

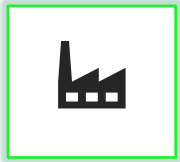
# Data Spaces Connection IOTA Tangle Integration.

*Workshop on Digital ID management and data governance through emerging edge computing and DLT solutions, February 2025*

**Anhelina Kovach**

# Introduction.

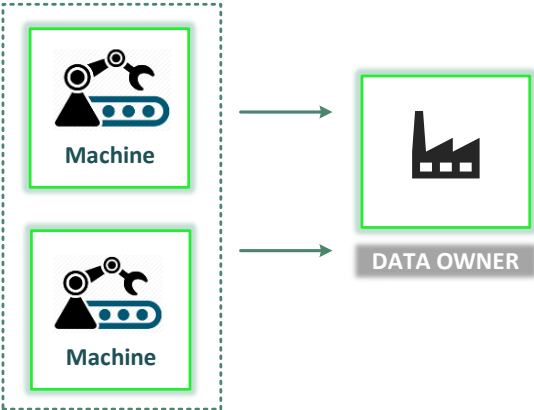
Context: Industrial IoT & Data Lifecycle.



DATA OWNER

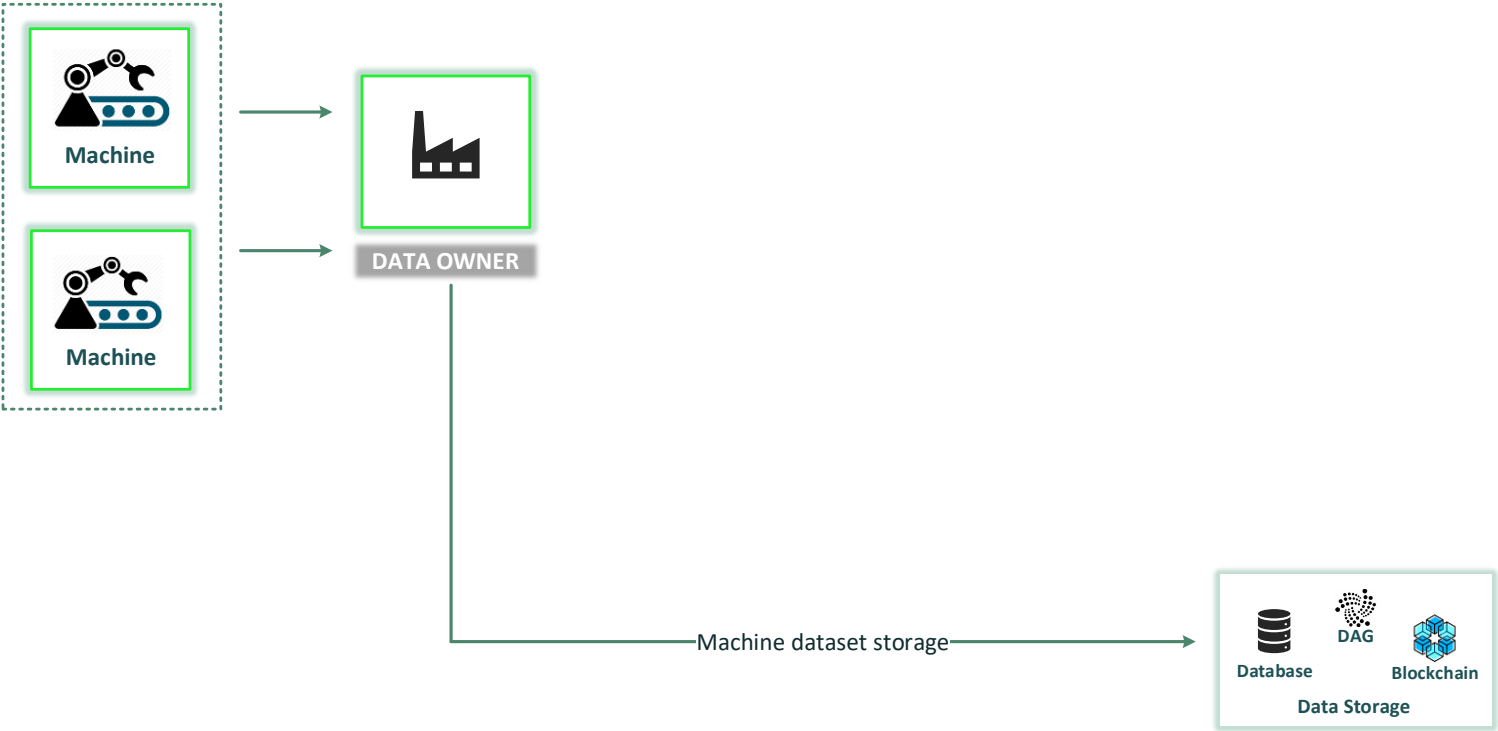
# Introduction.

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



# Introduction.

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

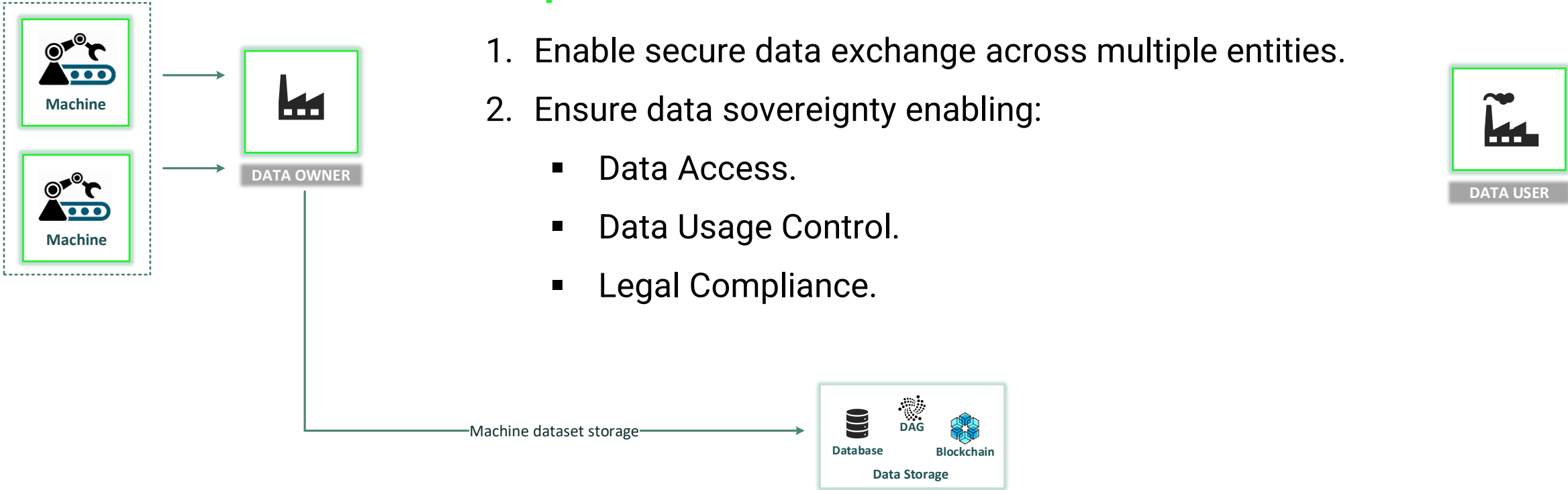


# Introduction.

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

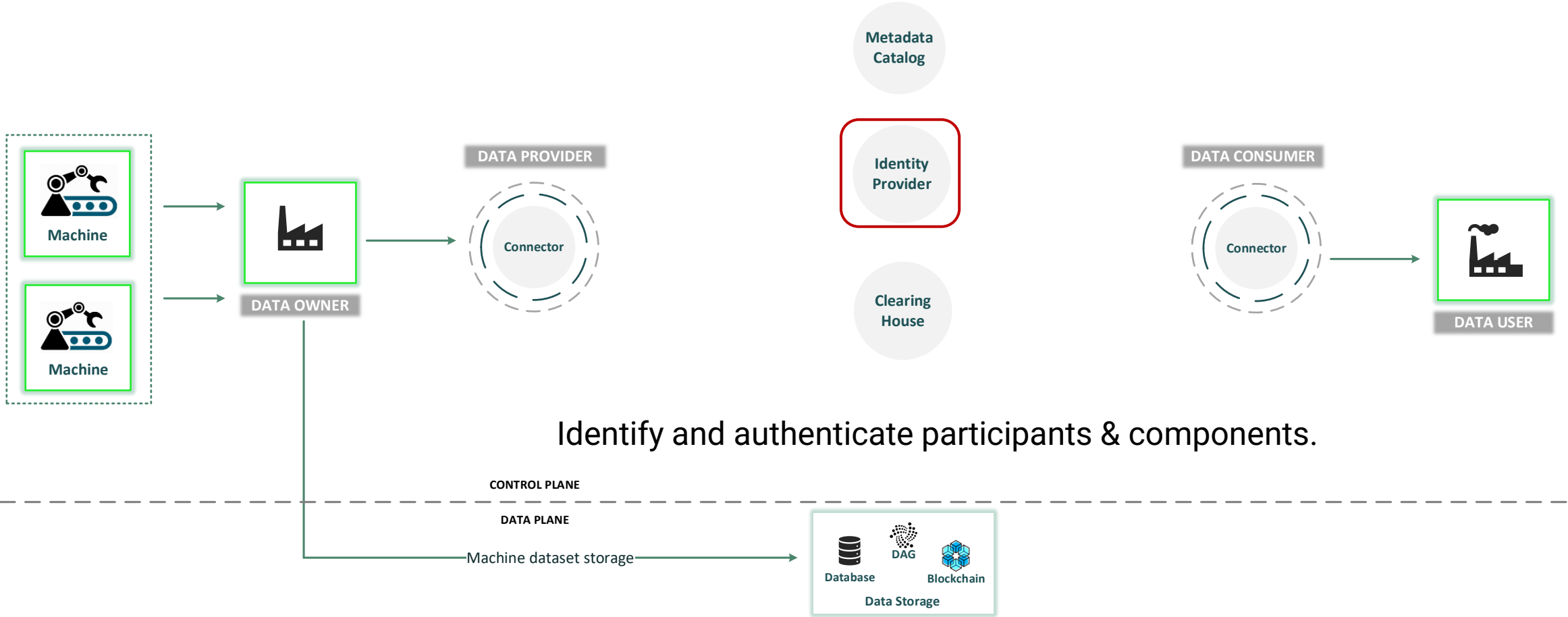
## Requirements

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



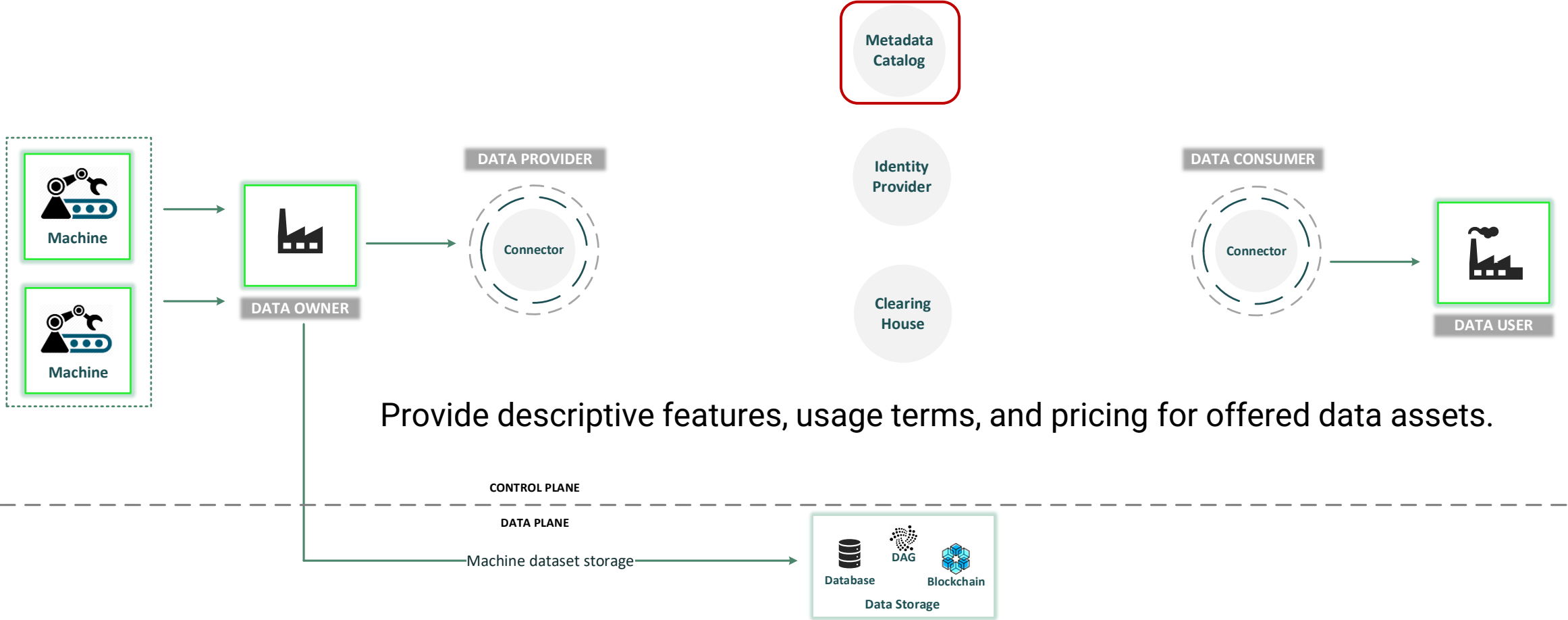
# Introduction.

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



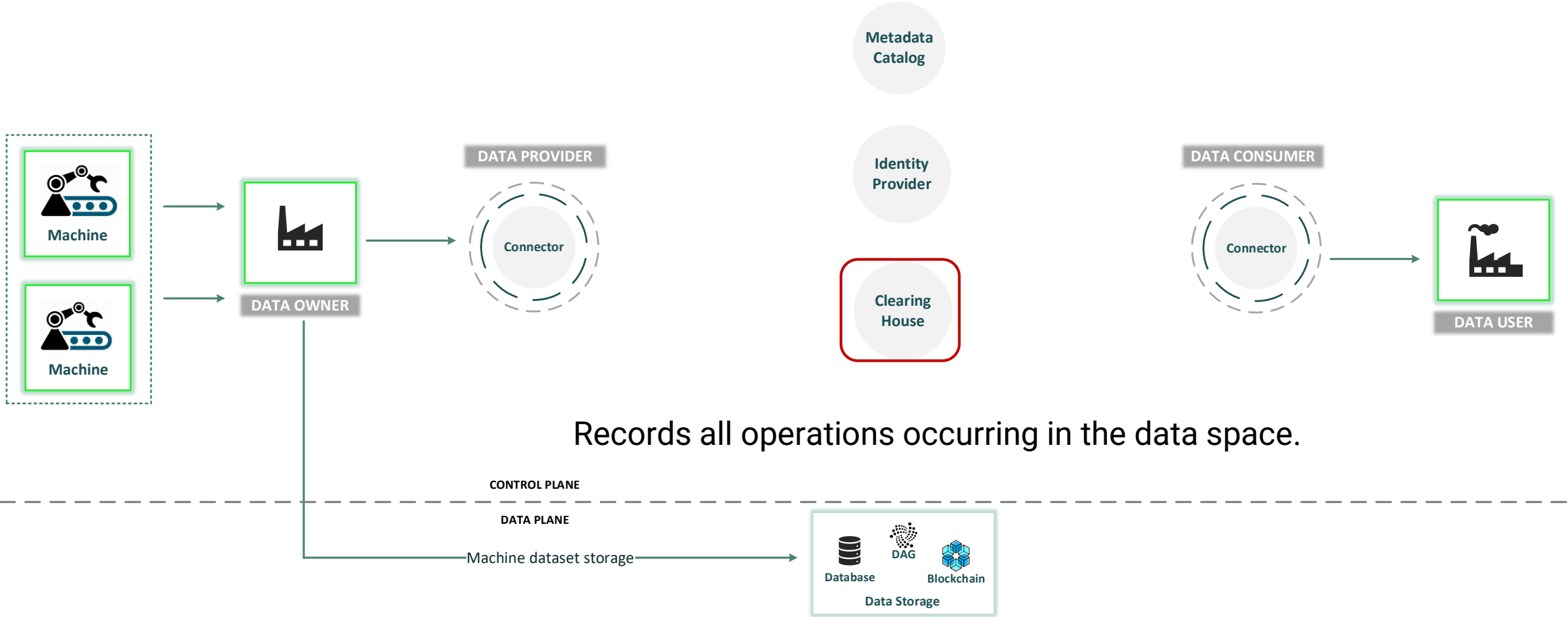
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Records all operations occurring in the data space.

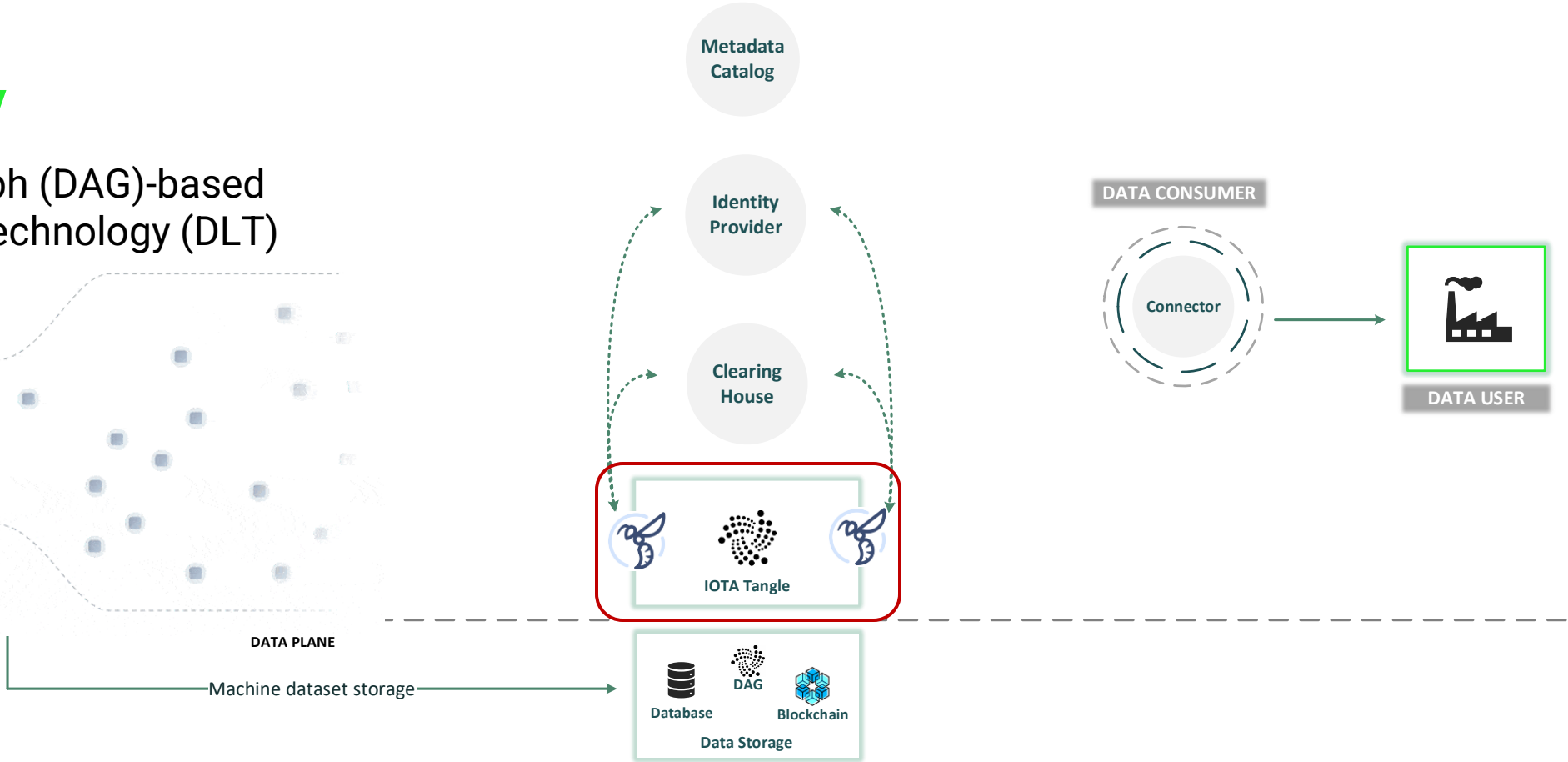
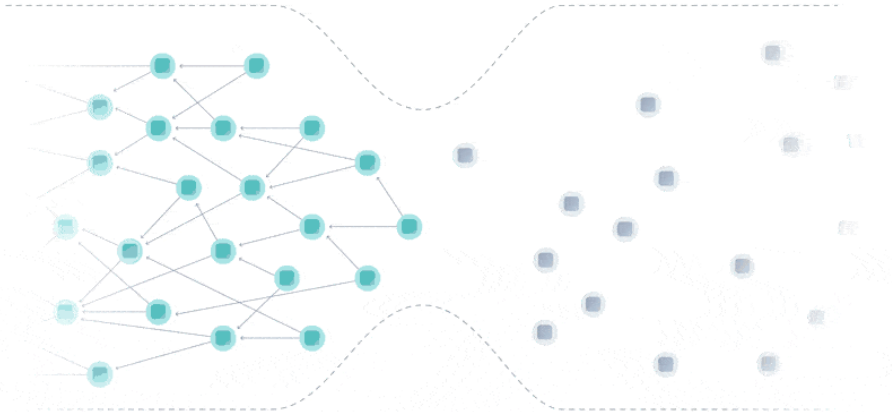


# Introduction.

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

## IOTA Technology

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



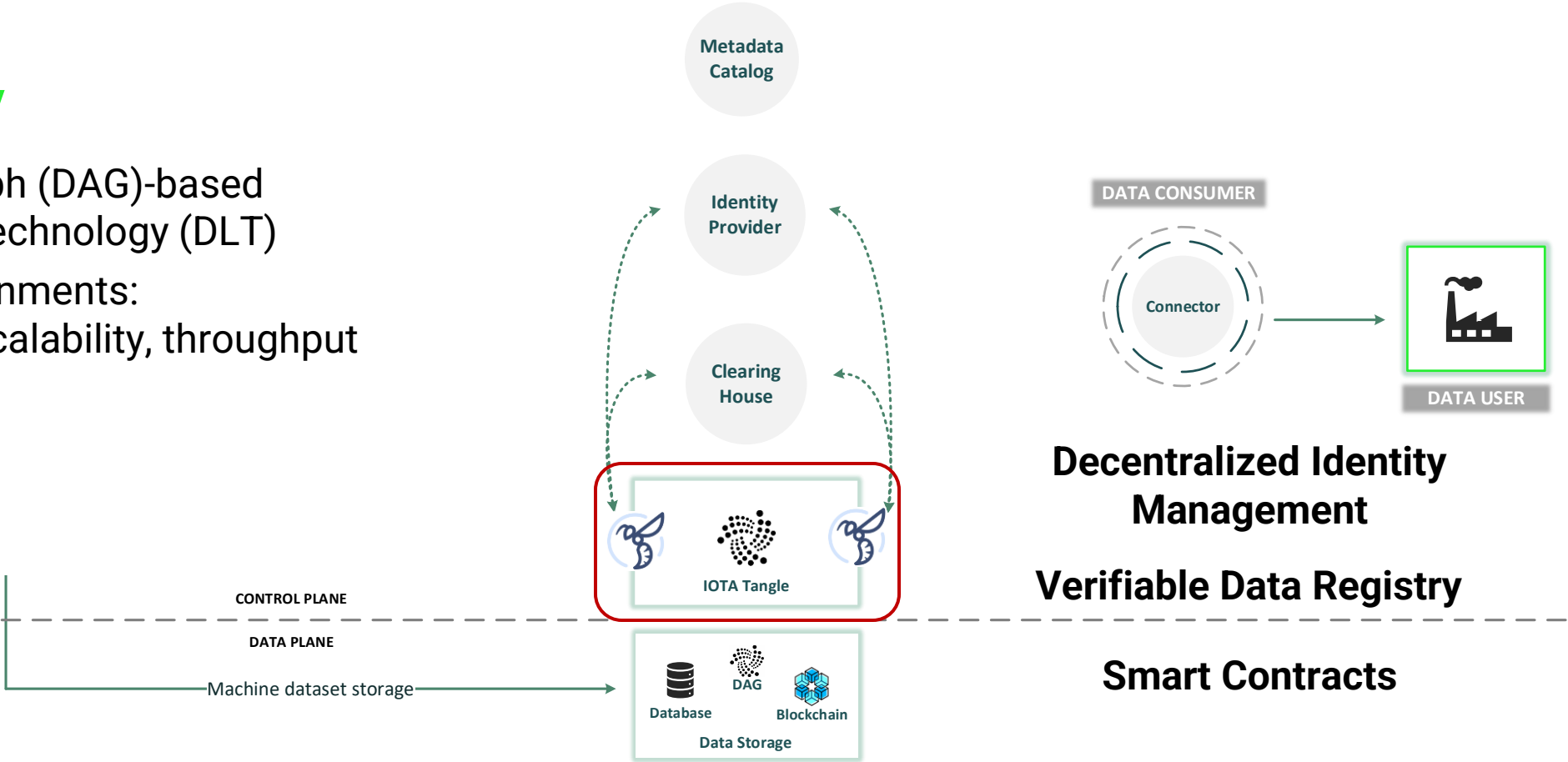
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## IOTA Technology

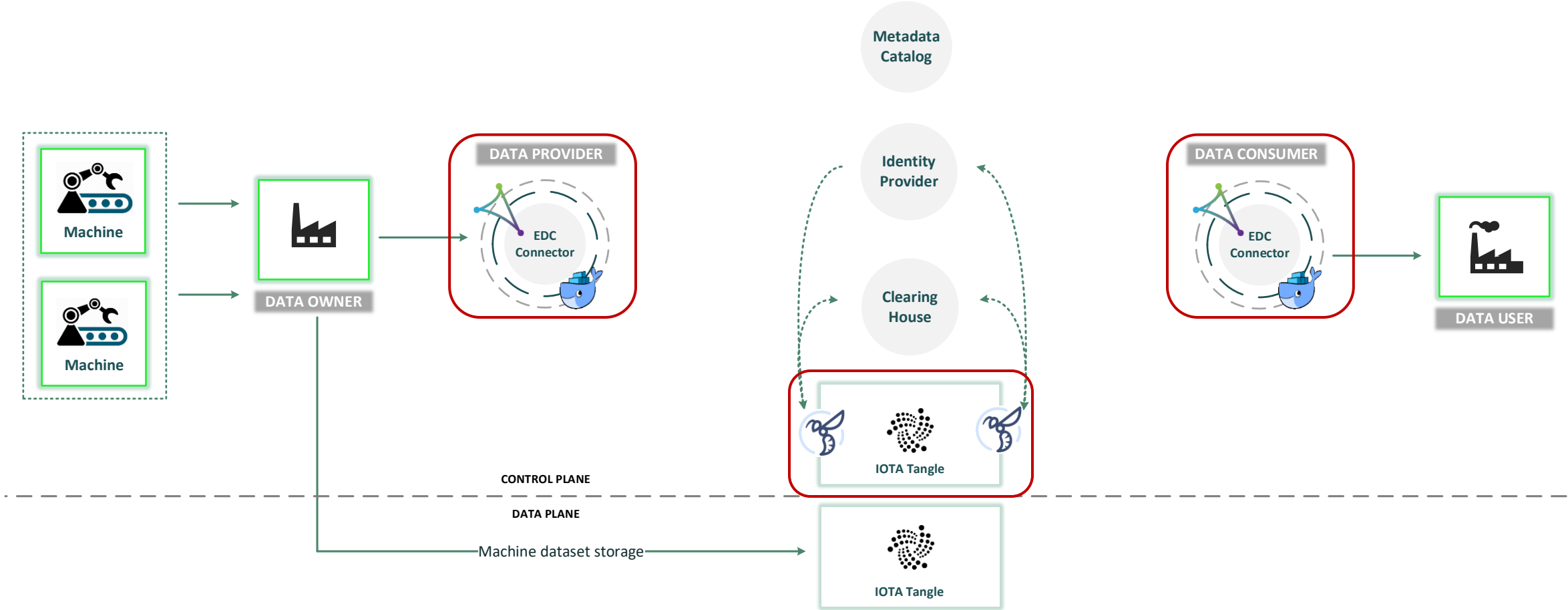
Directed Acyclic Graph (DAG)-based Distributed Ledger Technology (DLT)  
Suited for IIoT environments:  
microtransactions, scalability, throughput

- 1. Data Immutability
- 2. Data Traceability
- 3. Data Provenance



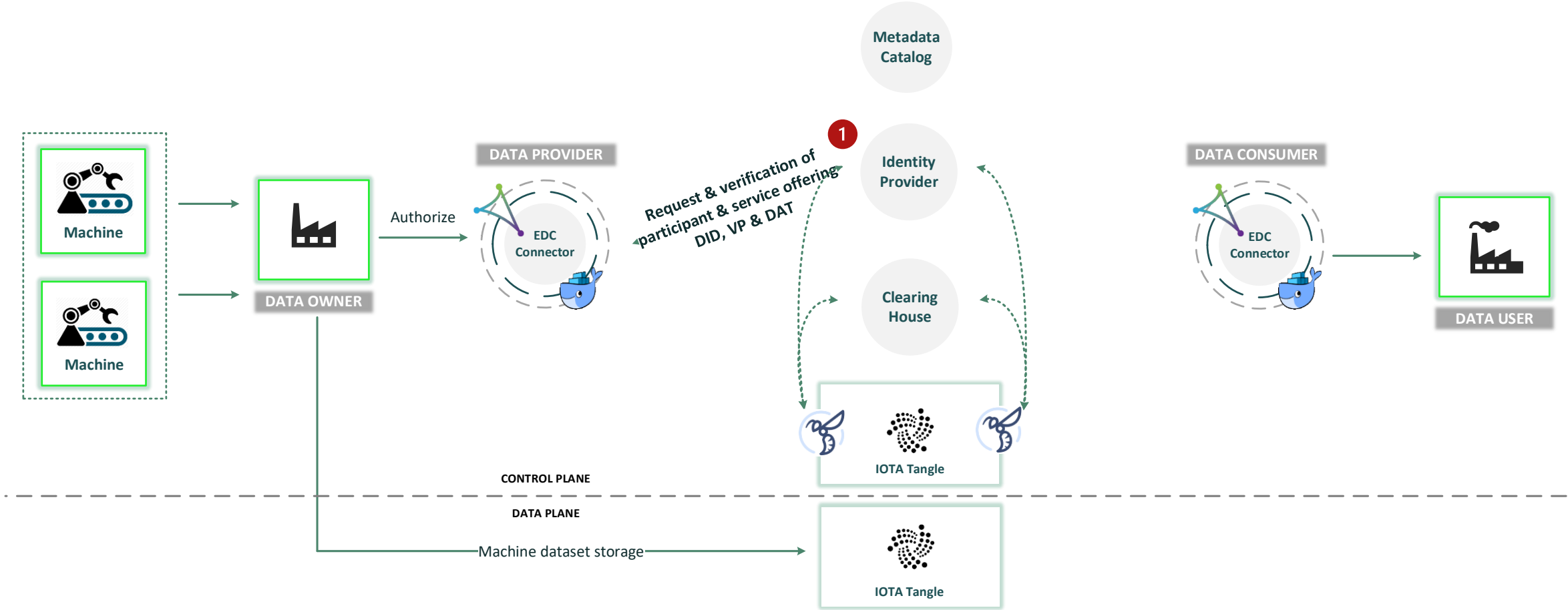
# Proposed Solution.

Integration of IDS core conceptual components with IOTA framework.



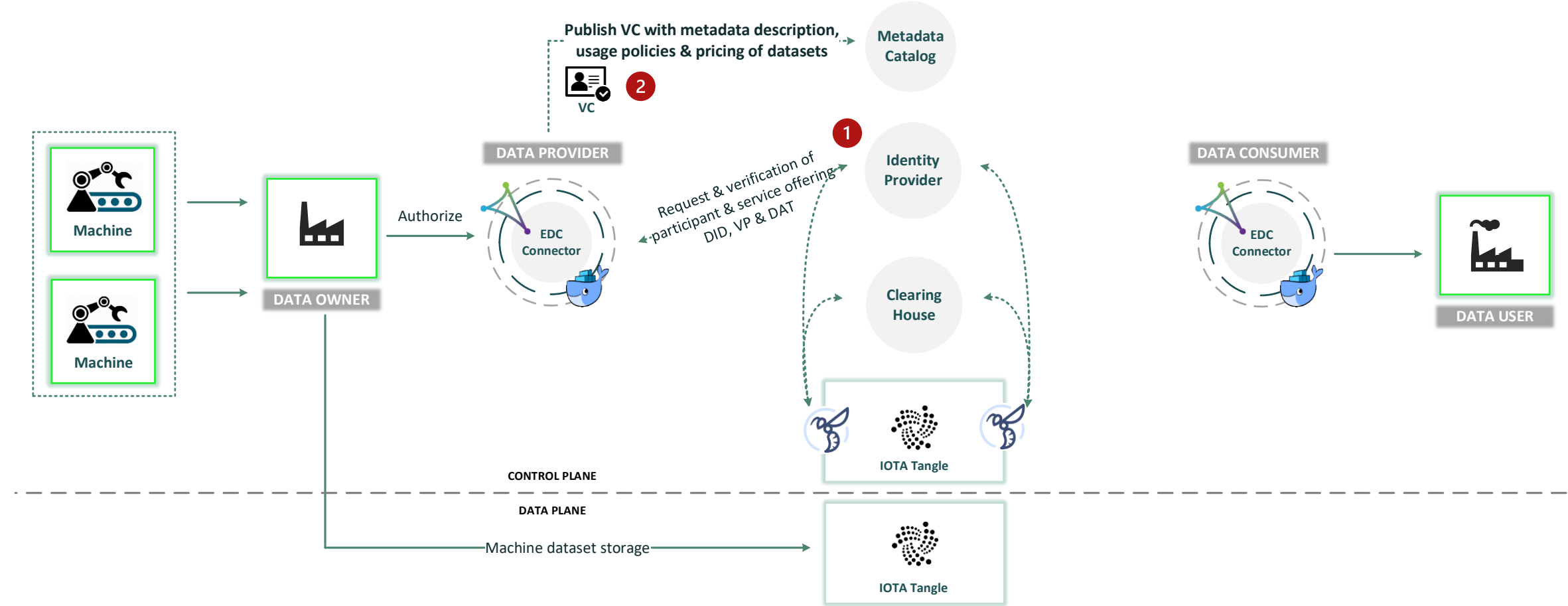
# Proposed Solution.

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



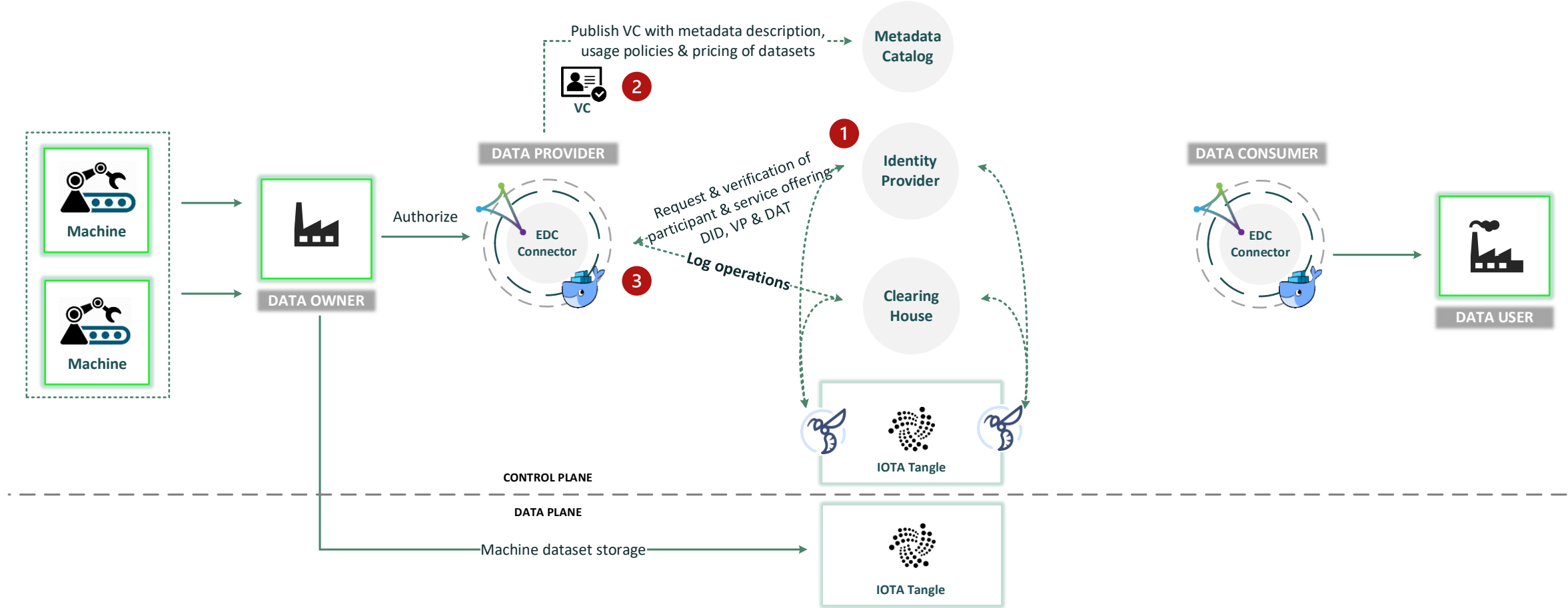
# Proposed Solution.

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



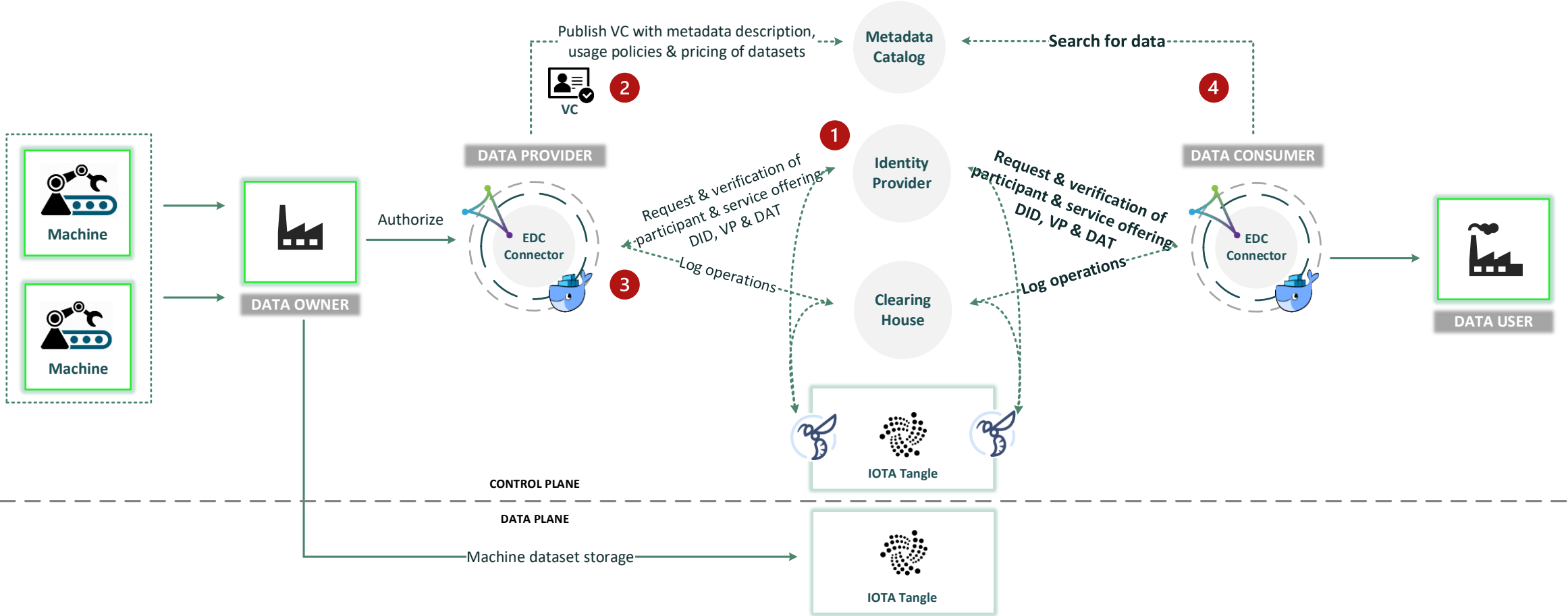
# Proposed Solution.

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



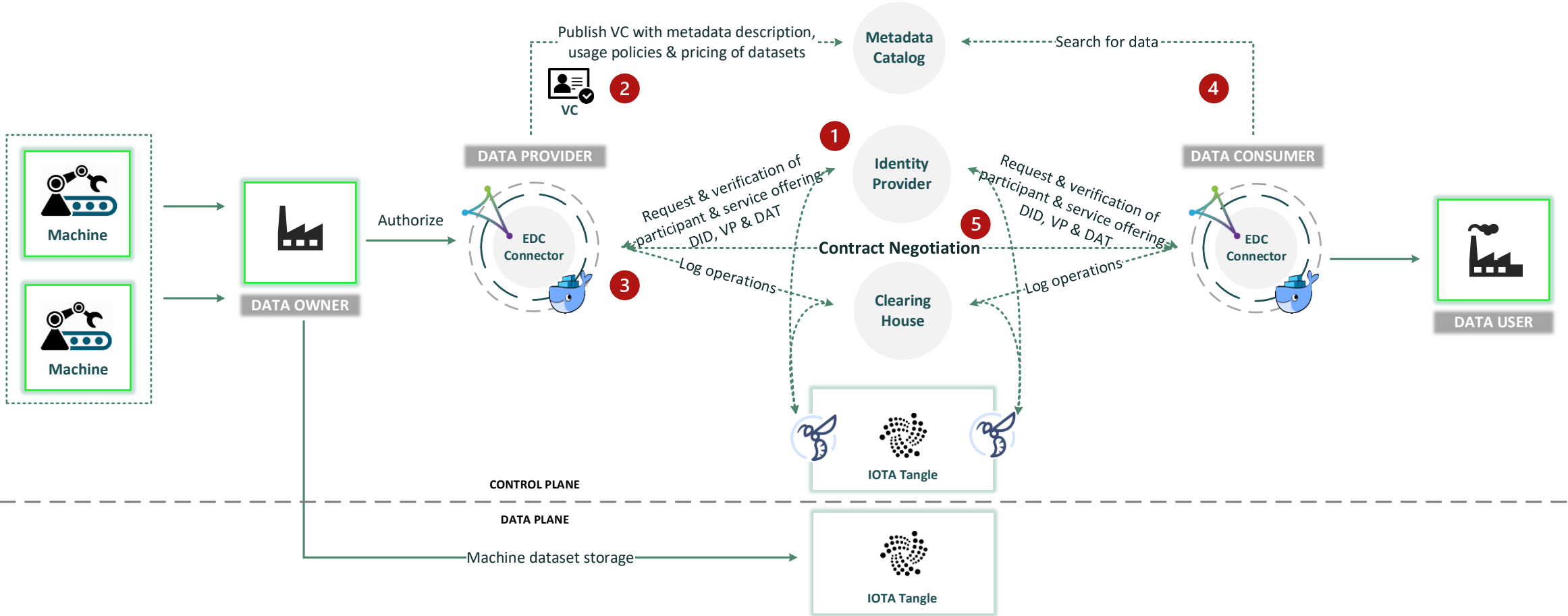
# Proposed Solution.

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



# Proposed Solution.

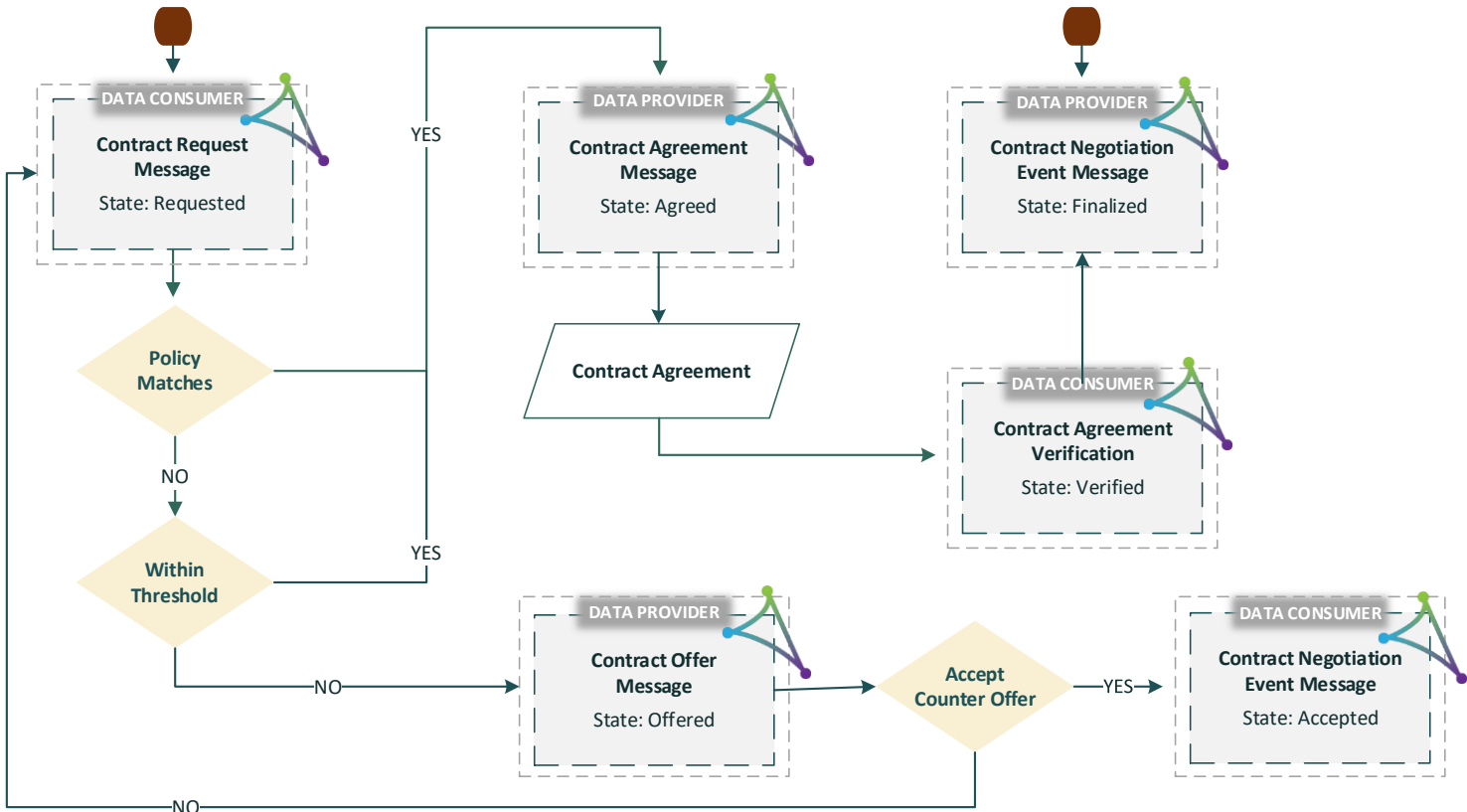
**Contract Negotiation:** negotiating contract Terms between consumers and providers.





# Proposed Solution.

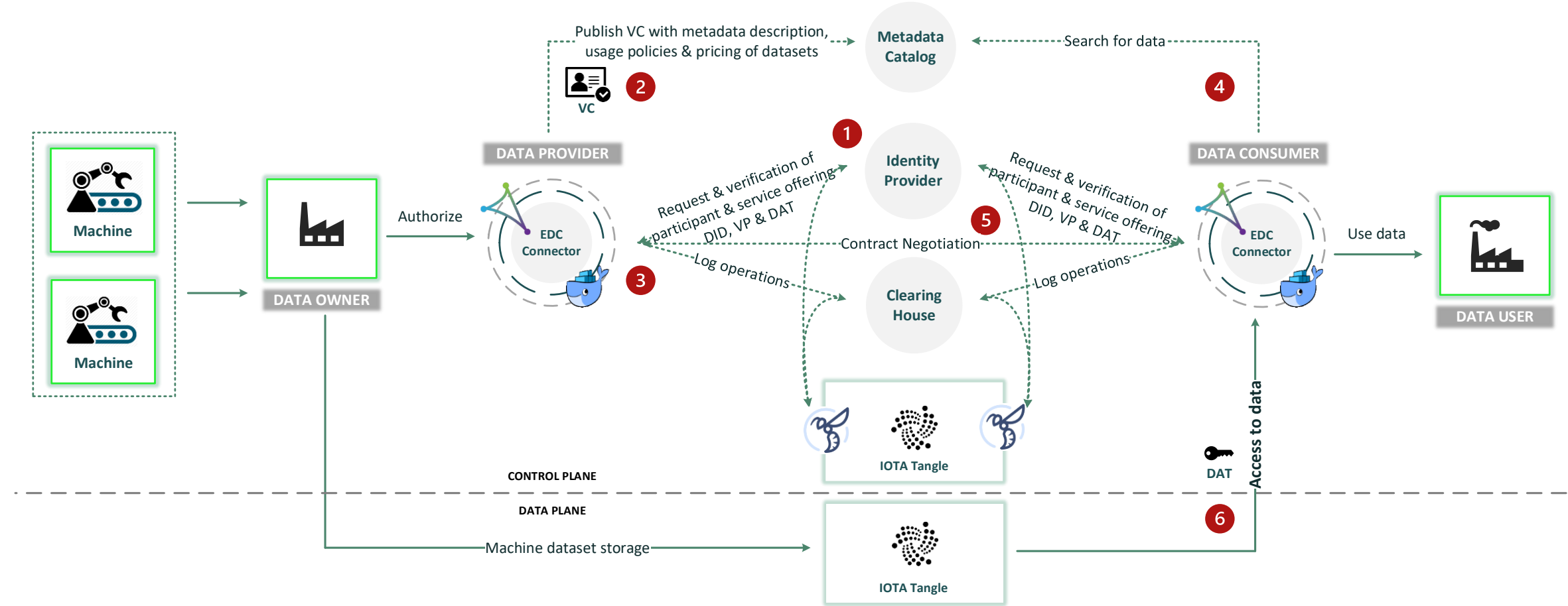
**Contract Negotiation:** proposed workflow for the negotiation process of usage policies with defined thresholds, based on the Dataspace Protocol (DSP) [1].



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

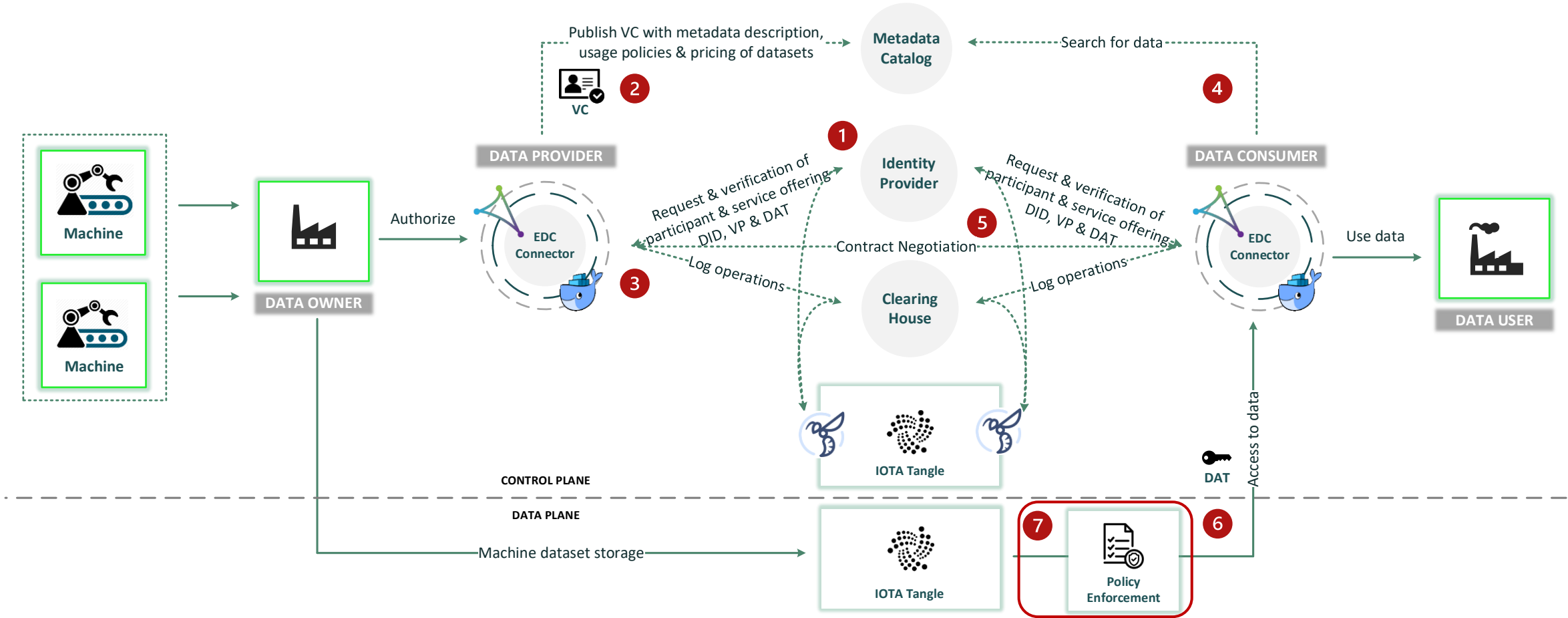
# Proposed Solution.

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



# Proposed Solution.

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



# Conclusions.

IOTA DAG-based implementation of core IDS components.

## Conclusion Remarks

Integration of DLTs in data spaces architecture:

- **Identity Provider**  
Decentralized identity management (Self-Sovereign Identity).
- **Metadata Catalog**  
Registry of connectors and data offerings with descriptive metadata (Verifiable Credentials).
- **Clearing House**  
Monitoring, transaction states, and policy enforcement with immutable records.
- **Smart Contracts**  
Enables automated contract negotiation and compliance enforcement.
- **Wallets**  
Facilitates secure and automates payment processing within data spaces.



# Thank you



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