Sovereign IIoT Data Exchange Using DAG-Based DLT and International Data Spaces Architecture

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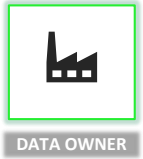
AGENCIA ESTATAL DE INVESTIGACIÓN

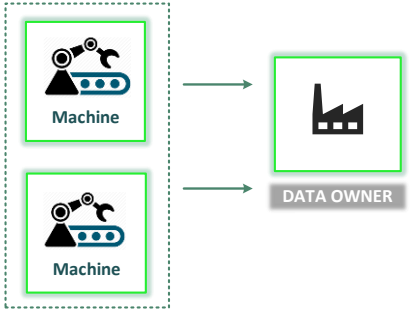
Introduction

Context: **Industrial IoT & Data Lifecycle**.



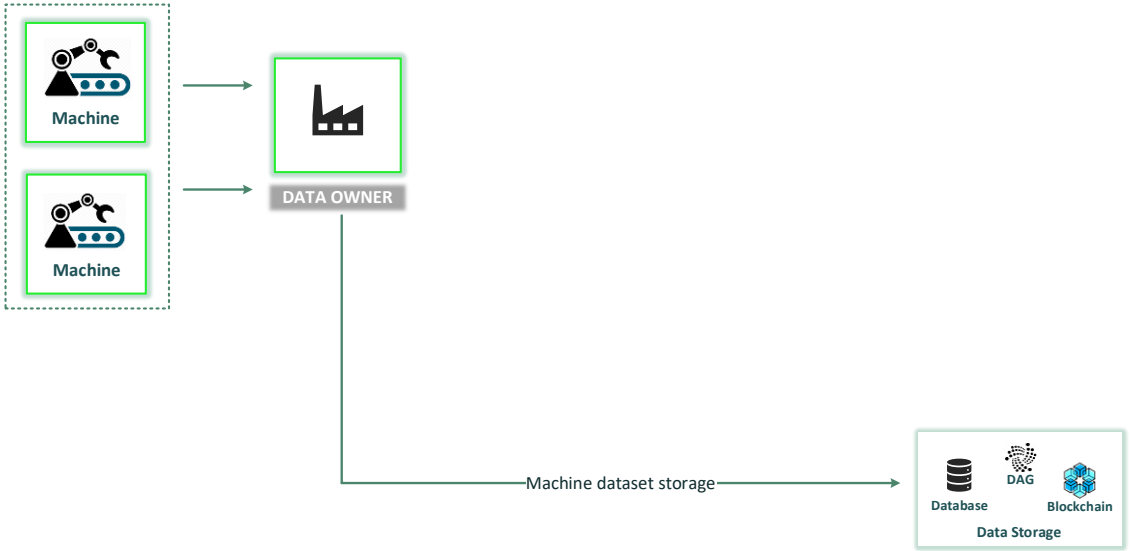
Introduction

Context: Industrial IoT & Data Lifecycle | **Data Generation**.



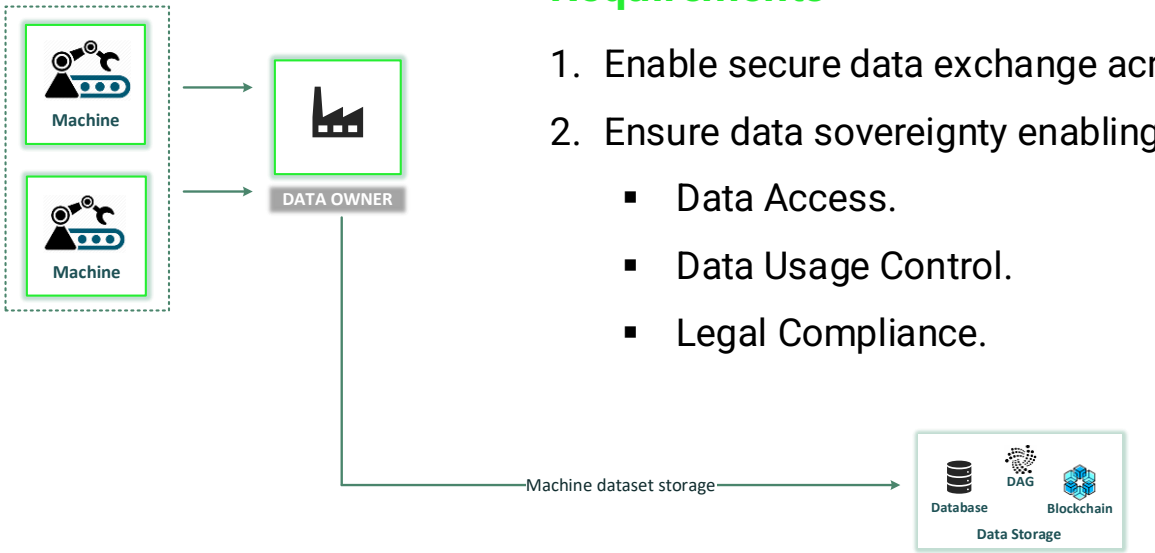
Introduction

Context: Industrial IoT & Data Lifecycle | **Data Storage**.



Introduction

Context: Industrial IoT & Data Lifecycle | **Data Exchange & Exploitation**.

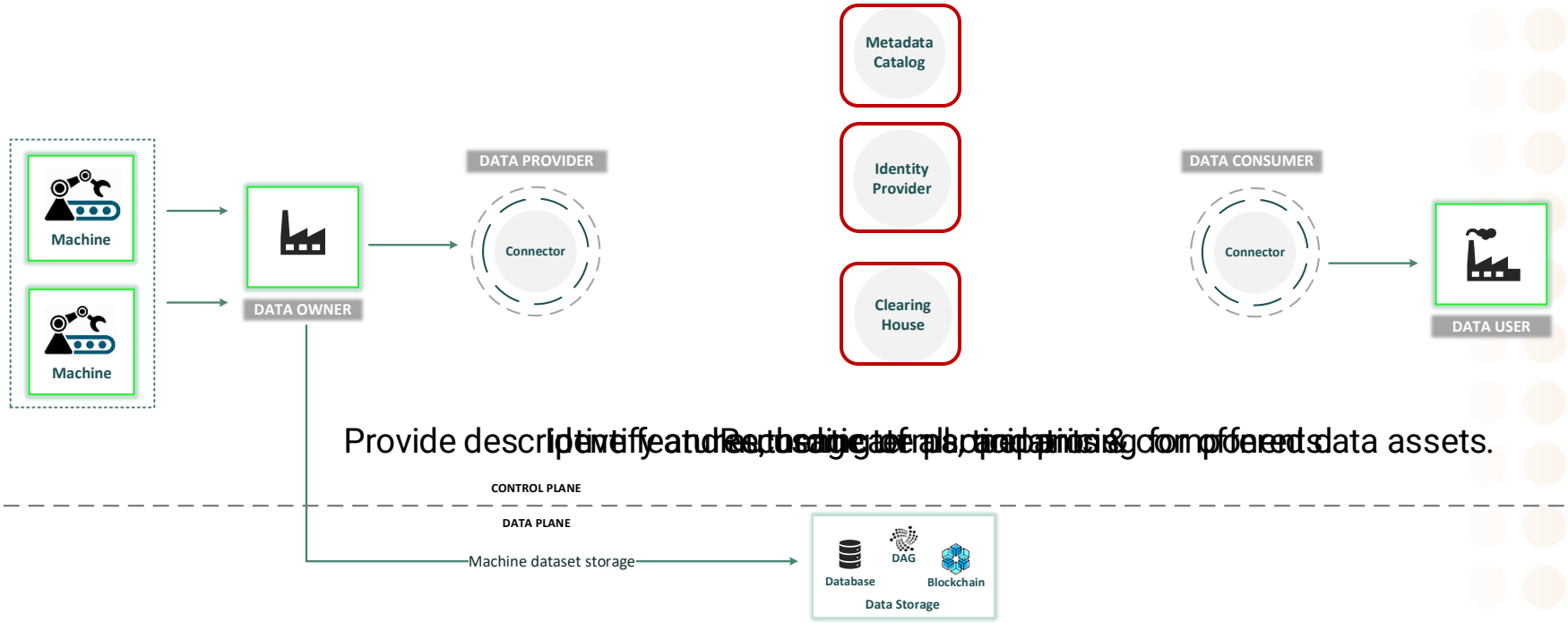


Requirements

1. Enable secure data exchange across multiple entities.
2. Ensure data sovereignty enabling:
   - Data Access.
   - Data Usage Control.
   - Legal Compliance.

Introduction

Problem Statement: data space for IIoT data exploitation with third parties.

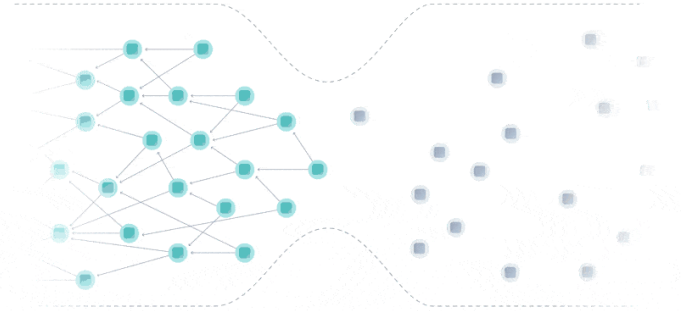


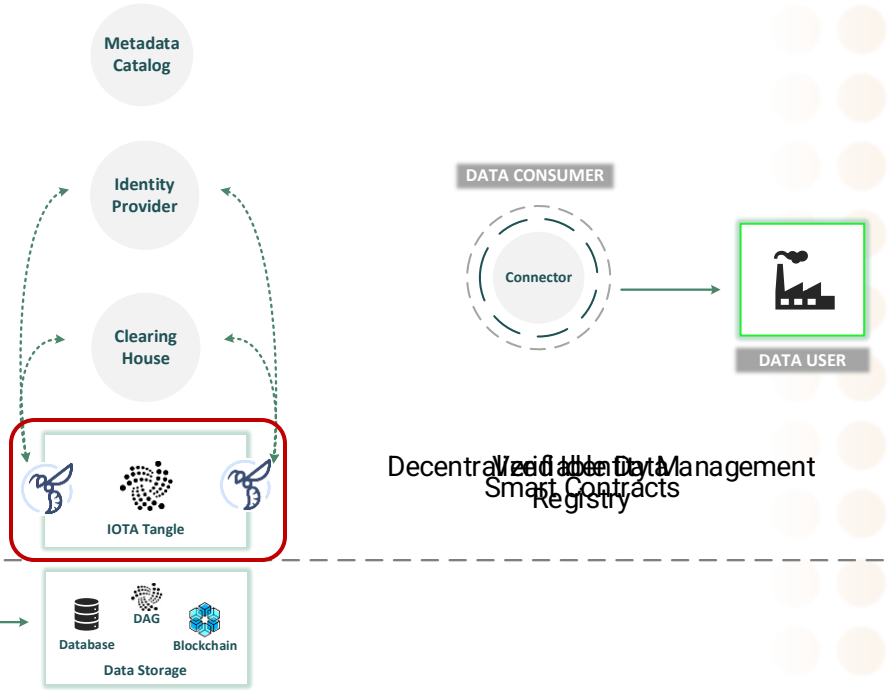
Introduction

Contributions: implementation of a data space for IIoT grounded on IOTA framework.

IOTA Technology

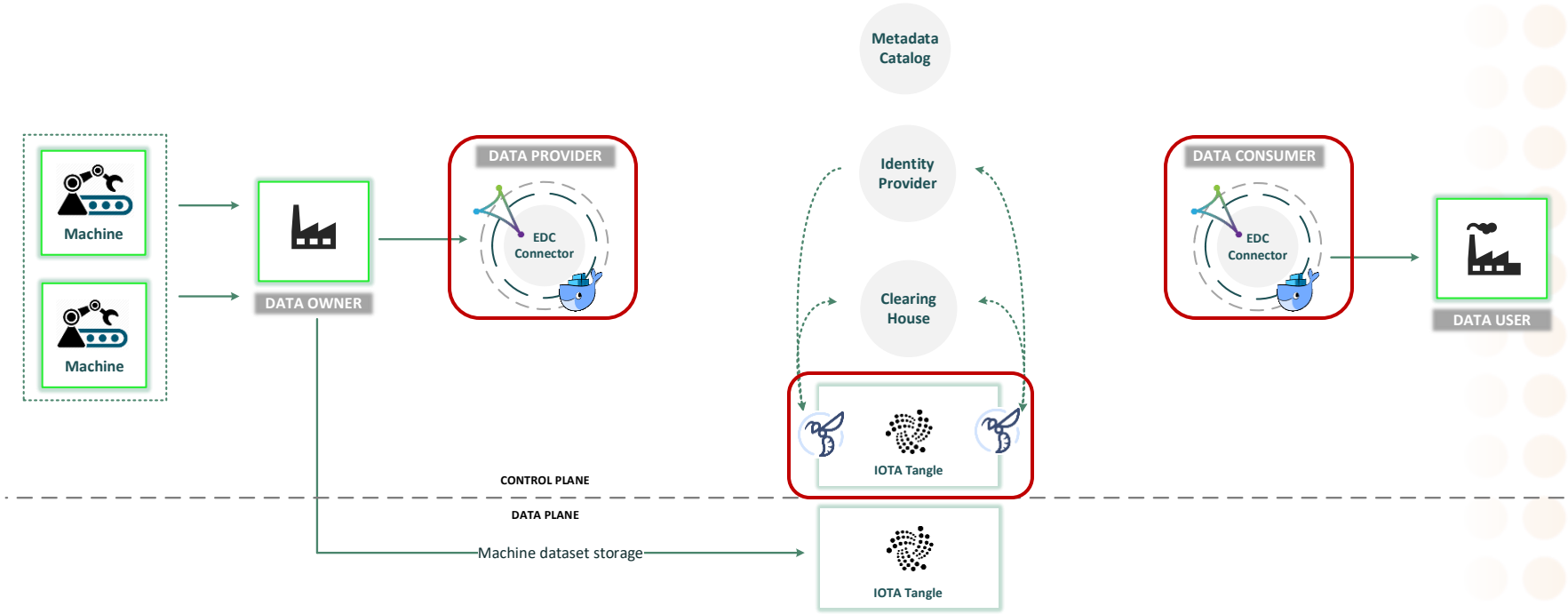
Directed Acyclic Graph (DAG)-based
Distributed Ledger Technology (DLT)





Proposed Solution

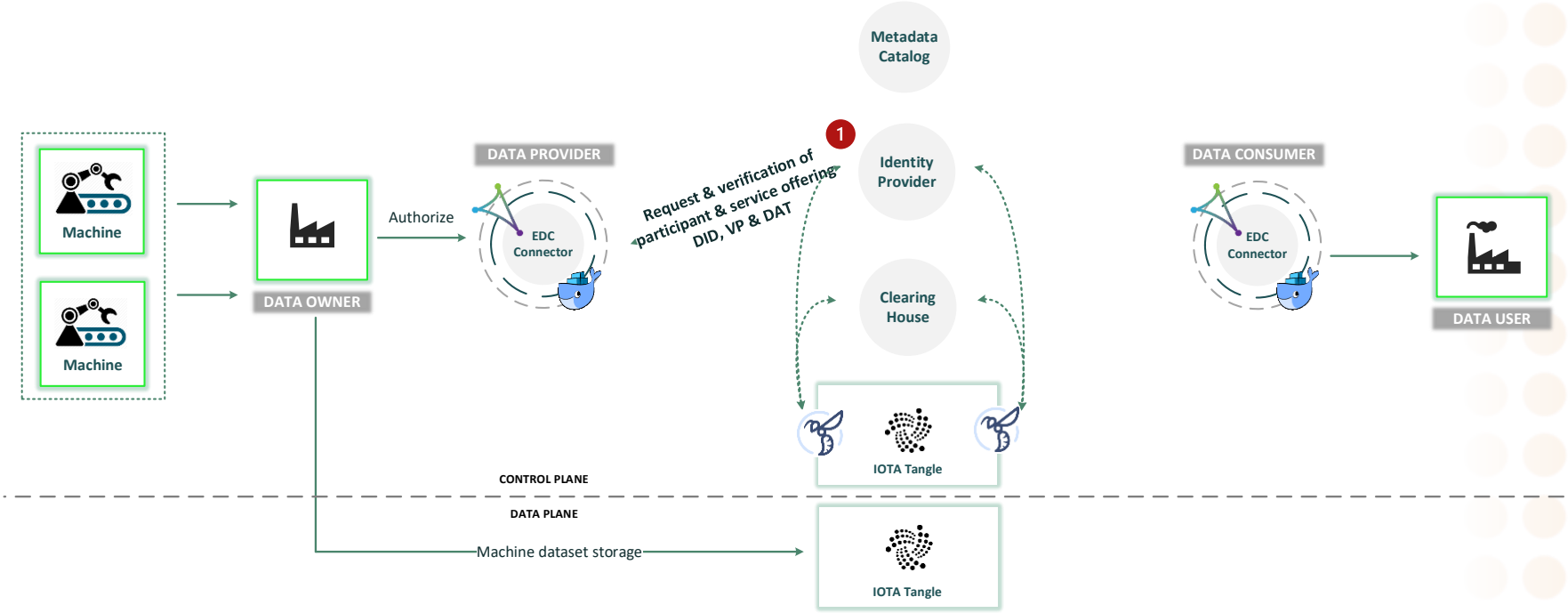
Integration of IDS core conceptual components with IOTA framework.



Status:

Proposed Solution

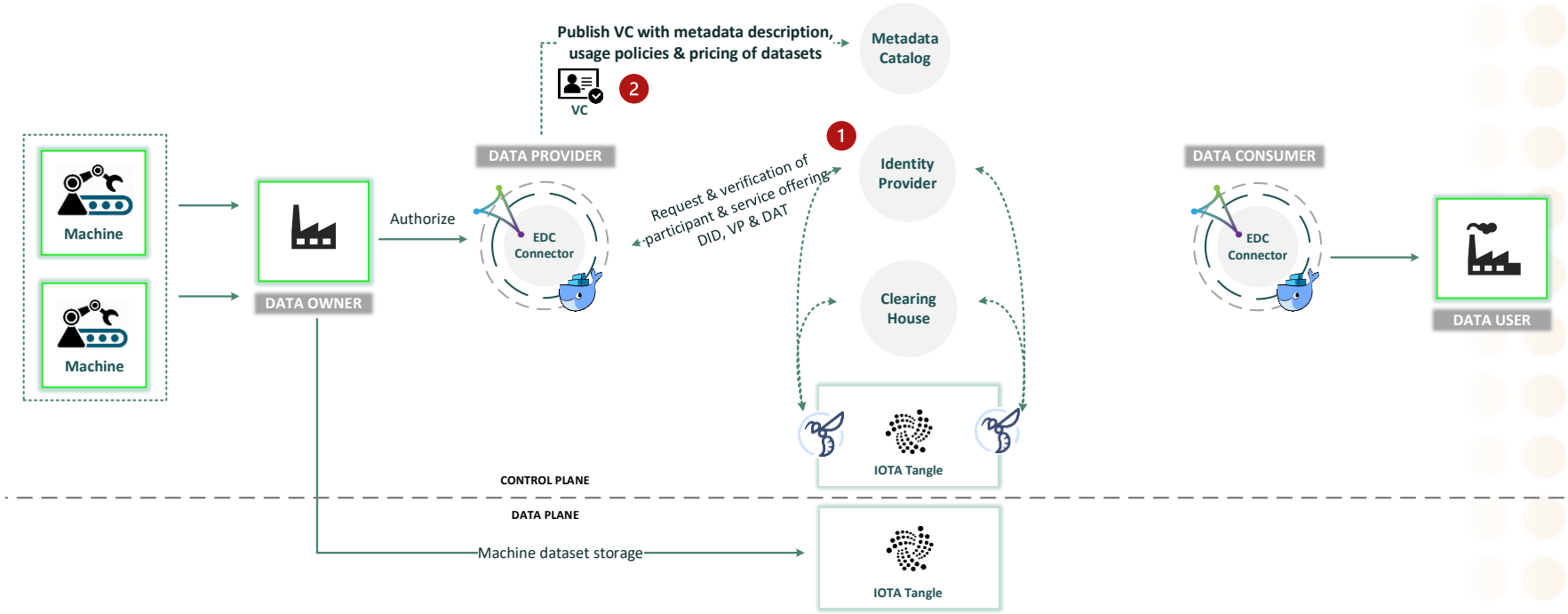
Participant Onboarding: decentralized identity management through **IOTA Identity**.



Status:

Proposed Solution

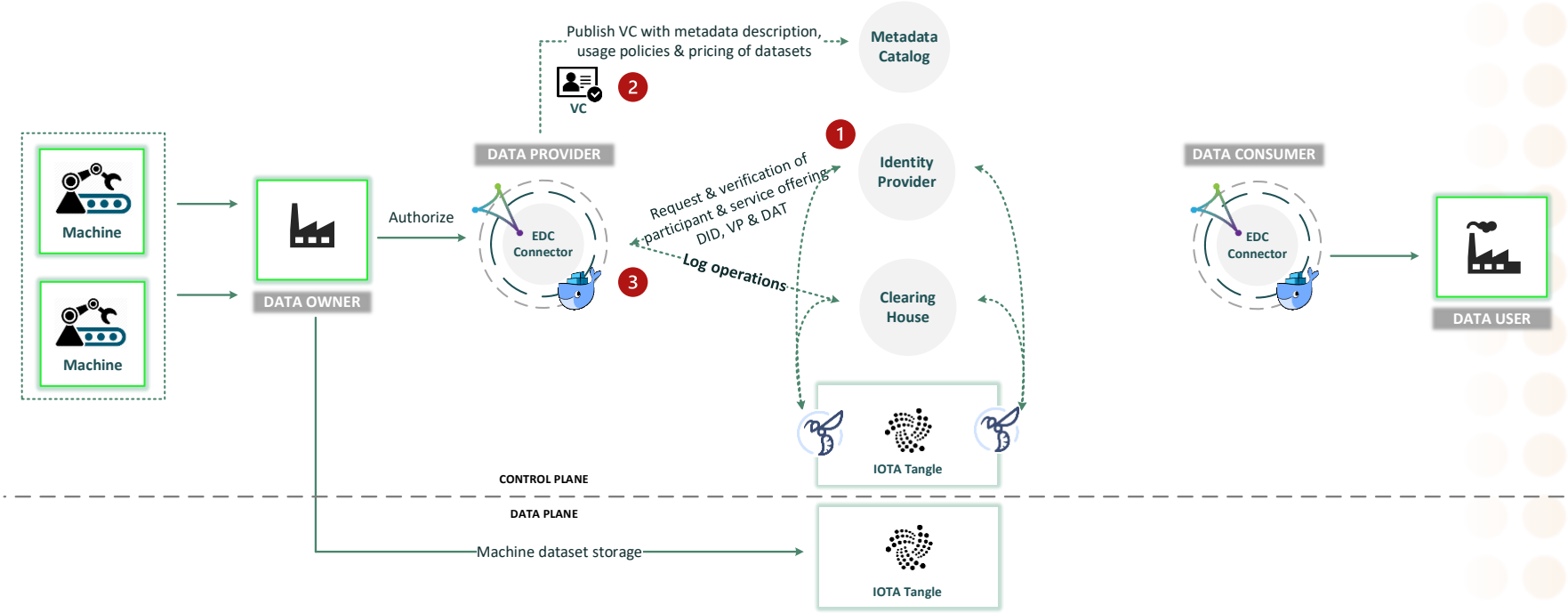
Data Offering: description of assets and usage policies within the **Metadata Catalog**.



Status:

Proposed Solution

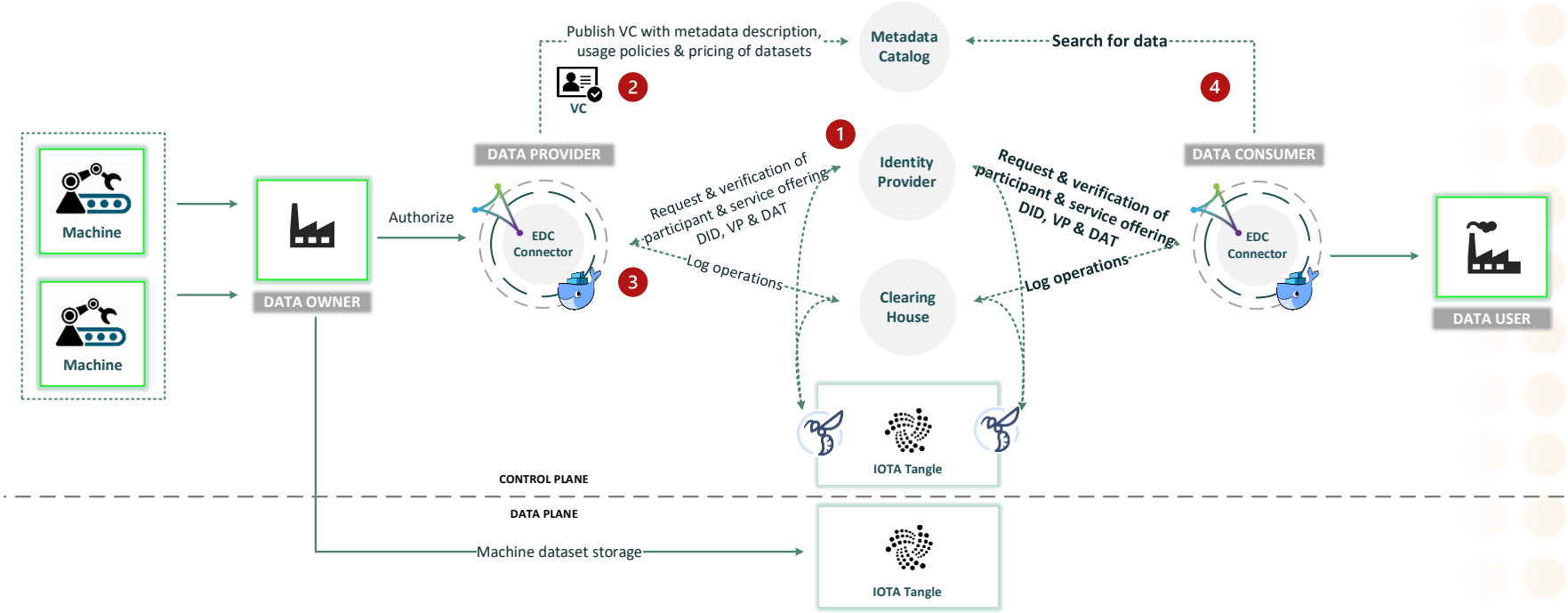
The system relies on logs managed by the **Clearing House**, stored on IOTA Tangle.



Status:

Proposed Solution

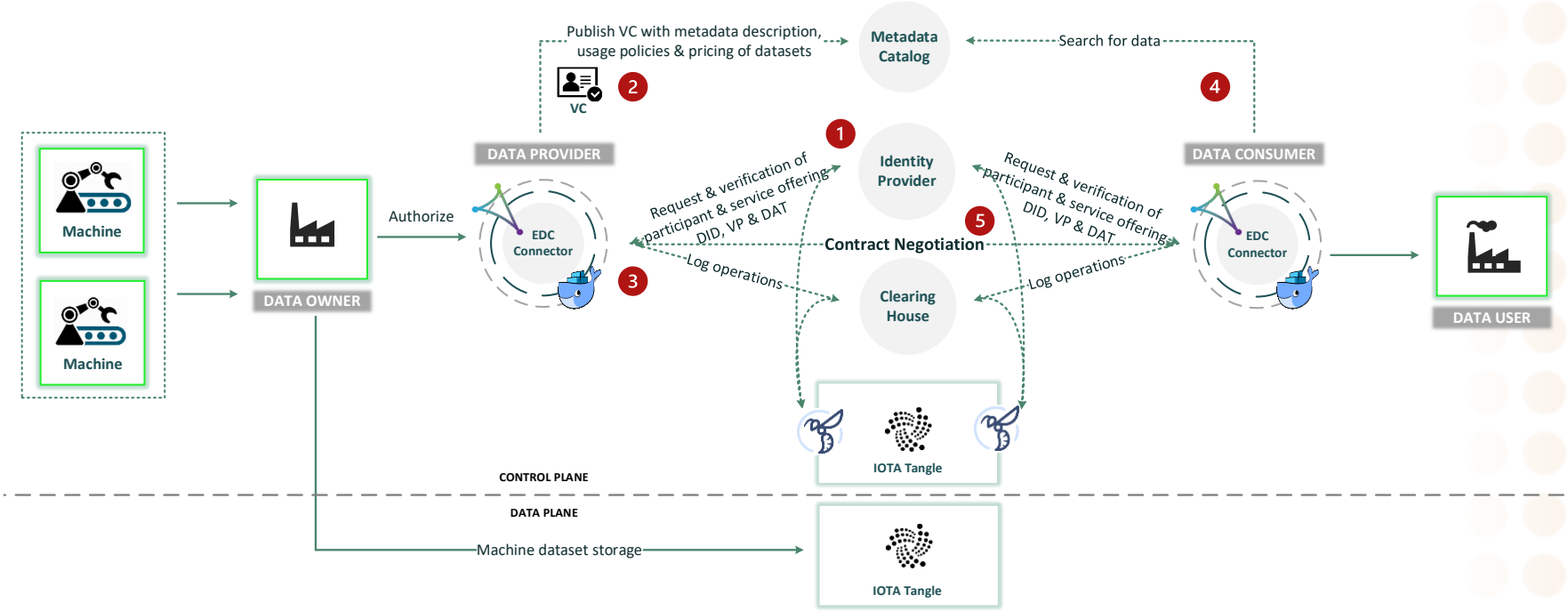
Participants query the **Metadata Catalog** after being authenticated in the data space.



Status:

Proposed Solution

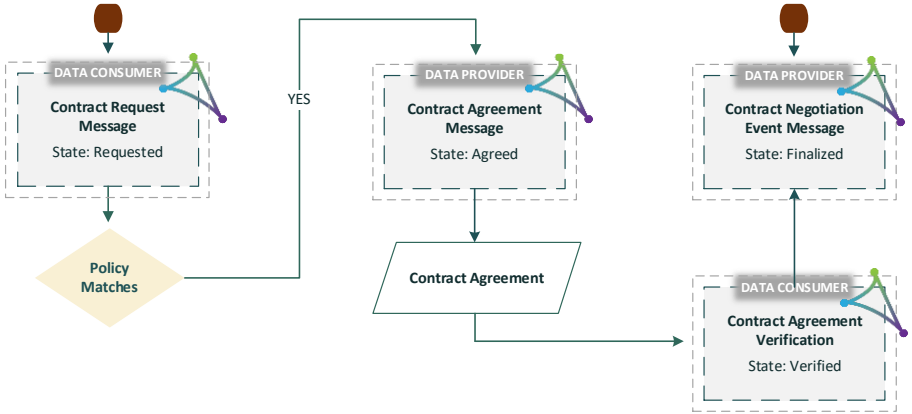
Contract Negotiation: negotiating contract terms between consumers and providers.



Status:

Proposed Solution

Contract Negotiation: proposed workflow for the negotiation process of usage policies with defined thresholds, based on the Dataspace Protocol [1].



[1] "Dataspace Protocol Specification v.2024-1", International Data Spaces Association, 2024.

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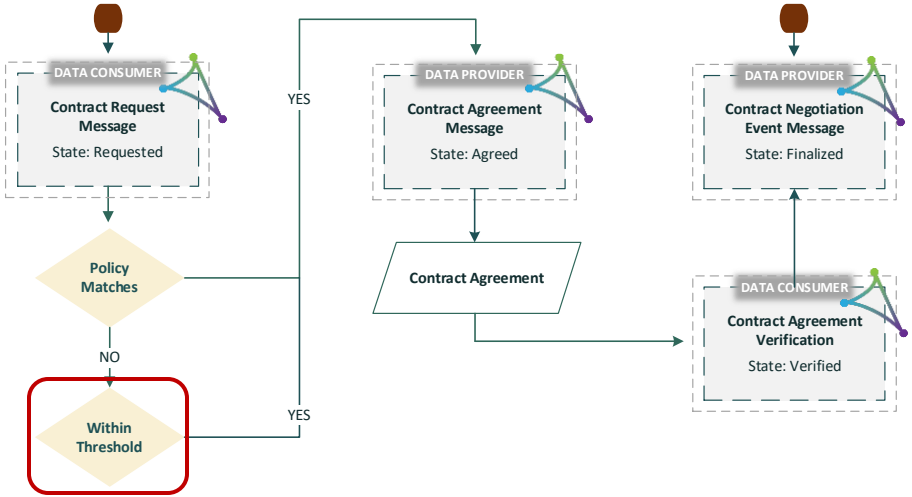

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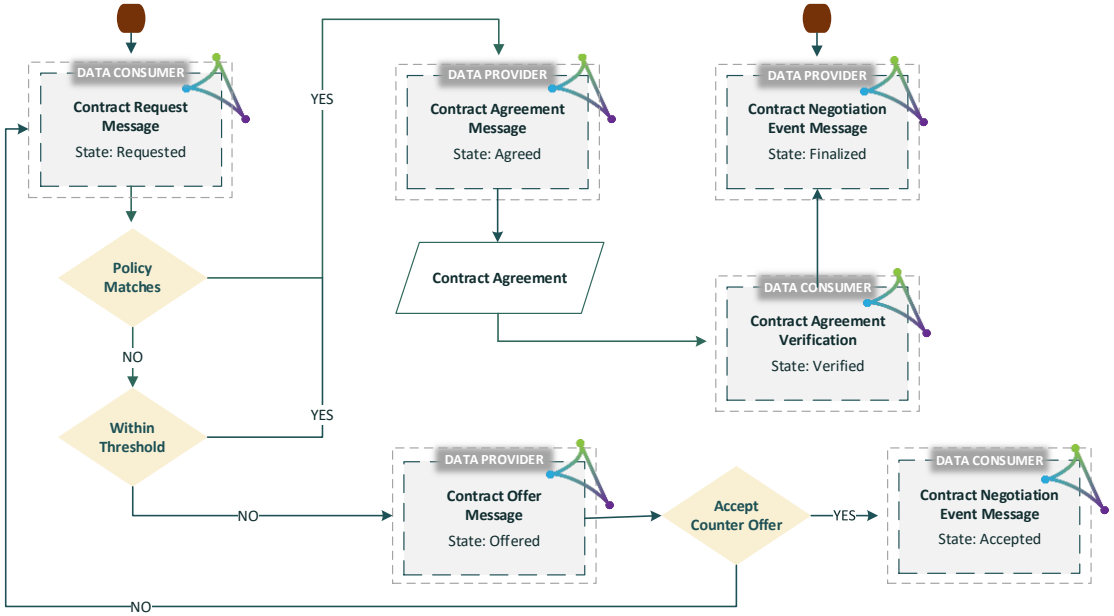

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Status:

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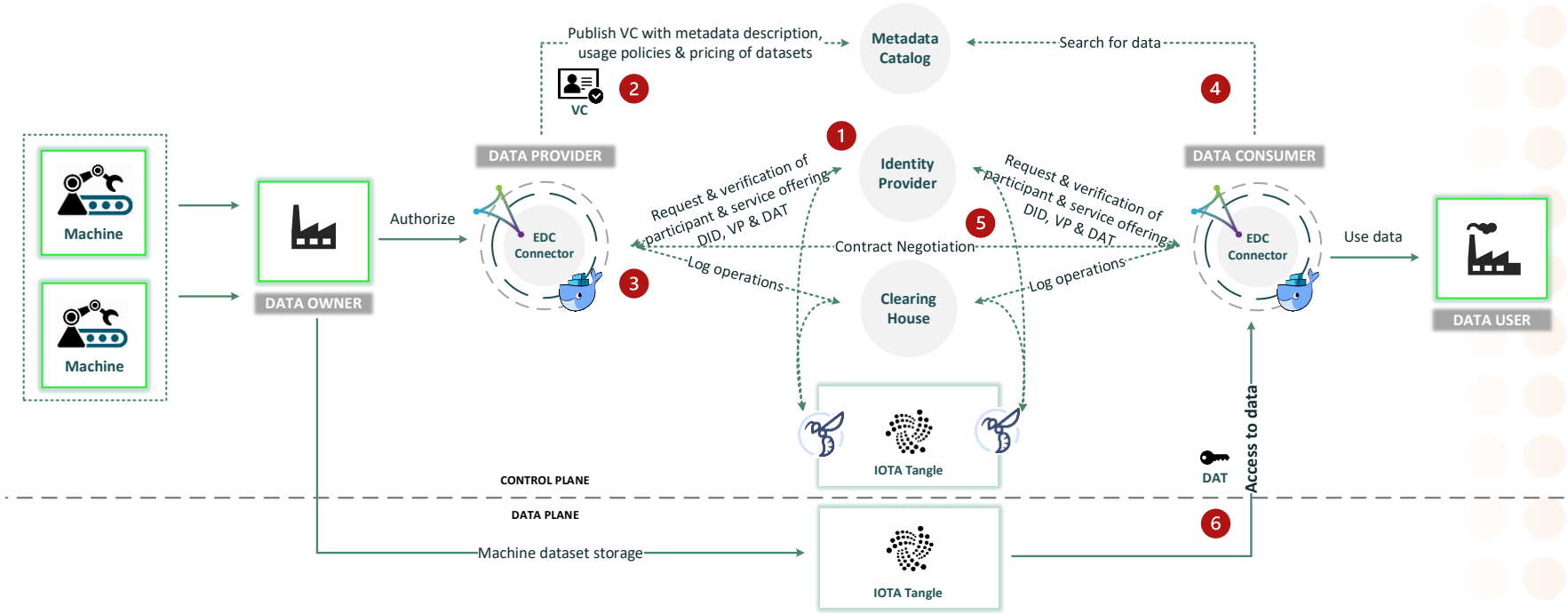
Data Exchange: provide access to offered data, using IOTA Tangle as storage system.



Status:

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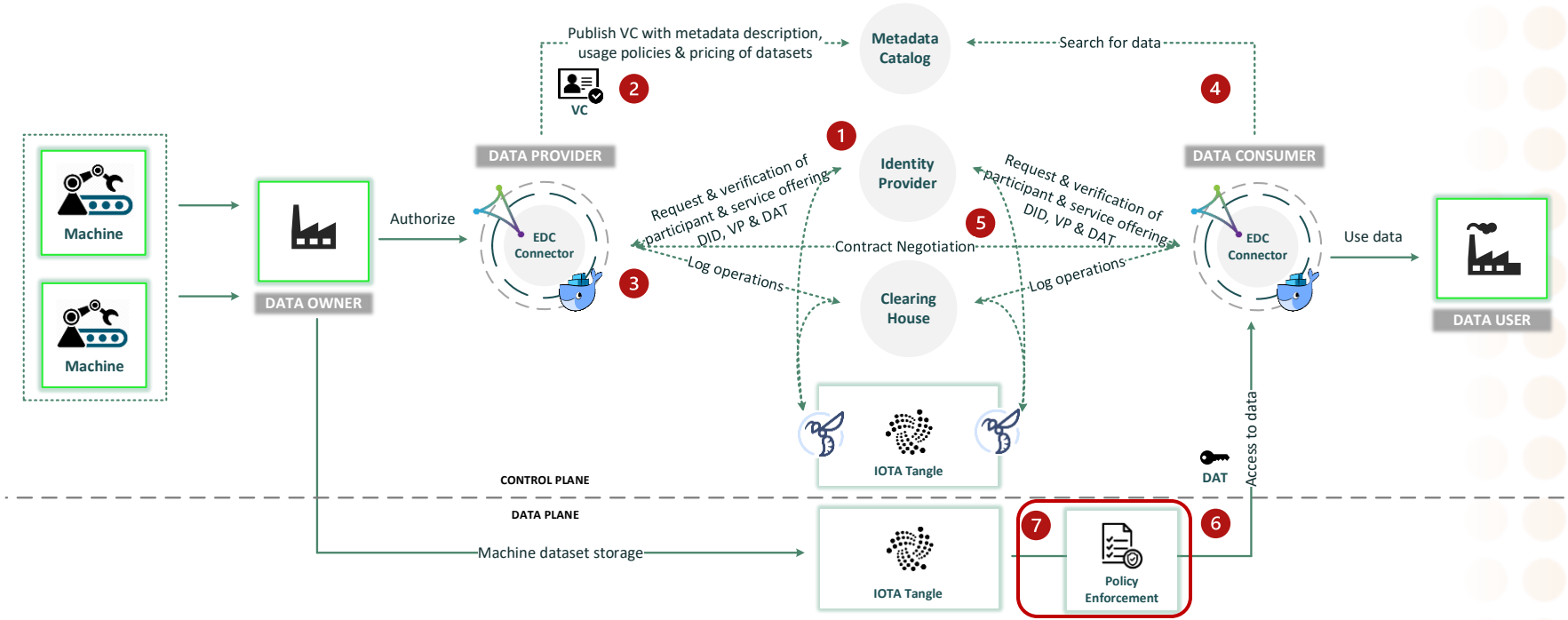
Policy Enforcement: technical enforcement of policies, according to contract agreement.



Implementation

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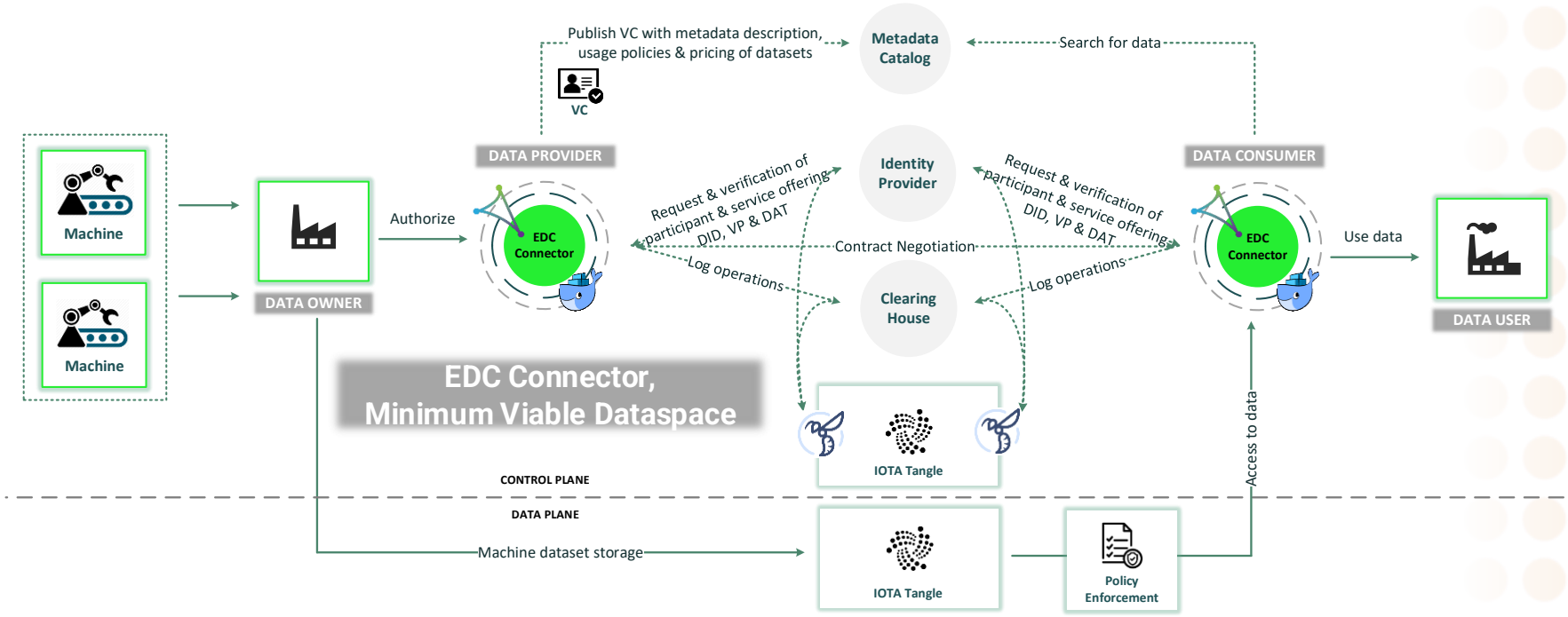

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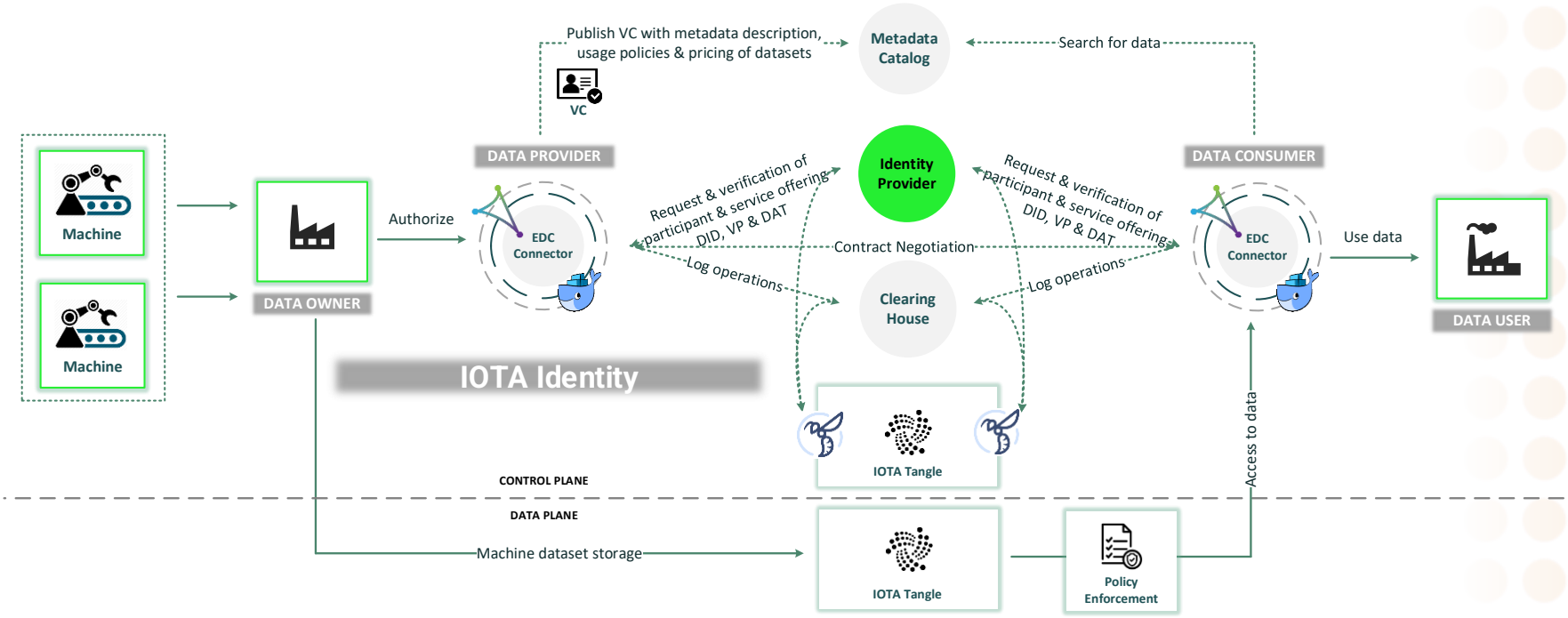

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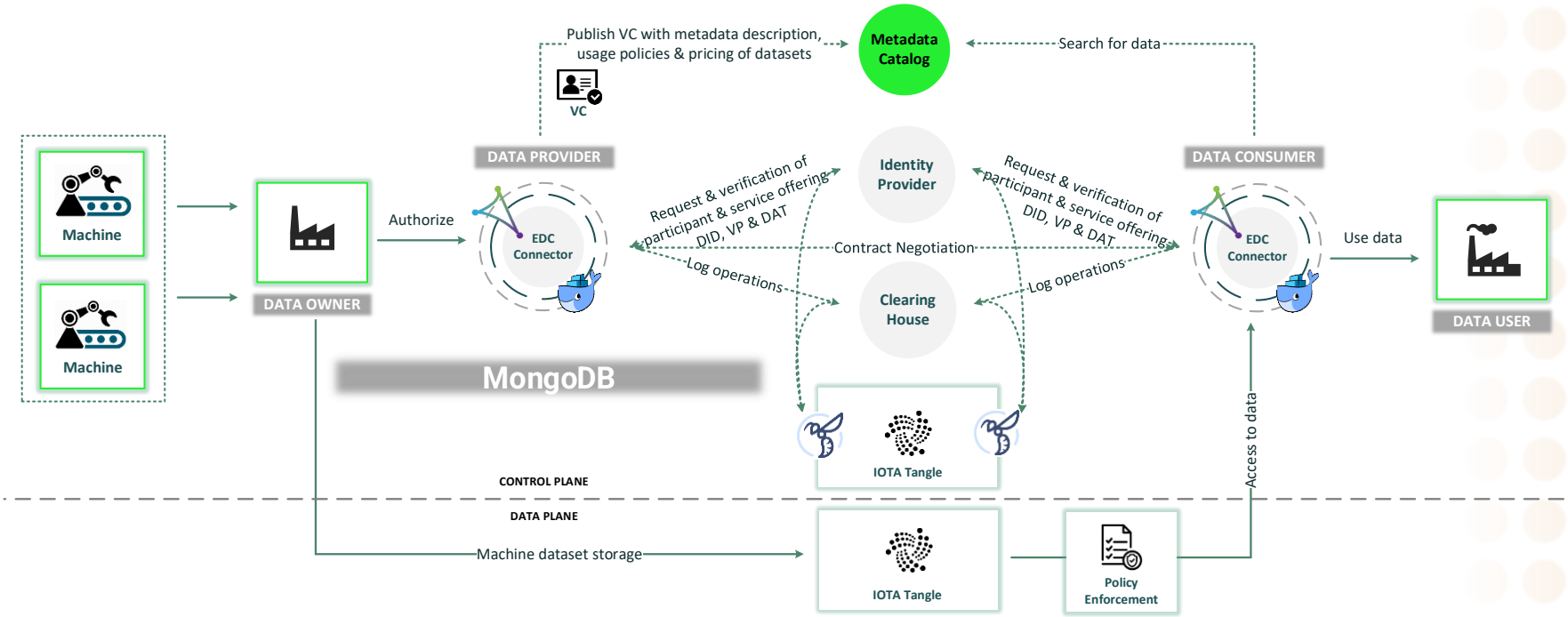

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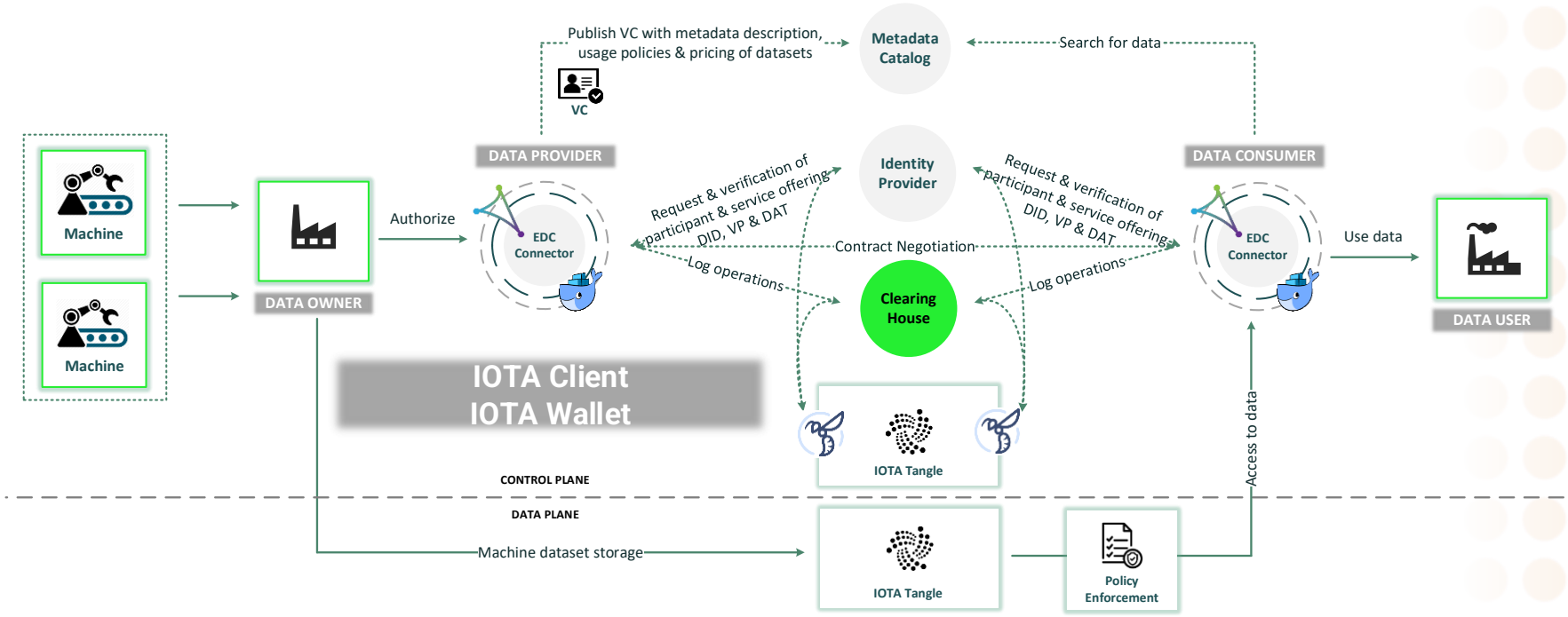

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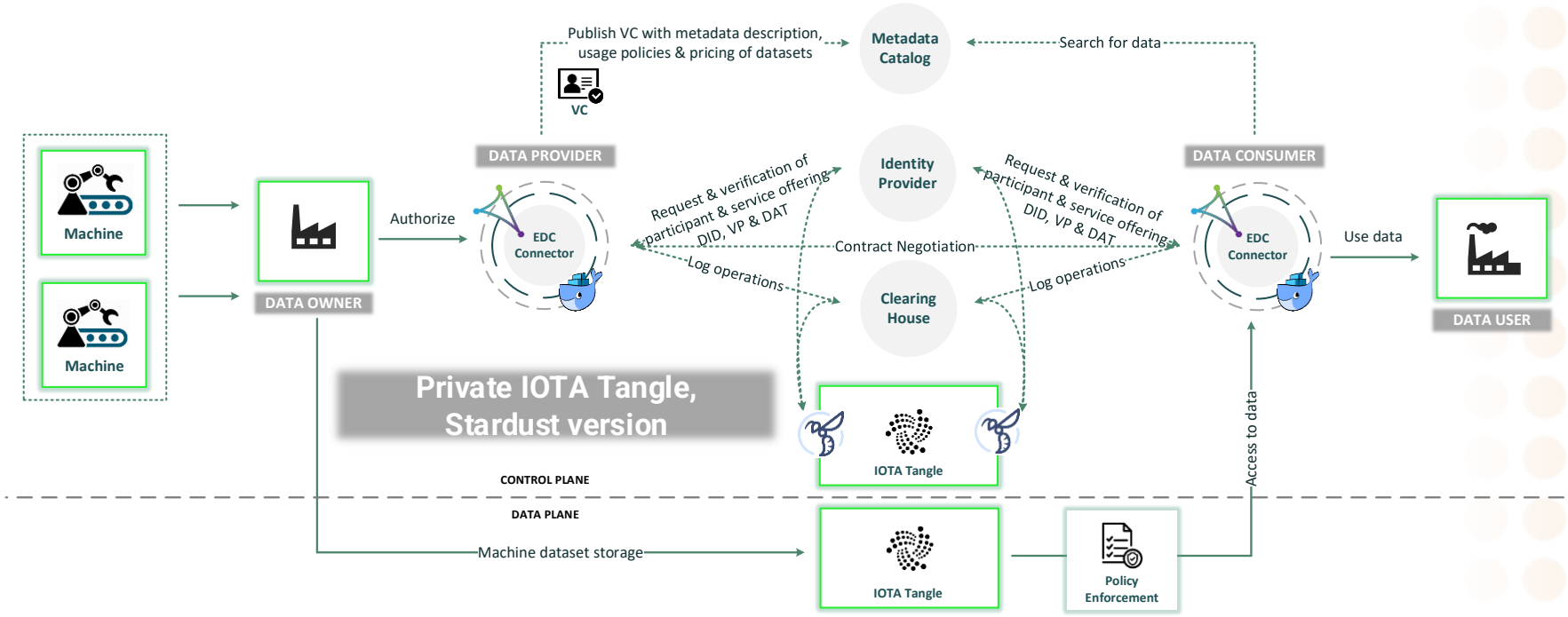

Conclusions & Future Work

Integration of IDS RAM conceptual framework with IOTA to enhance IIoT data spaces.

Conclusion

Unlike traditional theoretical blockchain-focused studies, this work leverages IOTA's DAG structure to implement core IDS components:

- **Identity Provider**
- **Metadata Catalog**
- **Clearing House**

Advancement in secure, sovereign, interoperable, and efficient data management, exchange and exploitation with external entities, enabling **data economy** within IIoT ecosystems.

Future Work

1. Implement and automate **contract negotiation**.
2. Integration of **policy enforcement** tools.
3. Enhance interoperability by the integration of:
    - **Vocabulary Provider**
    - **Data App Provider**

Thank you

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