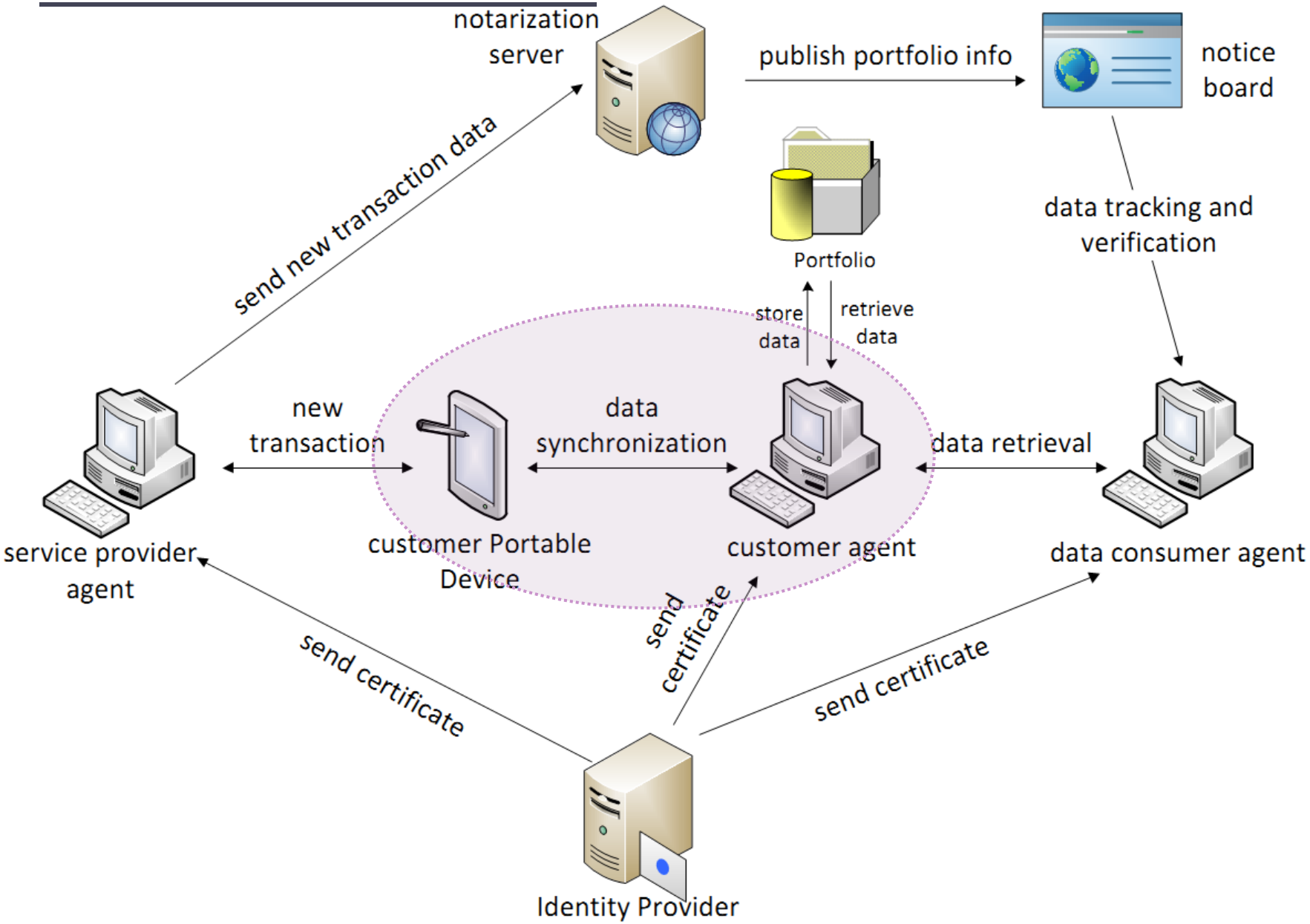

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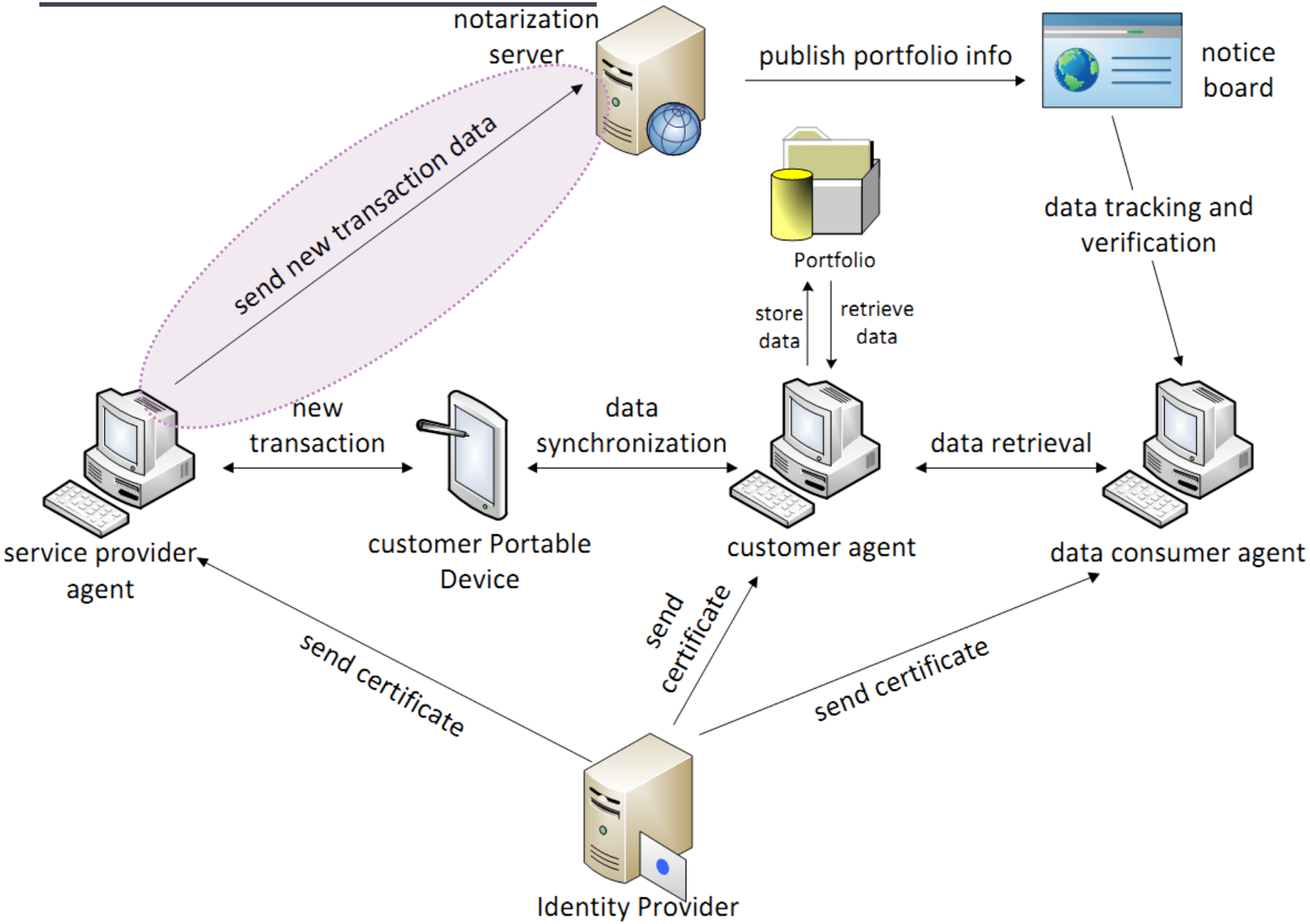

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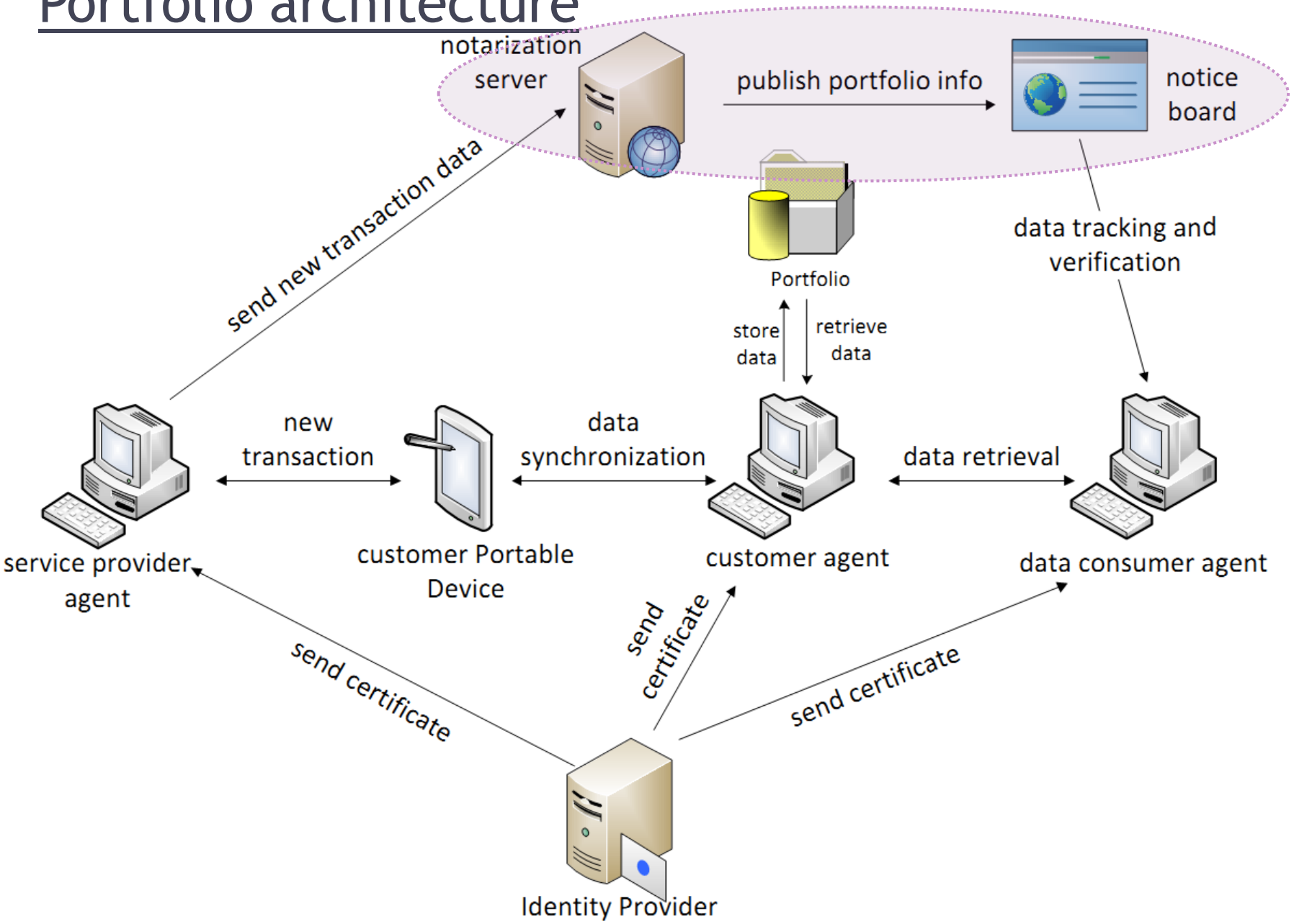

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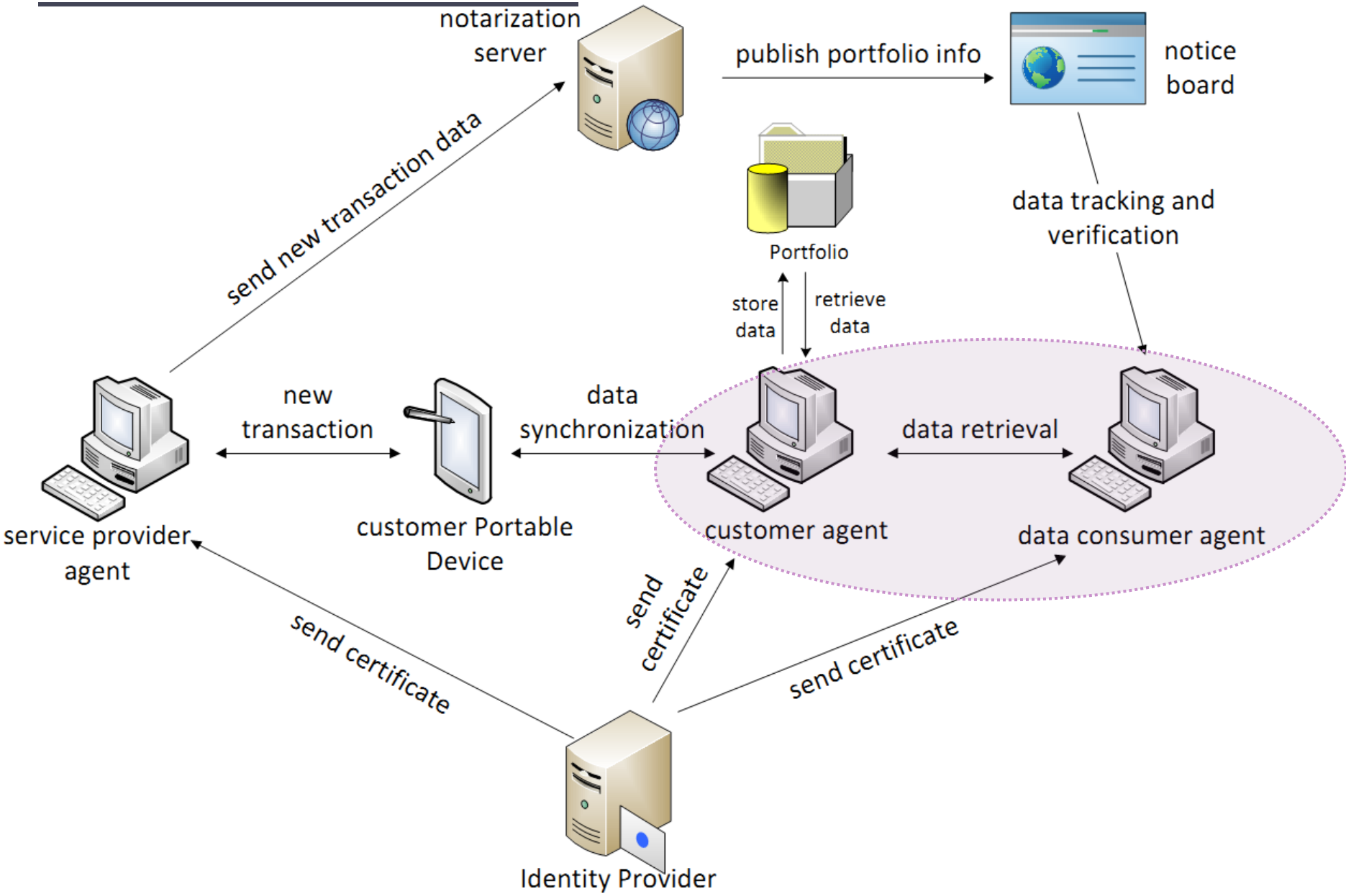

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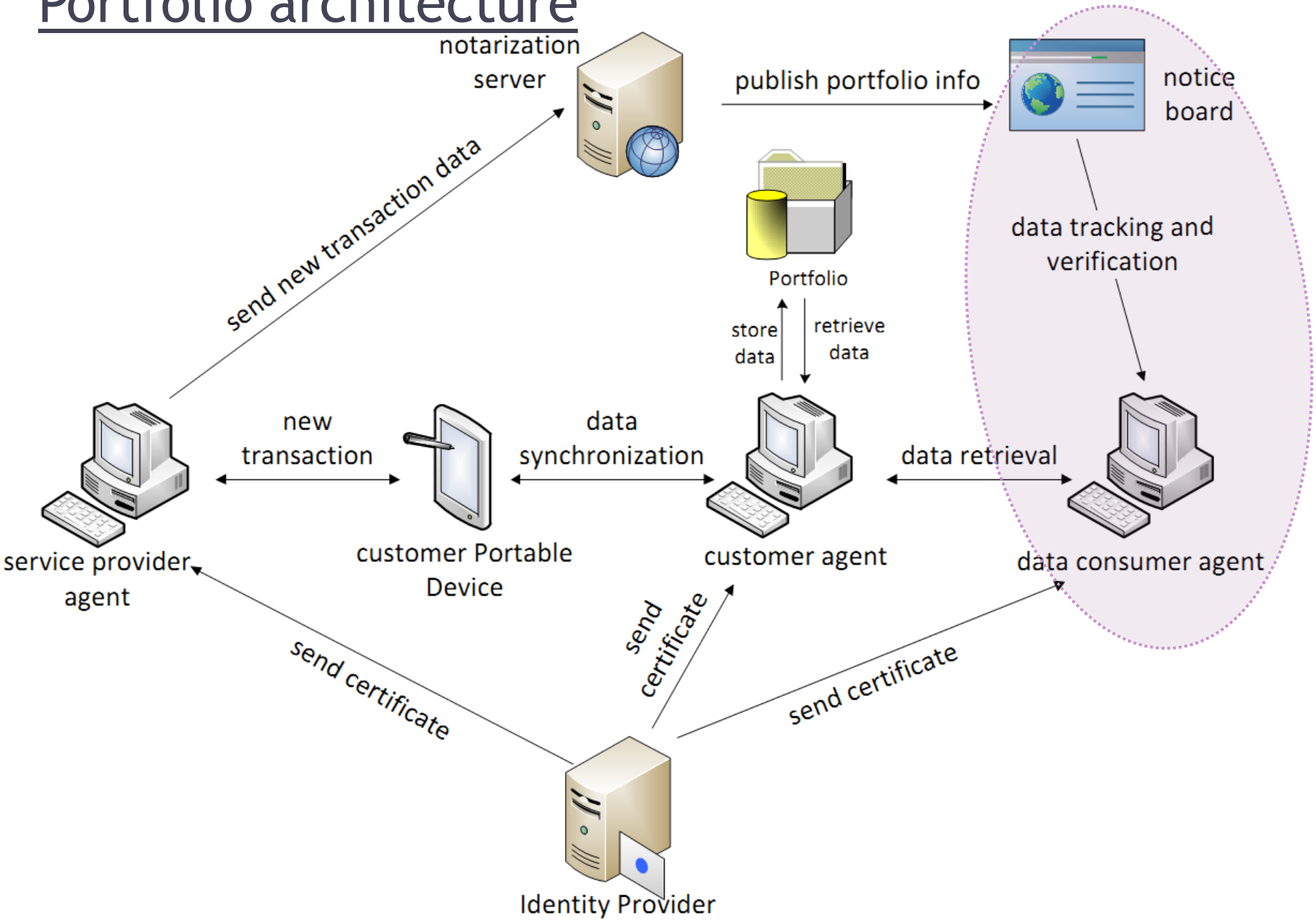


The Portfolio Approach

Building blocks

Anonymous Credentials

- A private credential system like the one described by Camenisch et. al. (Eurocrypt 2001) offers:
  - Different **unlinkable** pseudonyms based on the same credential.
  - **Unforgeability** of credentials.
  - **Unlinkability** of credential showings.
  - Anonymity **revocation**.

Public Key Encryption with Keyword Search

- PEKS (Boneh et. al., Eurocrypt 2004) allows for **keyword searches within encrypted data**.
- **Transactions encrypted** with the owner's public key .
- **Retrieval** achieved using **search trapdoors** that match the **PEKS keywords** of the transactions.
- PEKS keywords posted on the **notice board** to track and verify transaction data.

Tamper Detection

- Tamper detection mechanisms (Snodgrass et. Al., VLDB 2004) are used **to ensure data accountability**.
- Individuals should not be able to **alter**, **remove** or **hide** transactions from their portfolio, thus presenting invalid profile attributes.
- The **notarization service** is introduced in the portfolio architecture to serve towards this end.
- **Digital signatures** are used to **prohibit tampering** with transaction contents.

The Portfolio approach

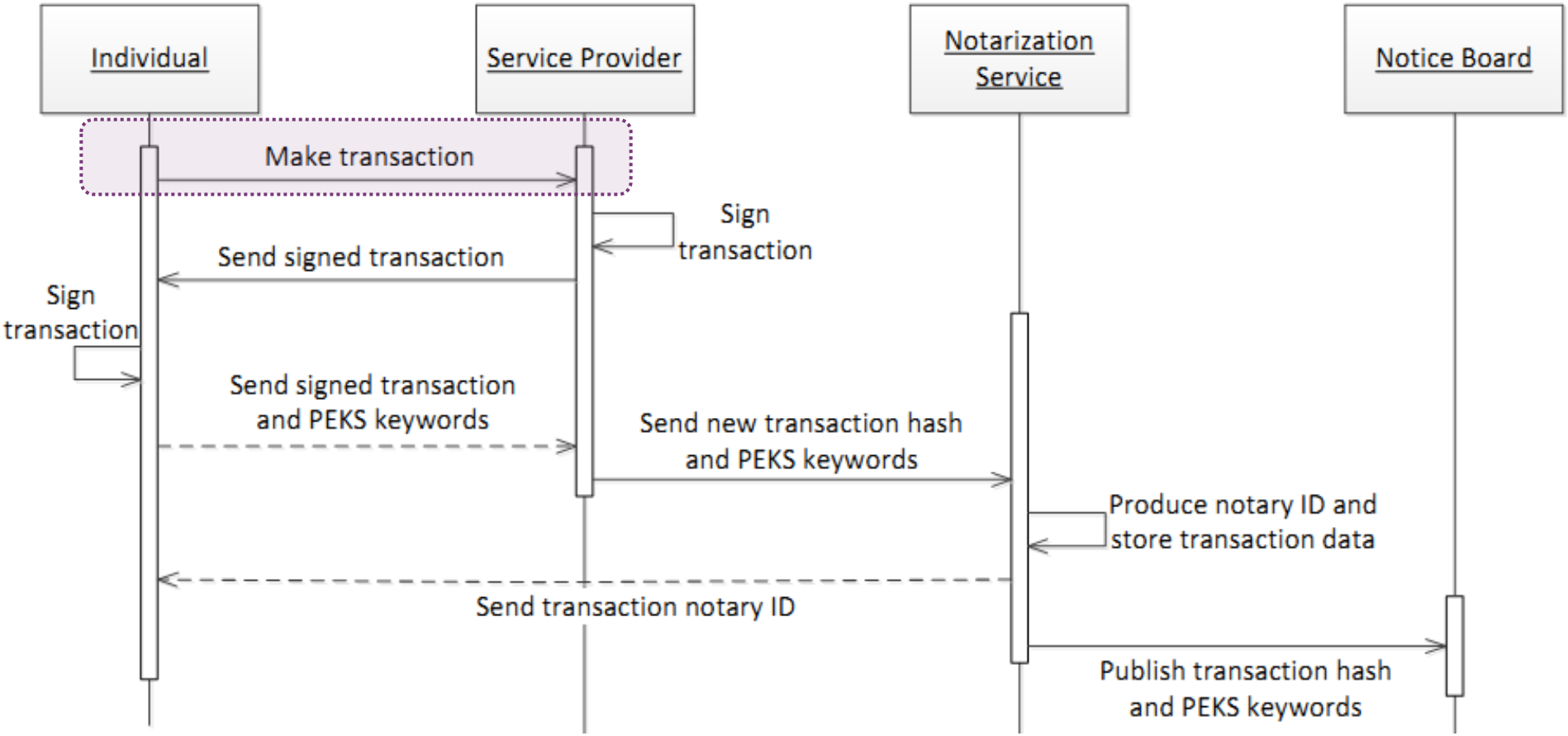
Functionality

Portfolio functionality

- Two protocols were designed to complement agent interaction in the portfolio system and demonstrate its functionality:
  - Transaction insertion protocol.
  - Data retrieval protocol.

- Both protocols achieve the desired functionality, while offering privacy protection and information accountability.

Transaction Insertion Protocol



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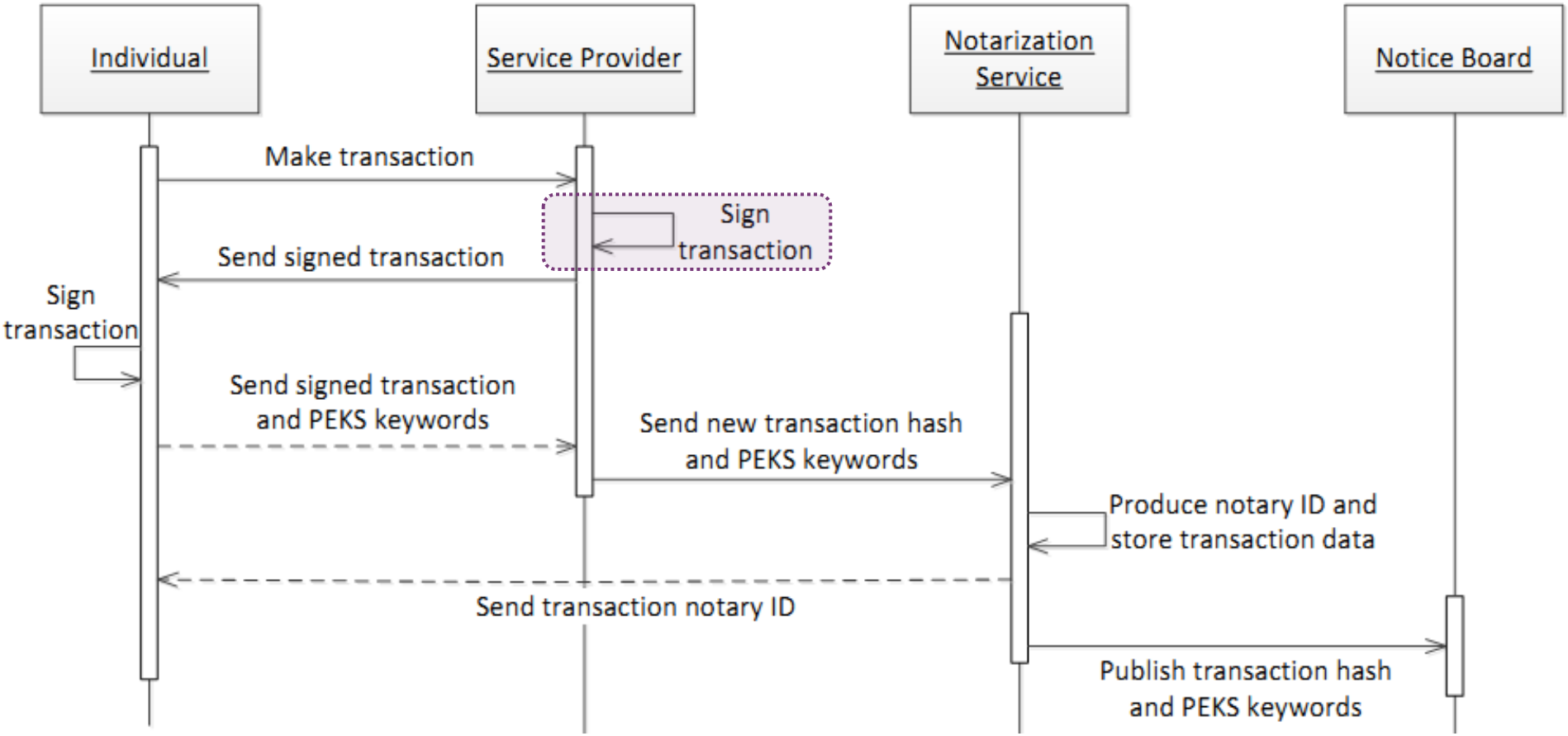

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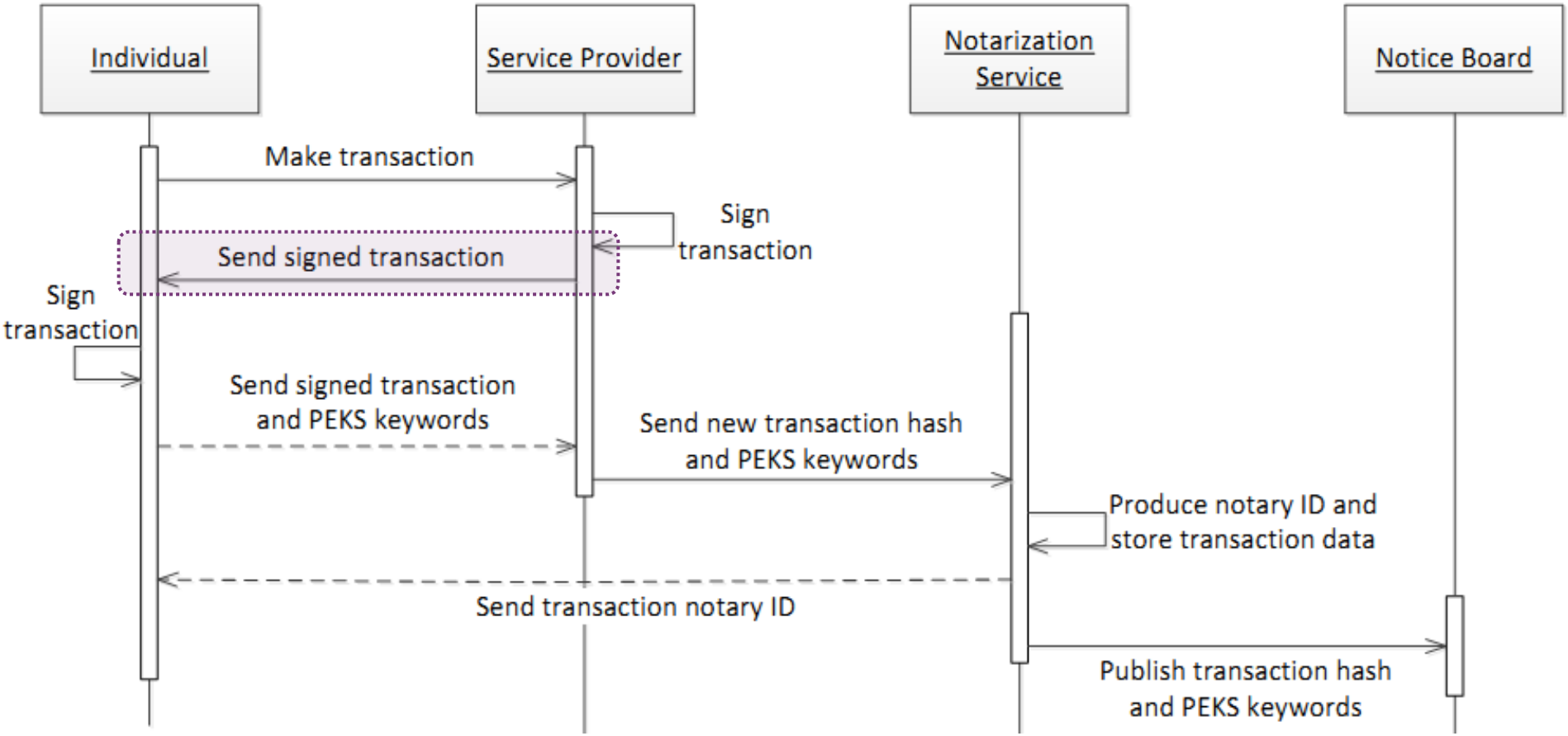

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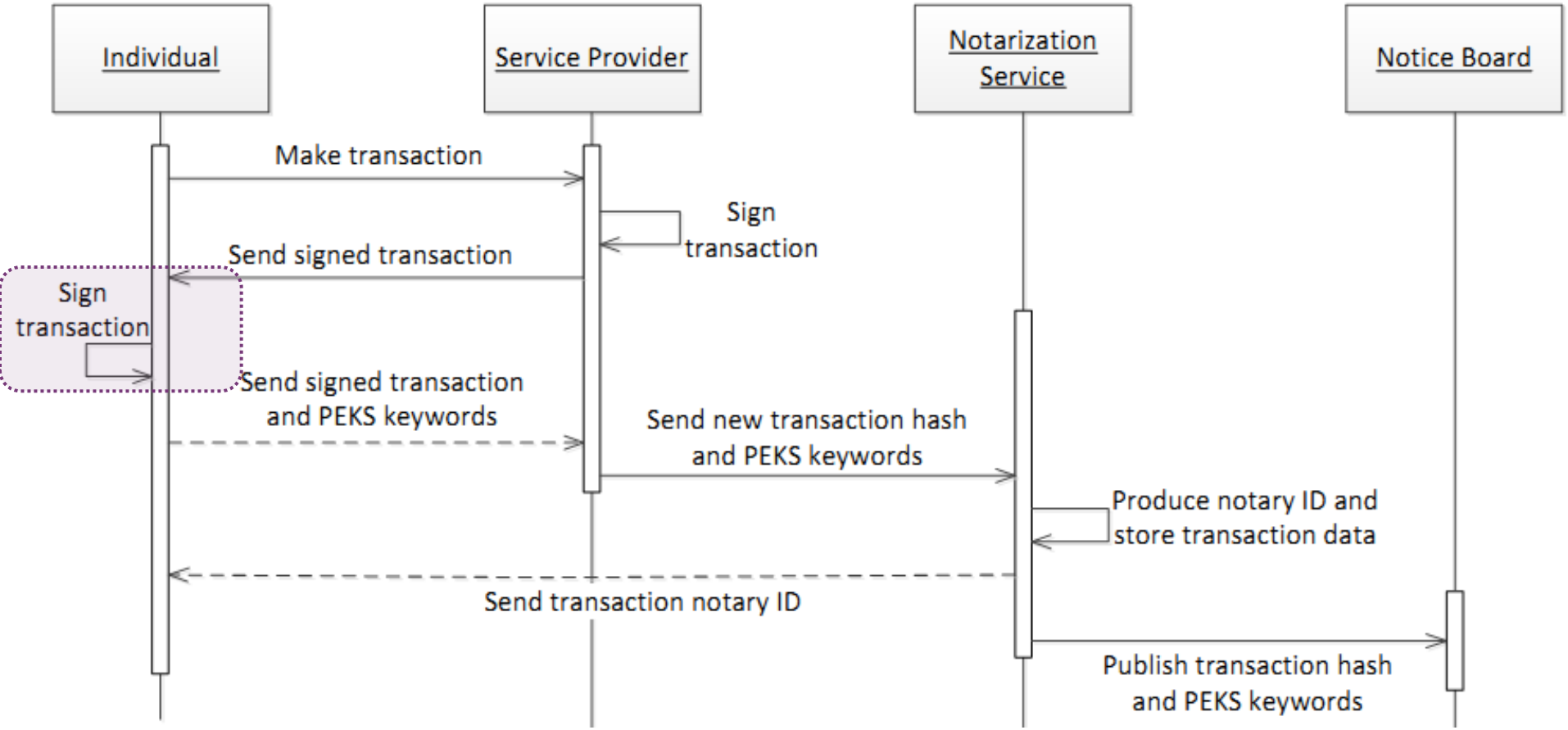

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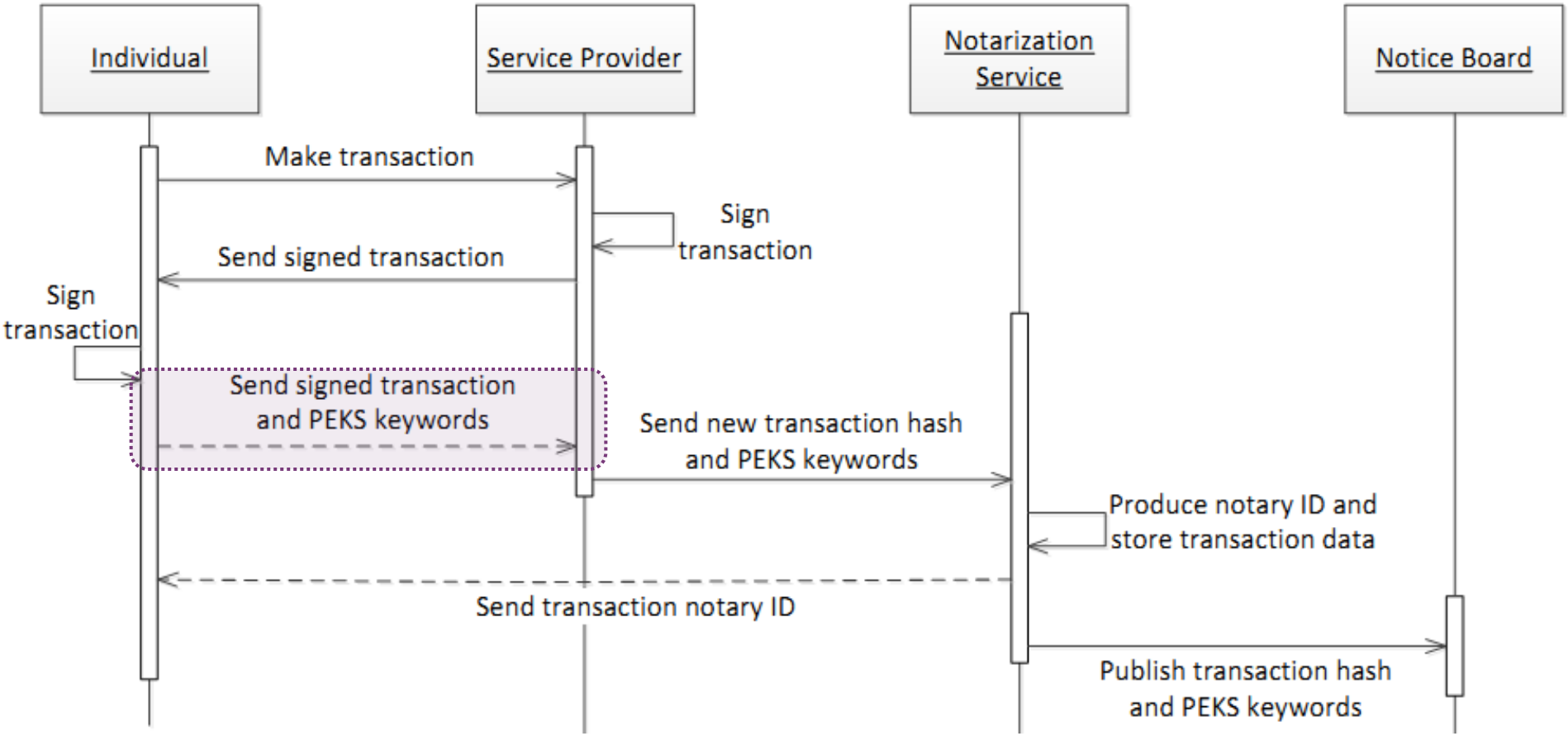

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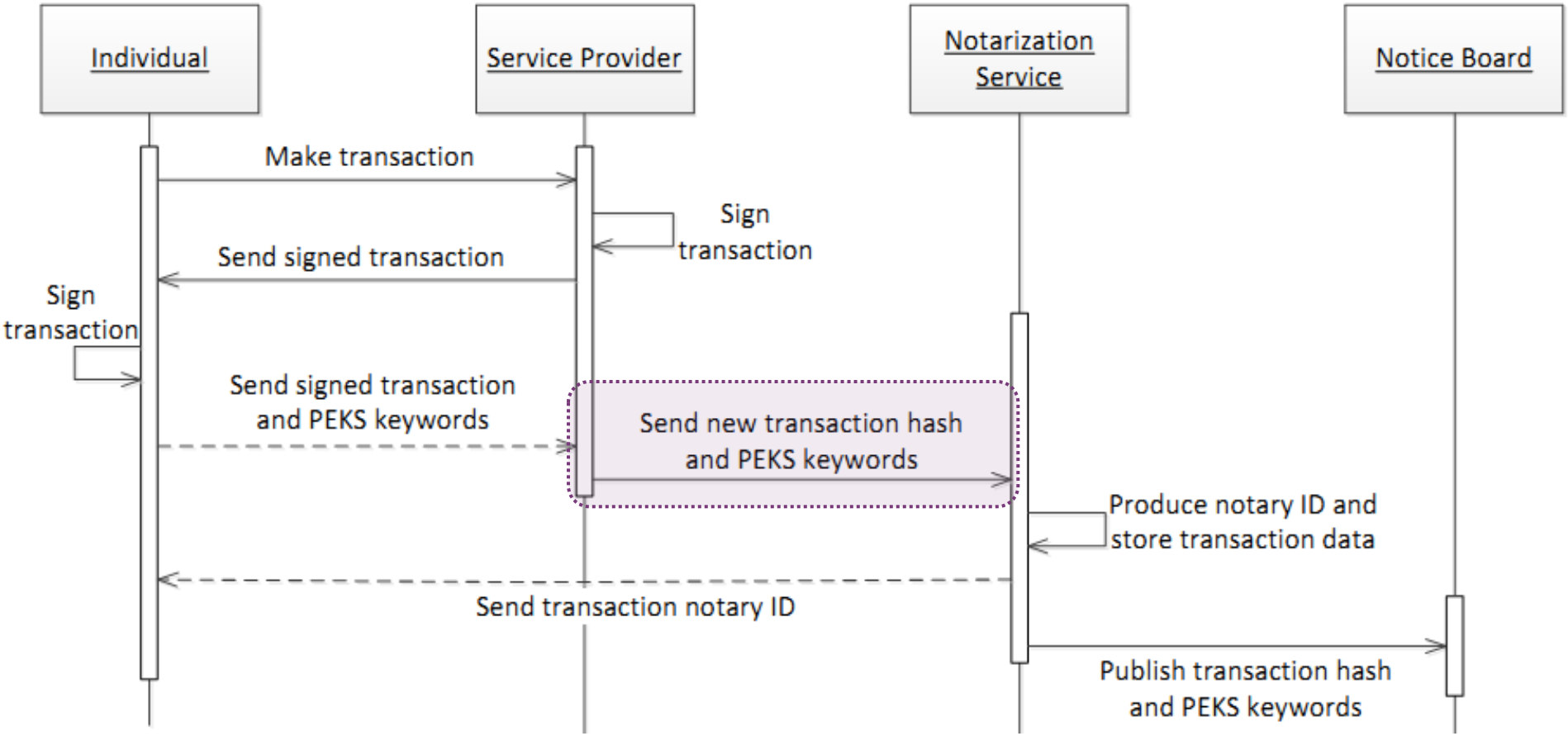

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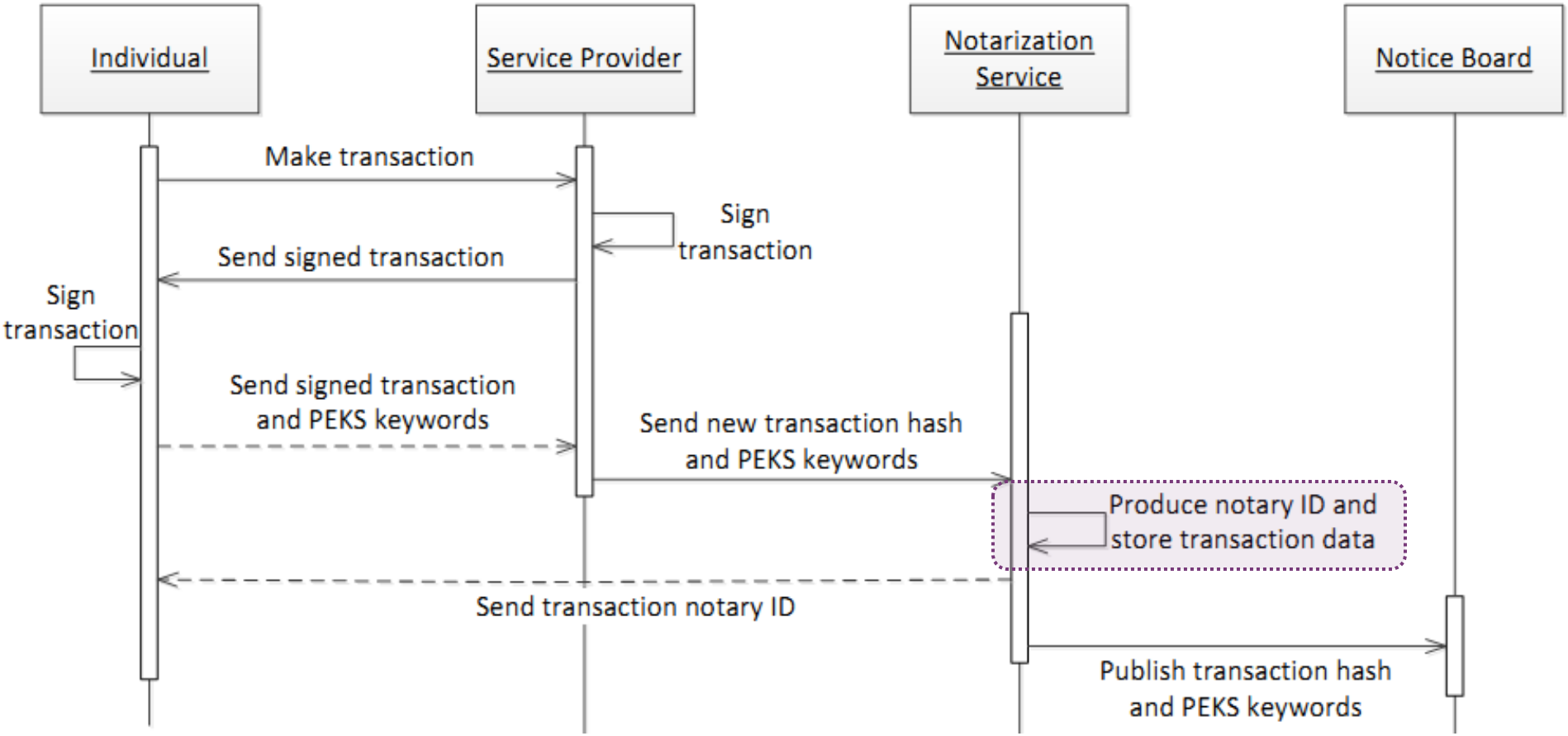

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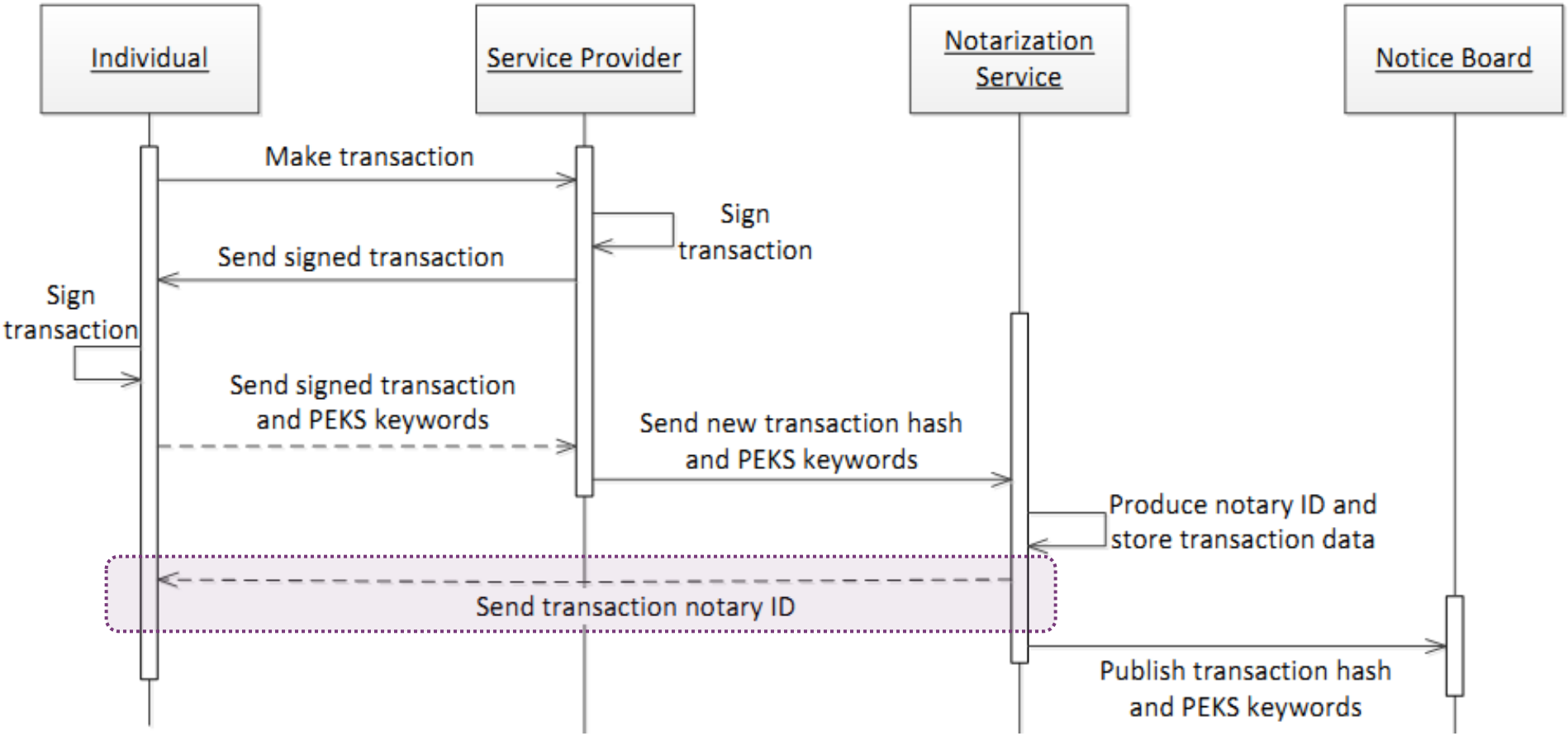

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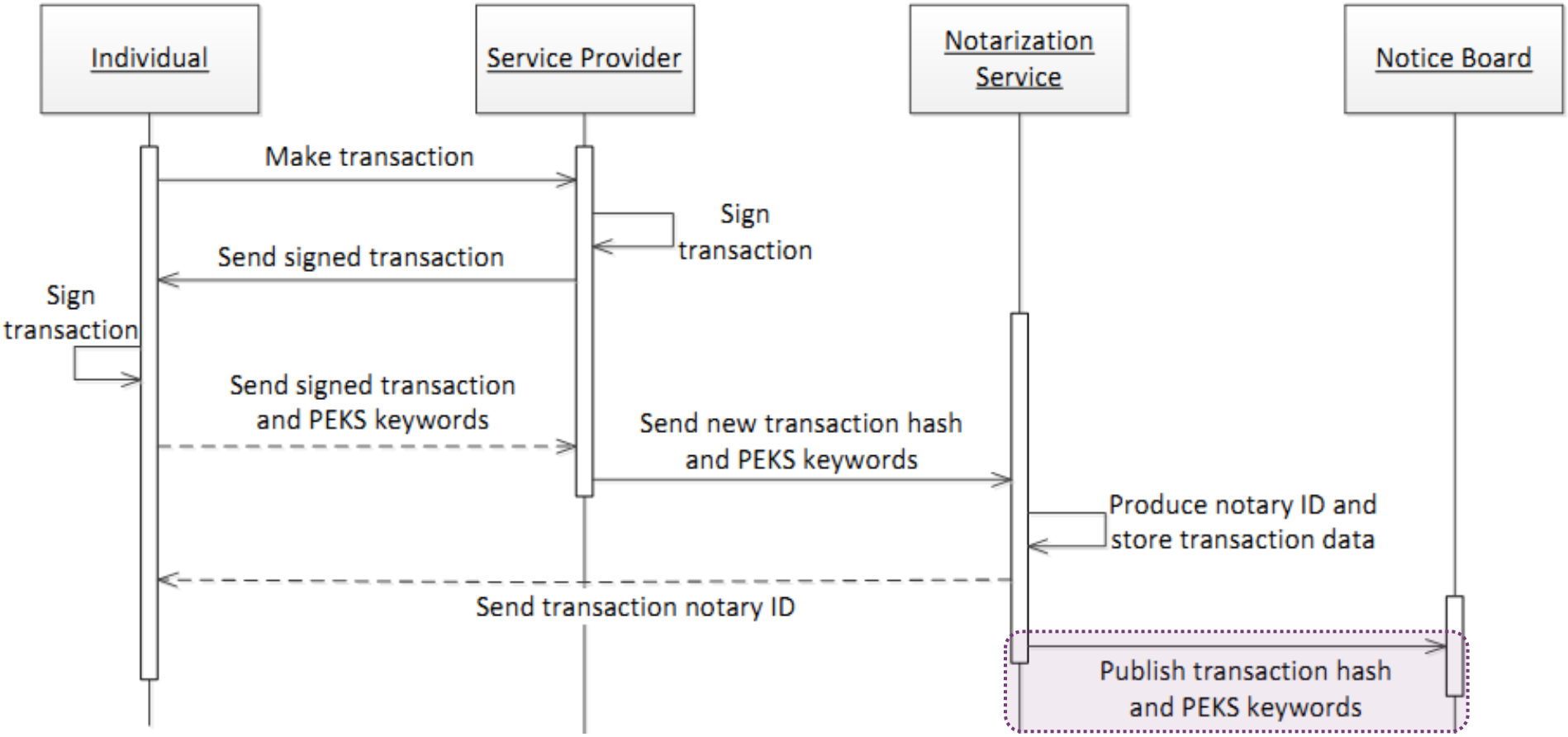
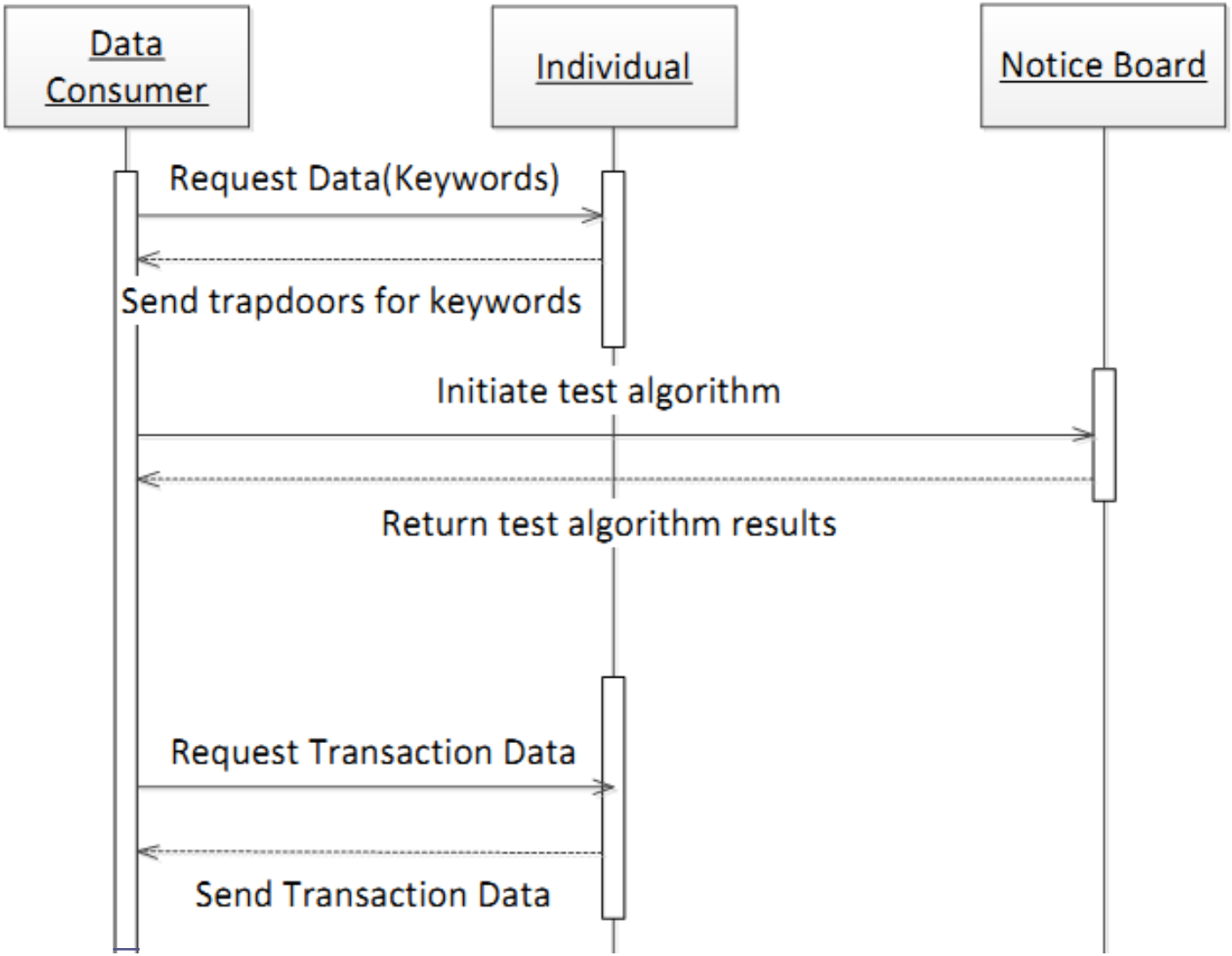


Data Retrieval Protocol



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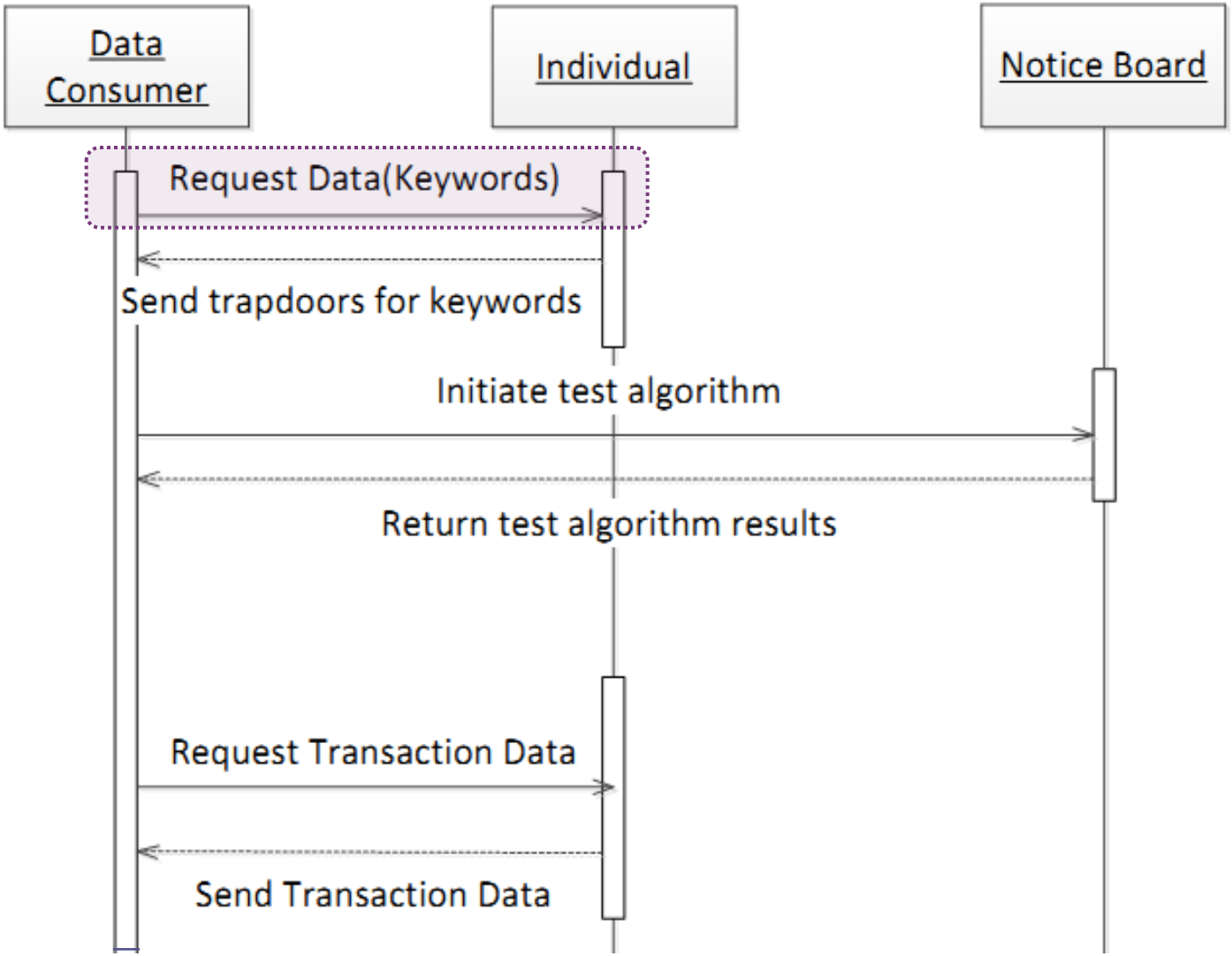

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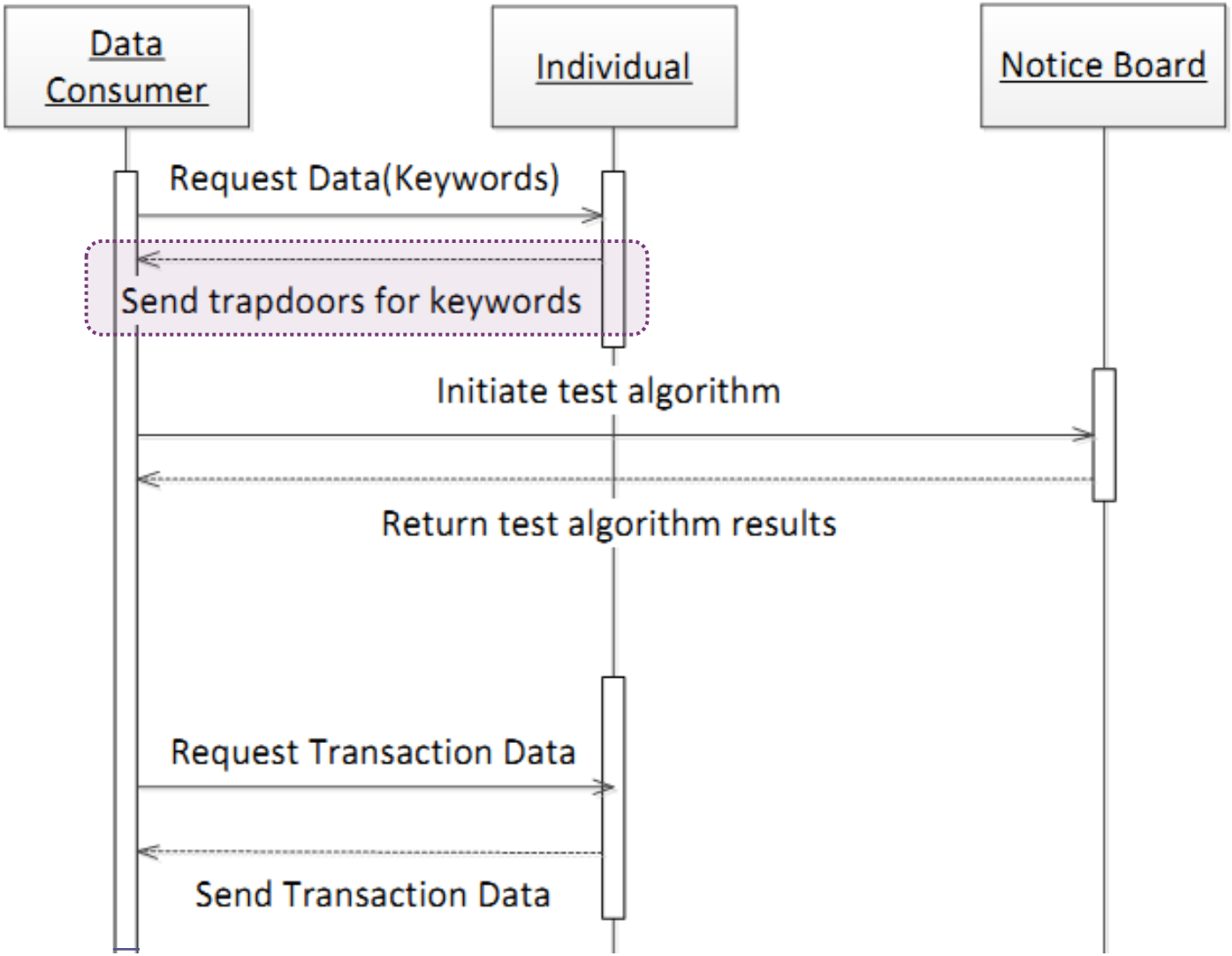

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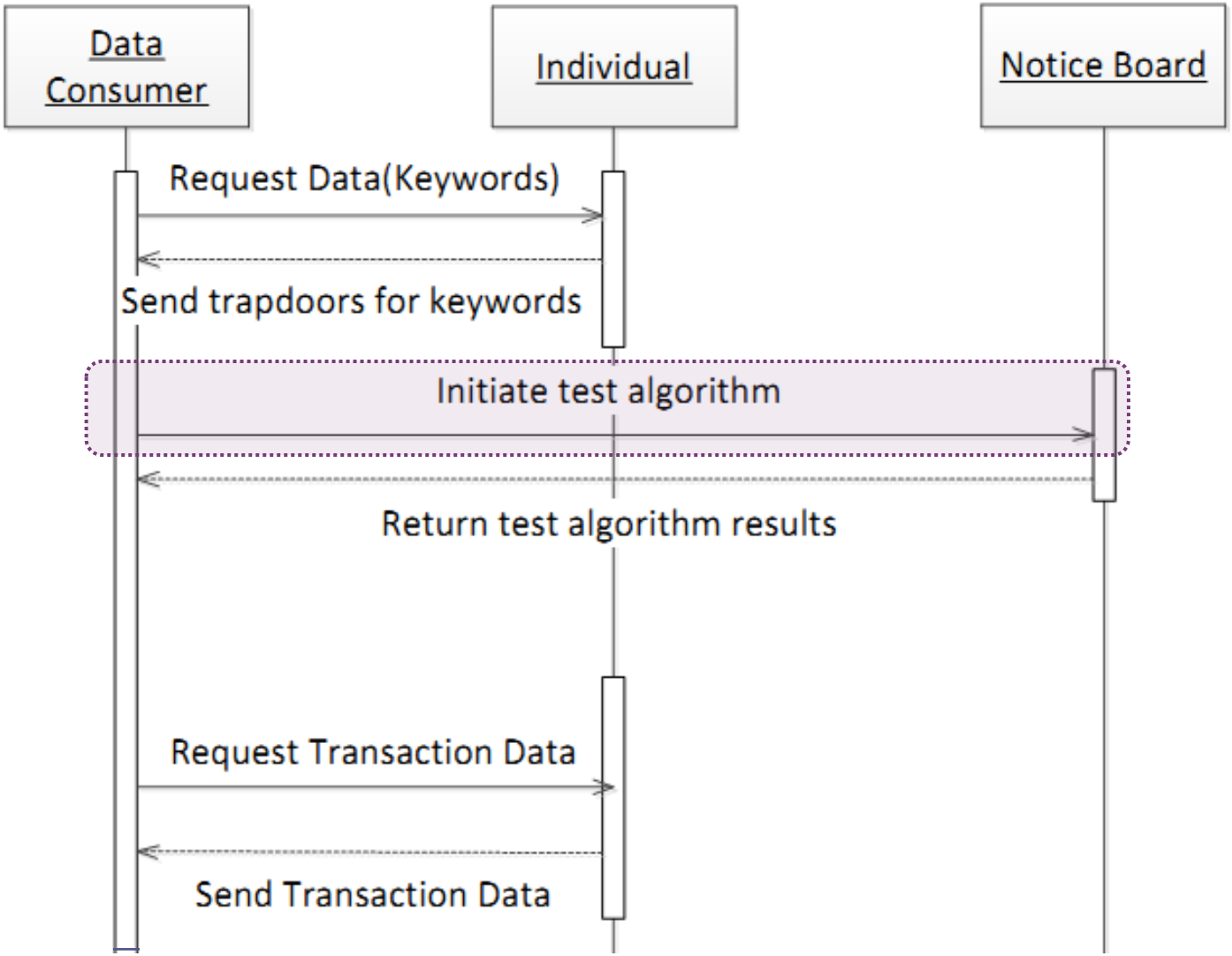

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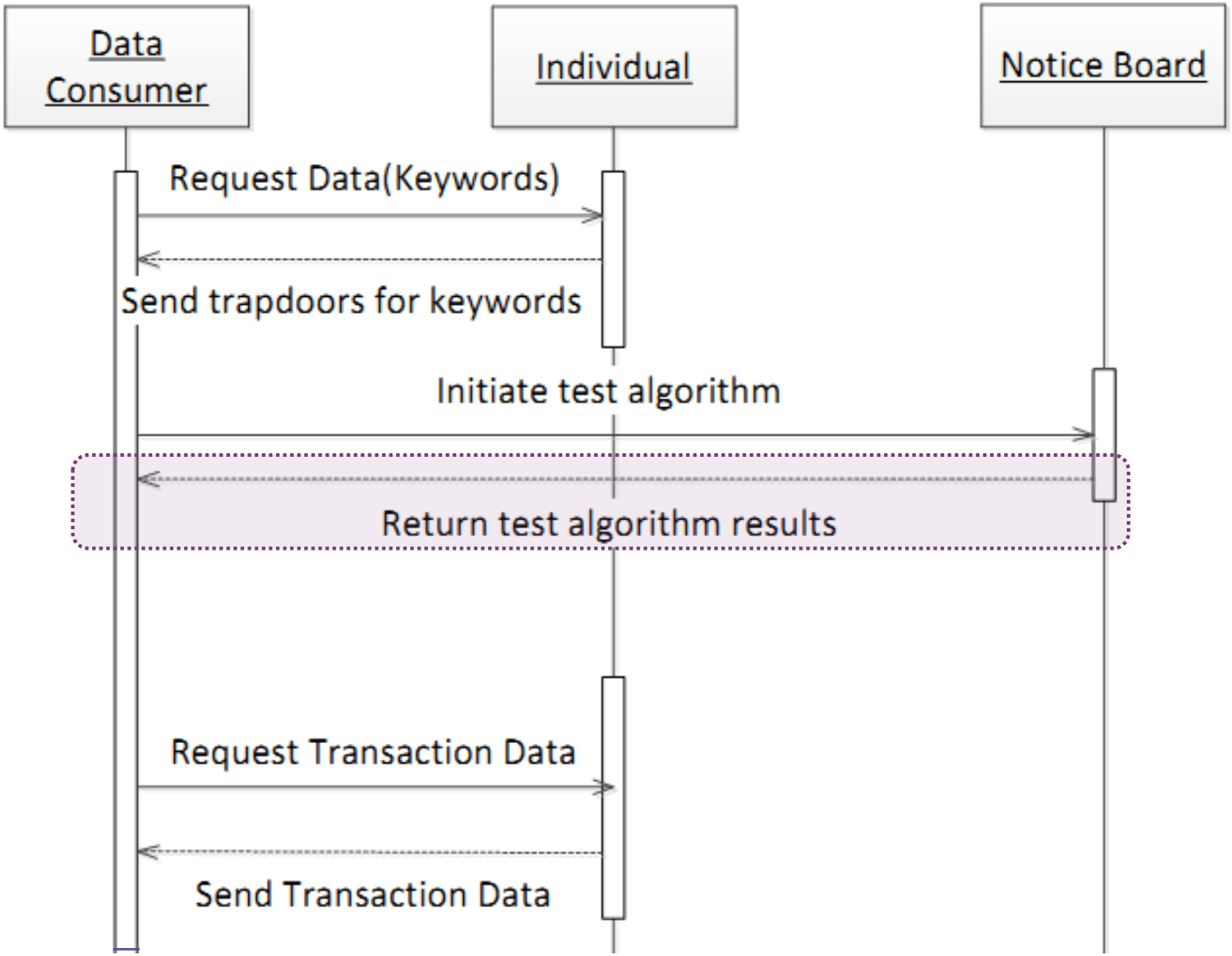

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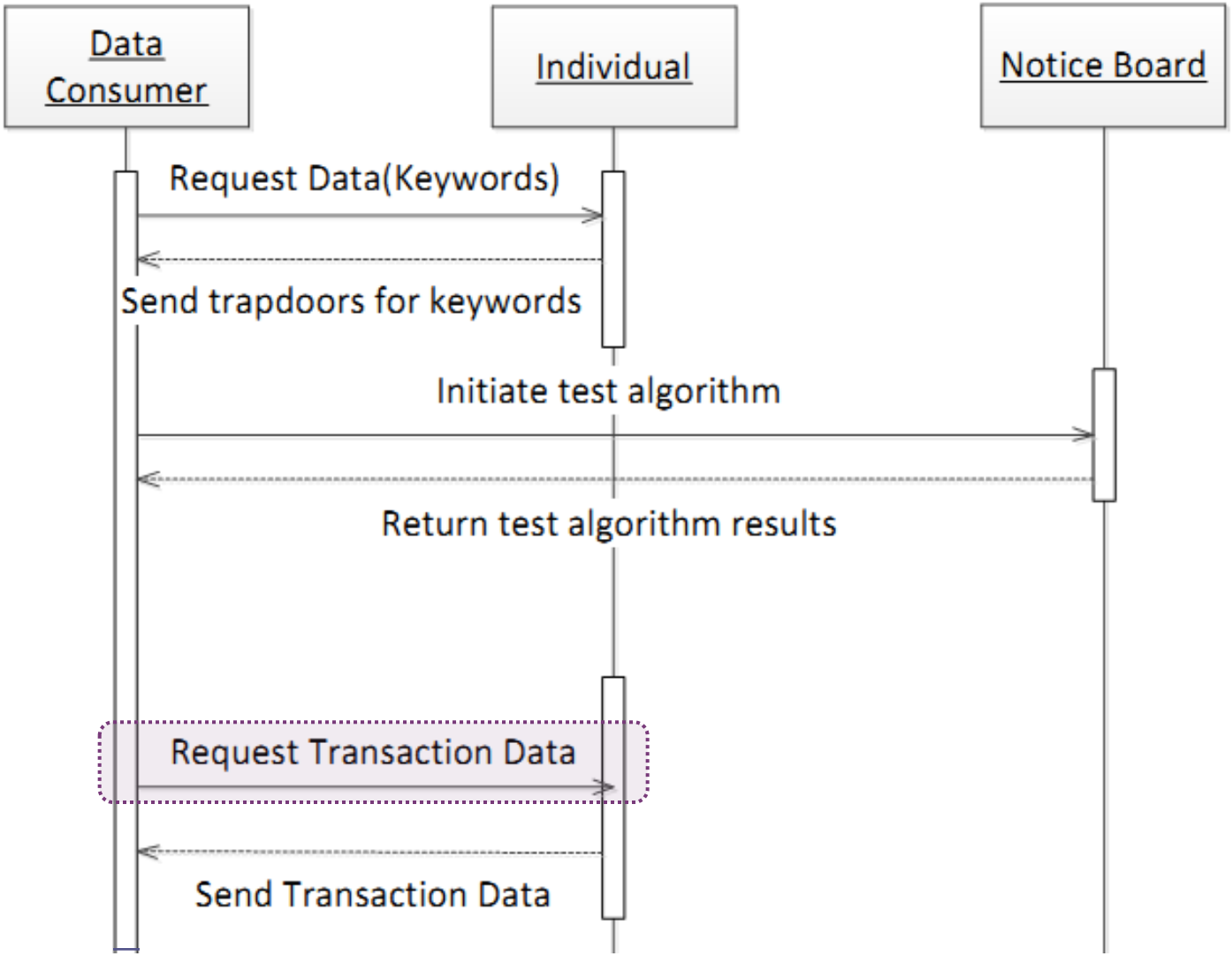

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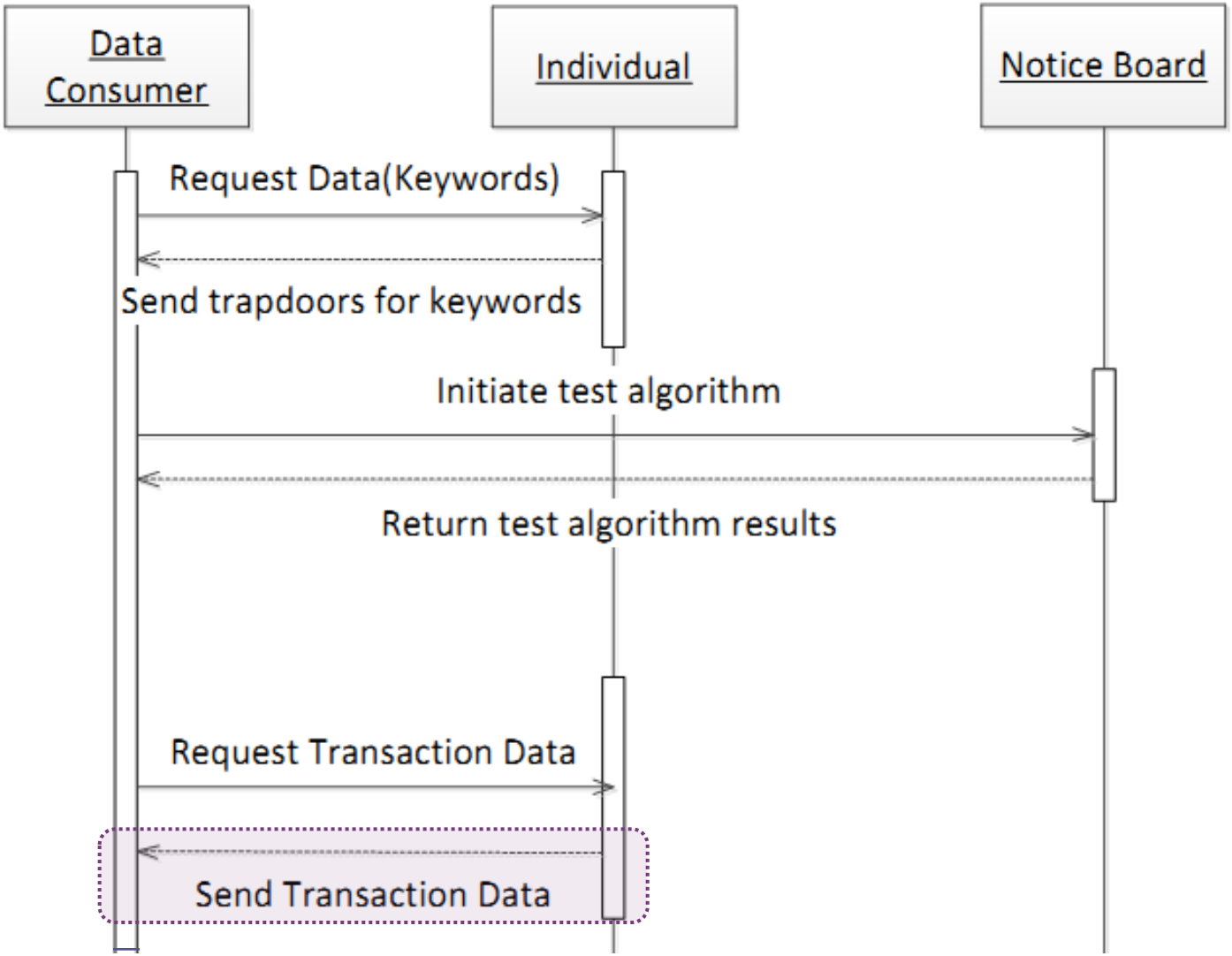

The Portfolio approach

Applications

Portfolio applications

- Tax records.
- Health records.
- Biographic records and e-identities.
- Opinion records for statistics and polls.
- Common requirements:
  - Private **information protection**.
  - **Efficient** and **accountable access** to the portfolio data **for legitimate users**.
  - **Strong accountability**, prohibiting tampering with the portfolio data.

Conclusions

Conclusions

- We propose moving the control of the transaction profile to the customer.
- Today's paradigm can change:
  - Availability of contemporary cryptographic techniques.
  - Increased data protection.
  - Trustworthy utilization of transaction data.
  - Usable with the existing common infrastructure.
- The proposed system is constructed from **existing** and **efficient building blocks**, therefore we believe that it will be **adequately efficient**.

Future work

Future work

- Determining the specifics of the portfolio functionality:
  - Threat model.
  - Implementing a prototype or simulation.
  - Portfolio protocols could be further enhanced and expanded.
- Possible extensions:
  - Support of distributed computations directly by the portfolio agent.
  - Introducing the portfolio into the Cloud.

Thank you!

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