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Project EDGE Demonstrations Insight Forum

September 2021

Energy Web was launched to help energy market participants digitise their systems in order to accelerate decarbonisation

Energy Web at a glance:

- International nonprofit foundation

- MIssion: develop and deploy an open-source operating system in support of a low-carbon energy future

- Est. 2017, founded and spun out of Rocky Mountain Institute

- All EWF software free and open source

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EWF's primary customers are grid operators and energy market participants from around the world
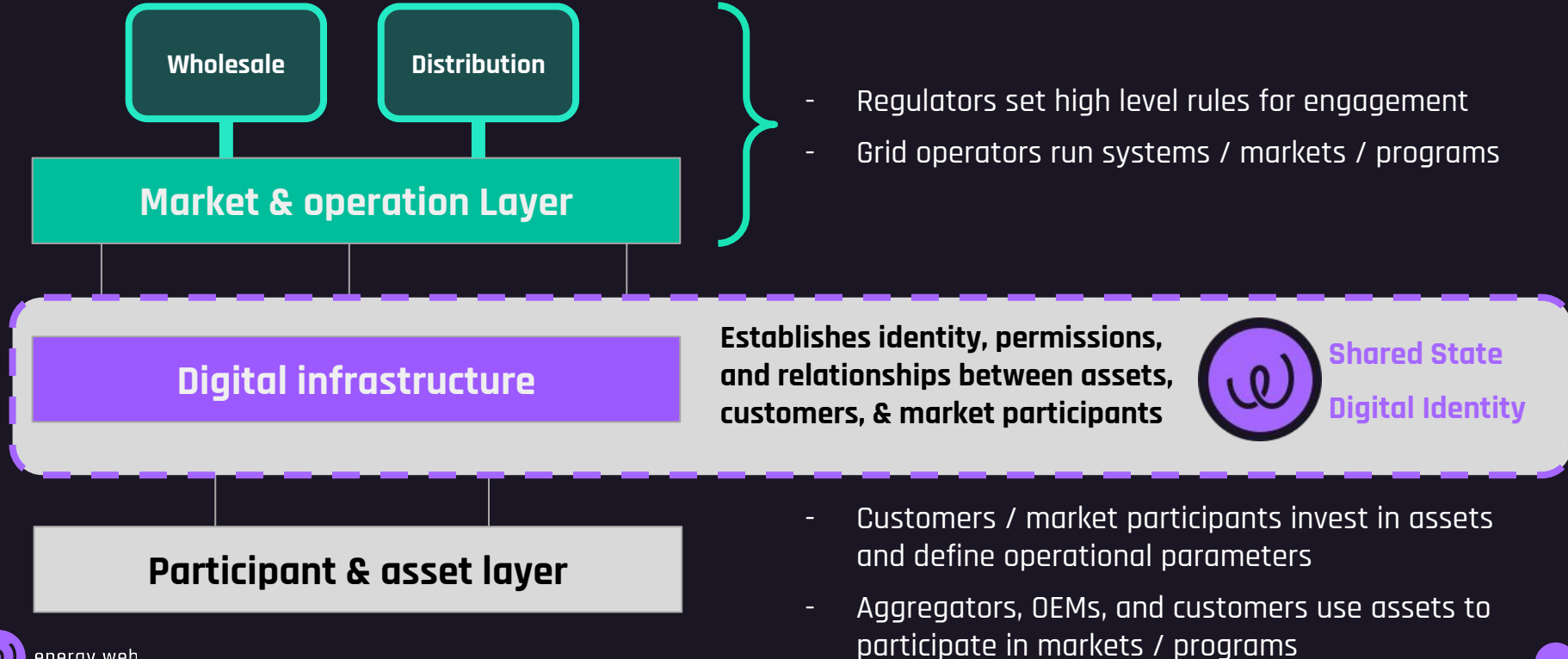
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The challenge: clean energy assets are not integrated with market participant operating systems. We solve that challenge with open source, digital infrastructure
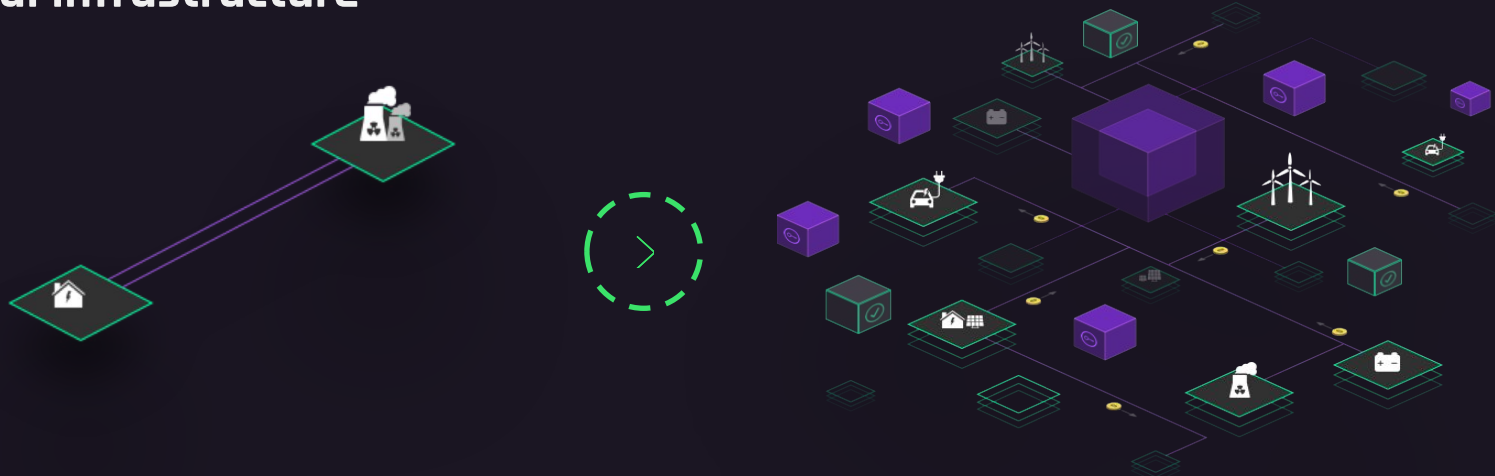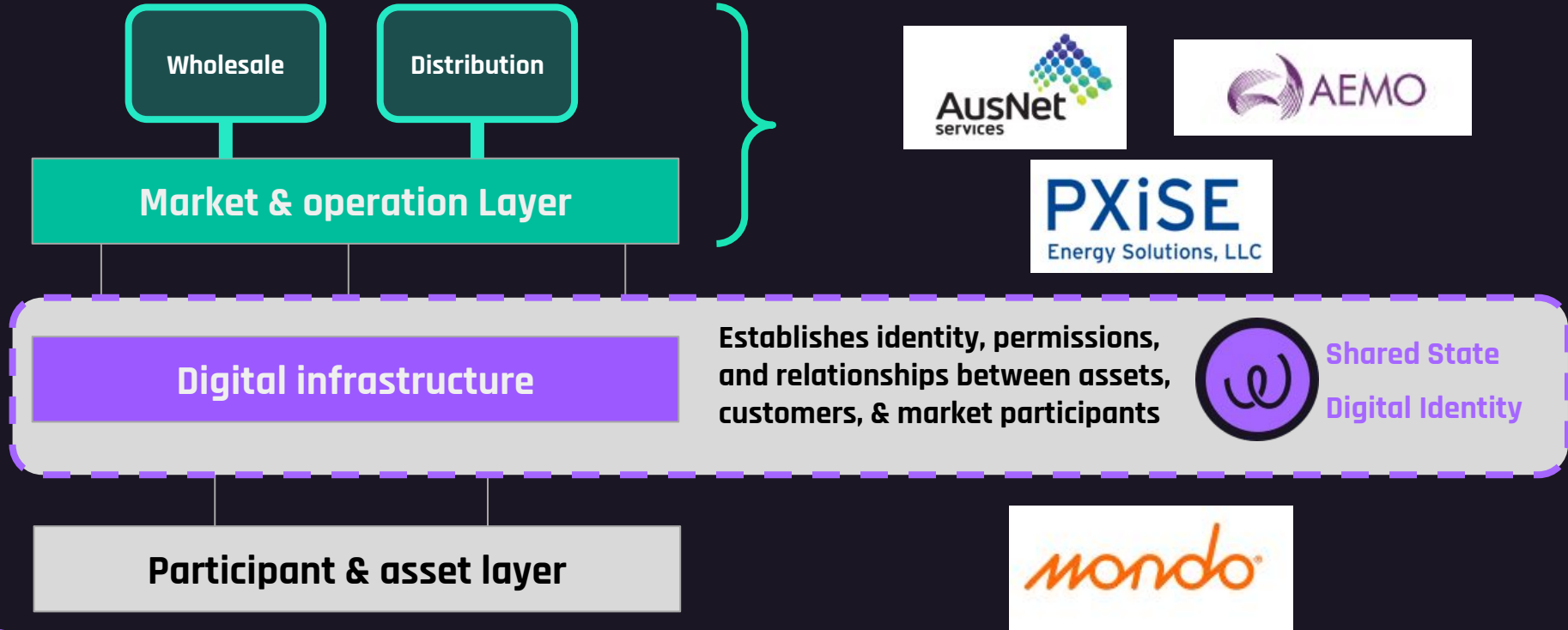

20th Century Model: centralized, top-down registration and operation of a small number of large fossil-fuel assets

Energy Web Model: enable any clean energy asset owned by any customer to participate in any energy market - a future where DER is at huge scale, billions of devices, hundreds (or more) of aggregators.
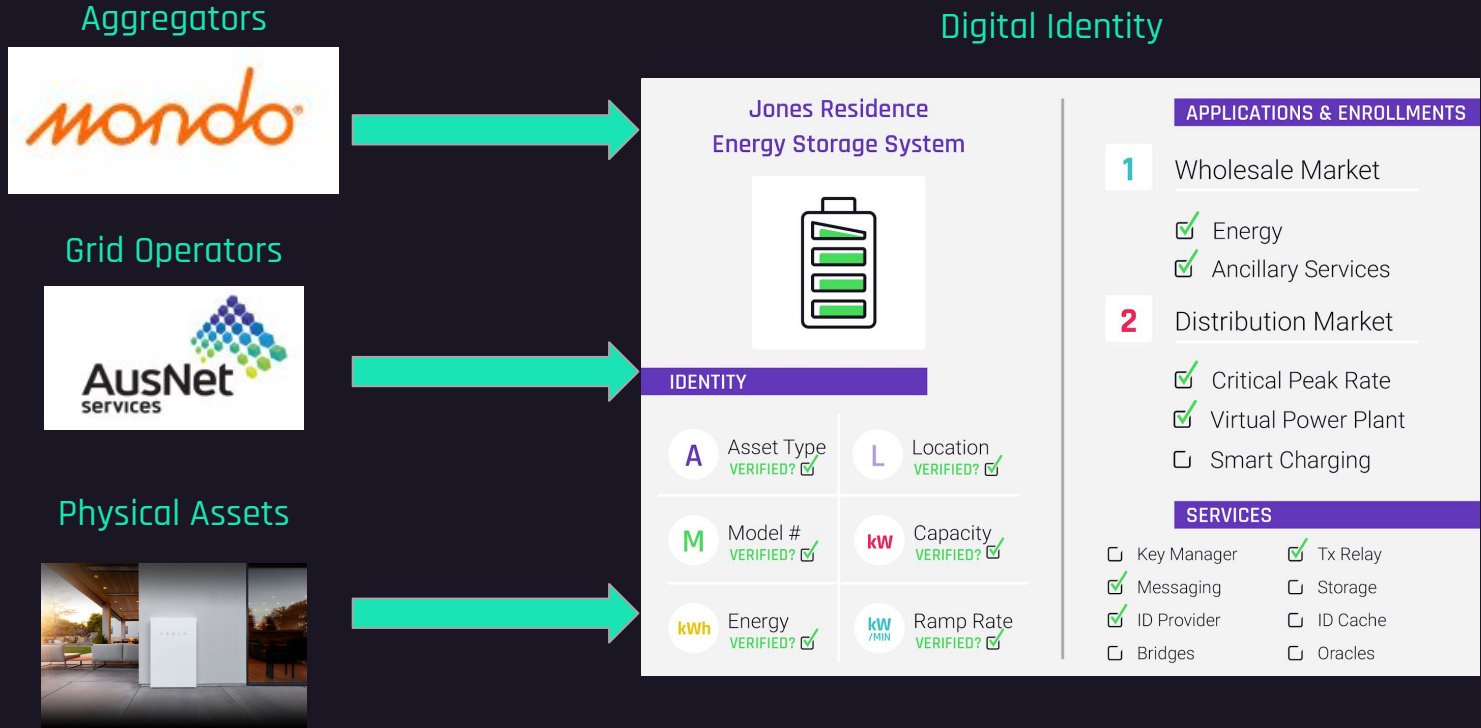
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Our open-source digital infrastructure helps assets, customers, and organizations integrate with grid / market operator systems

Wholesale

Distribution

Market & operation Layer

- Regulators set high level rules for engagement
- Grid operators run systems / markets / programs

Digital infrastructure

Establishes identity, permissions, and relationships between assets, customers, & market participants

Shared State
Digital Identity

Participant & asset layer

- Customers / market participants invest in assets and define operational parameters
- Aggregators, OEMs, and customers use assets to participate in markets / programs

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Our approach is focused on increasing grid operator trust in DER and reducing complexity for DNSPs and Aggregators

Wholesale

Distribution

Market & operation Layer

Digital infrastructure

Establishes identity, permissions, and relationships between assets, customers, & market participants

Shared State

Digital Identity

Participant & asset layer

AusNet services

AEMO

PXiSE Energy Solutions, LLC

mondo

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To do so, we use "digital identities" that form the basis of all data exchange and market processes

Aggregators

Grid Operators

Physical Assets

Digital Identity

Jones Residence
Energy Storage System

IDENTITY

A	Asset Type VERIFIED? ☑	L	Location VERIFIED? ☑
M	Model # VERIFIED? ☑	kW	Capacity VERIFIED? ☑
kWh	Energy VERIFIED? ☑	kW/MIN	Ramp Rate VERIFIED? ☑

APPLICATIONS & ENROLLMENTS

1 Wholesale Market

☑ Energy
☑ Ancillary Services

2 Distribution Market

☑ Critical Peak Rate
☑ Virtual Power Plant
☐ Smart Charging

SERVICES

☐ Key Manager	☑ Tx Relay
☑ Messaging	☐ Storage
☑ ID Provider	☐ ID Cache
☐ Bridges	☐ Oracles

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Digital identities are constructed using a new technology called "decentralized identifiers" (DID)

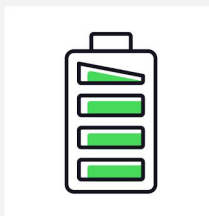A DID is a persistent, tamper-proof identity.

Each DID acts as a "portfolio" of information about a given customer, asset, or market participant.

This portfolio can hold technical, locational, relational, and/or historical information.

Each item of information is verified by other actors via cryptographic claims and proofs.

This creates certainty that portfolio contents are accurate.

Jones Residence
Energy Storage System

IDENTITY

|			
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M	Model # VERIFIED? ☑	**kW**	Capacity VERIFIED? ☑
kWh	Energy VERIFIED? ☑	**kW /MIN**	Ramp Rate VERIFIED? ☑

APPLICATIONS & ENROLLMENTS

1 Wholesale Market
- ☑ Energy
- ☑ Ancillary Services

2 Distribution Market
- ☑ Critical Peak Rate
- ☑ Virtual Power Plant
- ☐ Smart Charging

SERVICES

- ☐ Key Manager
- ☑ Messaging
- ☑ ID Provider
- ☐ Bridges
- ☑ Tx Relay
- ☐ Storage
- ☐ ID Cache
- ☐ Oracles

DIDs are permissioned to enroll to multiple systems / markets / programs. Single sign-on for energy is a useful analogy.
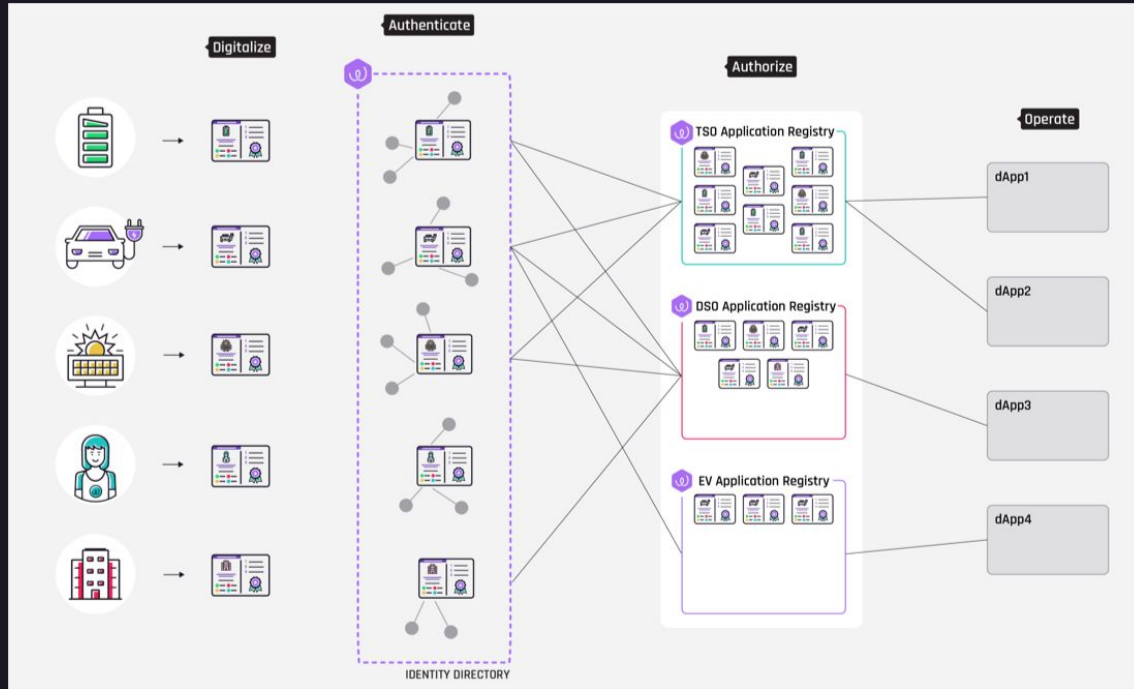
The EDGE Project has several objectives

- **Wholesale DER Integration**
  - 1. DER participation in wholesale markets at scale
  - 2. Distribution network limits in dispatch
- **Local Services Exchange**
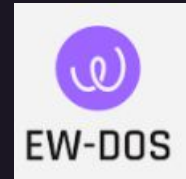 - 3. Efficient and scalable trade of Local Network Services
- **Data Exchange**
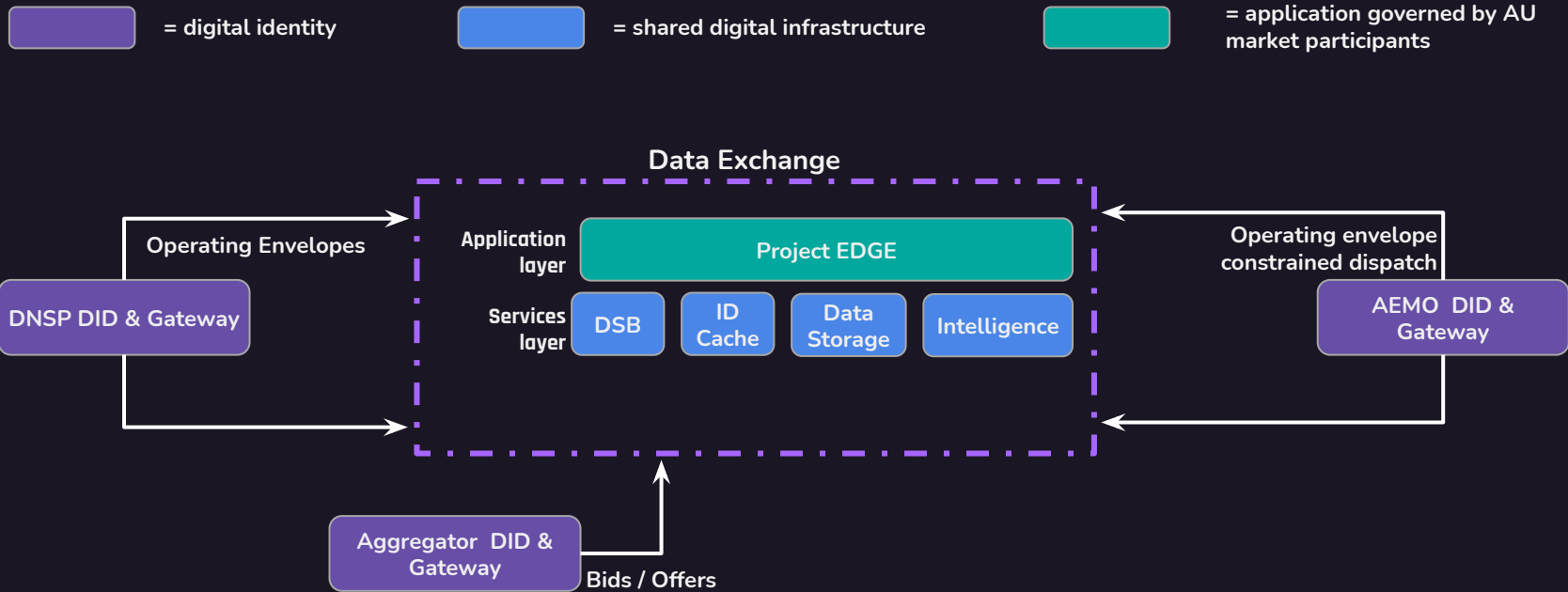 - 4. Efficient and scalable data exchange

5. Integrated technology system required to facilitate objectives 1-4

EW-DOS

High Level Data Exchange Architecture: Project EDGE

[purple box] = digital identity

[blue box] = shared digital infrastructure

[teal box] = application governed by AU market participants

Data Exchange

Application layer

| Project EDGE |

Services layer

| DSB | ID Cache | Data Storage | Intelligence |

DNSP DID & Gateway

Operating Envelopes

AEMO DID & Gateway

Operating envelope constrained dispatch

Aggregator DID & Gateway

Bids / Offers

- DNSP sends operating envelopes to AEMO via Data Exchange
- Aggregators submit bids and offers for wholesale market participation
- AEMO system responsible for ensuring operating envelope delivery to correct participants

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The technology approach we are using can create significant value for DNSPs and Aggregators by:

- Enabling local service exchange (from DER) via efficient communication amongst DNSPs, Aggregators, AEMO, and prosumers

- Addressing current and future requirements around customer data privacy regulation

- Providing near real-time visibility on individual DER (solar, battery, EV, flexible load) deployed on networks

All via open source, shared digital infrastructure (no vendor lock-in, software licensing obligations, or unpredictable costs)

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The EDGE trial is testing the waters for what a decentralized approach to data exchange can do for Australia

- Beyond providing an Identity and Access Management backbone for the trials, we see significant opportunities for the Energy Web stack to create additional value in Australia:
  - Provide a **shared, cooperative Australian** platform for DER market participation at scale
  - Support Zero Export Limit use cases (at both aggregator and IOT level)
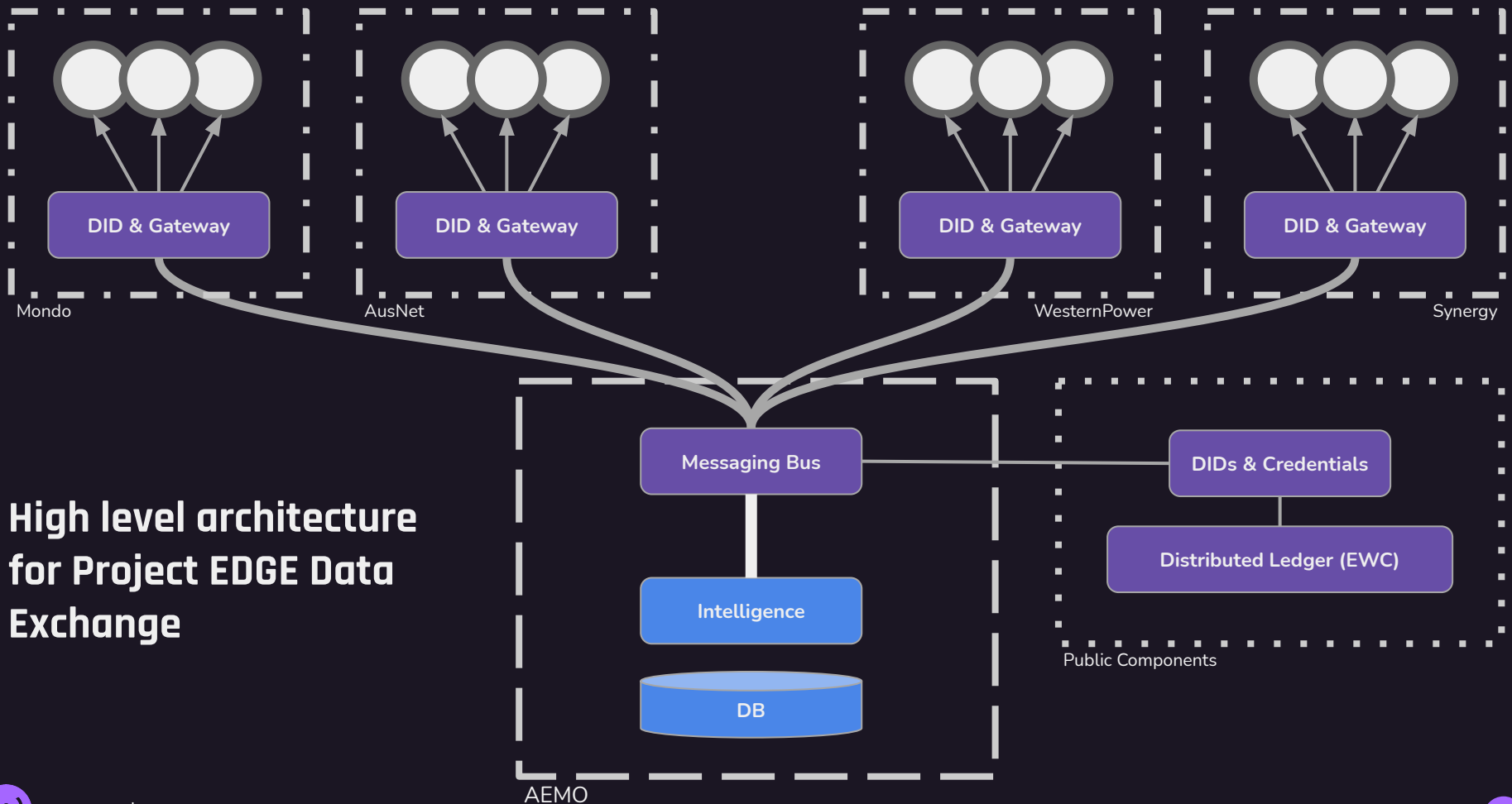 - Enhance DER register

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Q&A / Discussion

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Appendix

High level architecture for Project EDGE Data Exchange

Mondo

AusNet

WesternPower

Synergy

DID & Gateway

DID & Gateway

DID & Gateway

DID & Gateway

Messaging Bus

DIDs & Credentials

Distributed Ledger (EWC)

Intelligence

DB

AEMO

Public Components

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Operating Envelope Transmission and Processing EDGE & Symphony

```
DNSP  →  AEMO  →  Aggregator
                  Aggregator
```

```
DNSP  →  Aggregator
      →  Aggregator
      →  AEMO
```
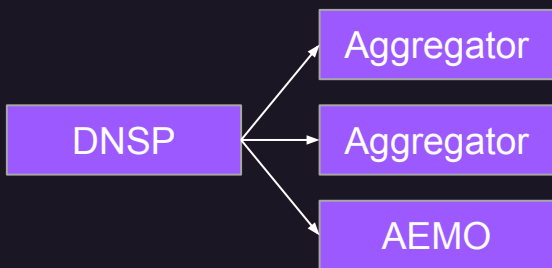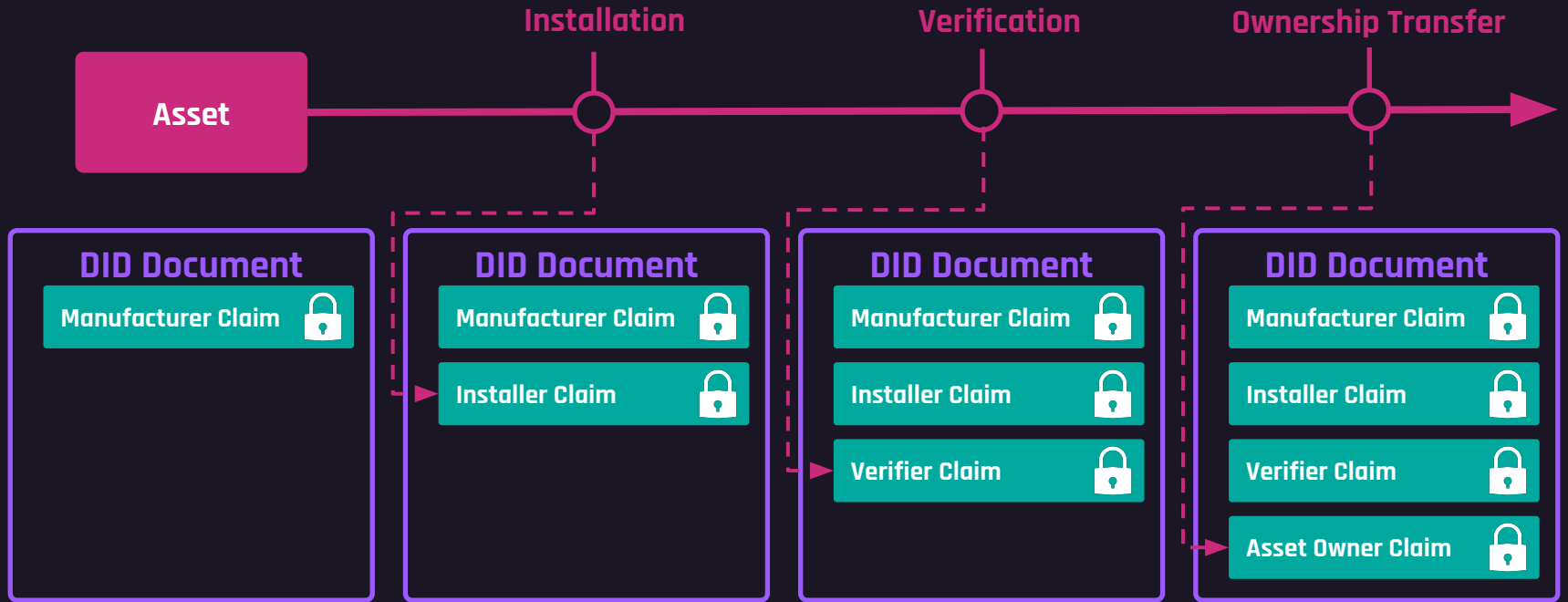
Case 1 - EDGE

- DNSP sends operating envelopes (OE) to AEMO
- AEMO system responsible for ensuring OE delivery to correct participants

Case 2 - Symphony

- DNSP sends OE's to AEMO and participant Aggregators
- DNSP system responsible for ensuring OE delivery to correct participants

EWF solution allows participants to agree on different data transmission pathways for different use cases

DIDs are enriched and validated through a process of claims between market participants

Installation Verification Ownership Transfer

Asset

DID Document
- Manufacturer Claim 🔒

DID Document
- Manufacturer Claim 🔒
- Installer Claim 🔒

DID Document
- Manufacturer Claim 🔒
- Installer Claim 🔒
- Verifier Claim 🔒

DID Document
- Manufacturer Claim 🔒
- Installer Claim 🔒
- Verifier Claim 🔒
- Asset Owner Claim 🔒

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The system is modular and designed to adapt to any combination of market rules and regulatory contexts

Geography

- Spain
- California
- Germany / Belgium
- Netherlands / Western Europe

Grid Operators, Regulators

- DSO: Electra Caldense
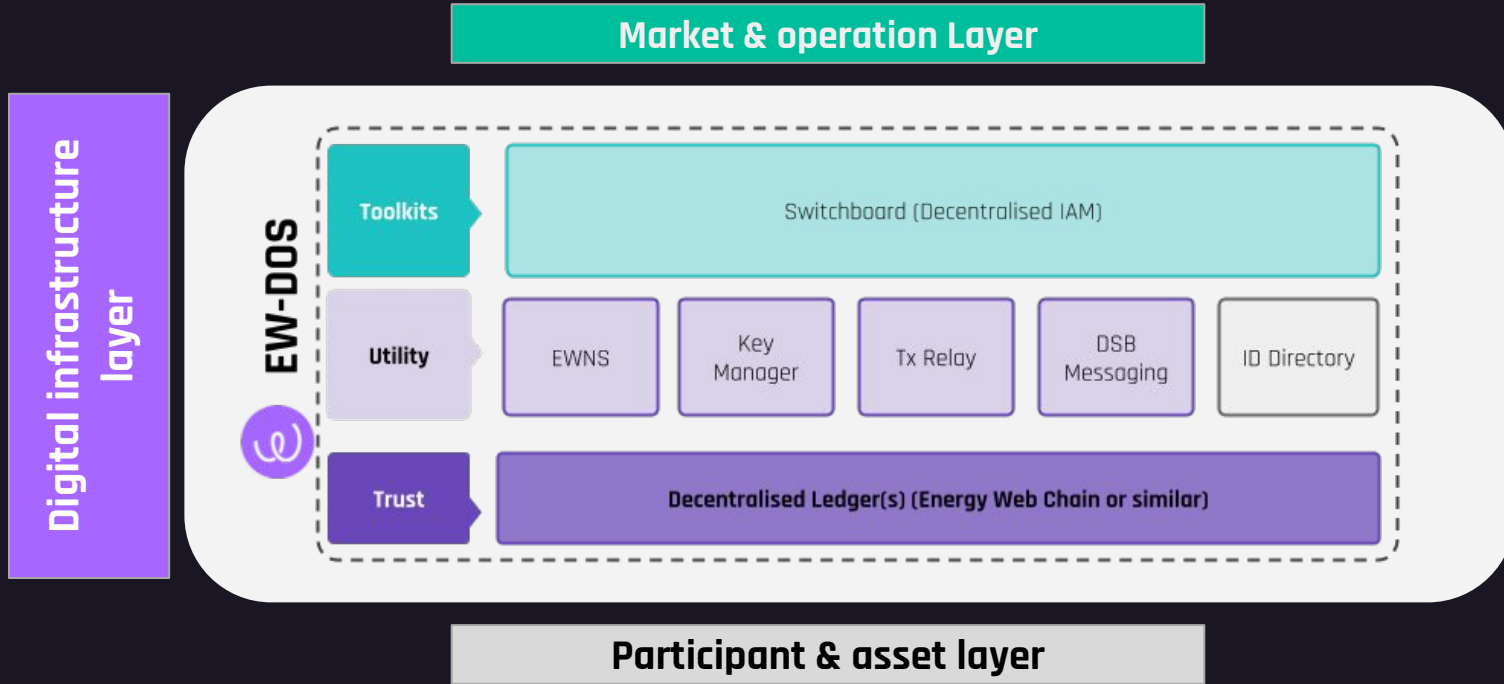- TSO / ISO: CAISO
- TSO / ISO: Elia & 50 Hz
- DSO: Stedin

DER / Aggregator / Other Partners

The infrastructure is the Energy Web Decentralized Operating System, an open source stack collectively owned & operated by the energy industry

Questions and Answers on Energy Web Tech Approach (1/2)

- **How is asset registration and record/portfolio management made simple for Aggregators and DNSPs?**
  - Assets are registered using Switchboard, and are assigned a DID. After, installers, aggregators, and DNSPs can add claims on the DID documents. All claims are stored in a blockchain with no possibility to tamper with them. There is no need for signing/collecting various documents onboarding customers/DERs.
- **How does the Decentralised Service Bus (DSB) provide simplicity, flexibility and scalability of integrations to many aggregators and DNSPs of varying capabilities?**
  - DSB is schema agnostic so it can work on every type of protocol/schema and it is highly flexible and scalable due to its decentralized architecture. If needed it can be easily scaled horizontally. If scaled/managed properly it can easily handle 1 million messages per second.
- **Is the decentralised IDAM system scalable as it relates to data exchange and DER integration?**
  - Every asset has a DID and private/public key pair. In order to publish messages these assets need to authenticate and every message is signed. Signing and encrypting messages gives traceability and security to this system.

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Questions and Answers on Energy Web Tech Approach (2/2)

- **How does the DSB impact security of messages exchanged over public internet?**
  - DSB uses encryption in transit with SSL plus, encrypts the payloads, plus uses cryptography (not passwords for access). Only authorized DIDs are able to send/receive messages.
- **Can the decentralised ledger/blockchain component of the solution be made opaque to consumers/other market participants?**
  - Yes. Energy Web typically makes any interaction with blockchain completely opaque to both end users and other market participants (e.g., DNSPs / aggregators).

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EDGE Platform Conceptual Architecture
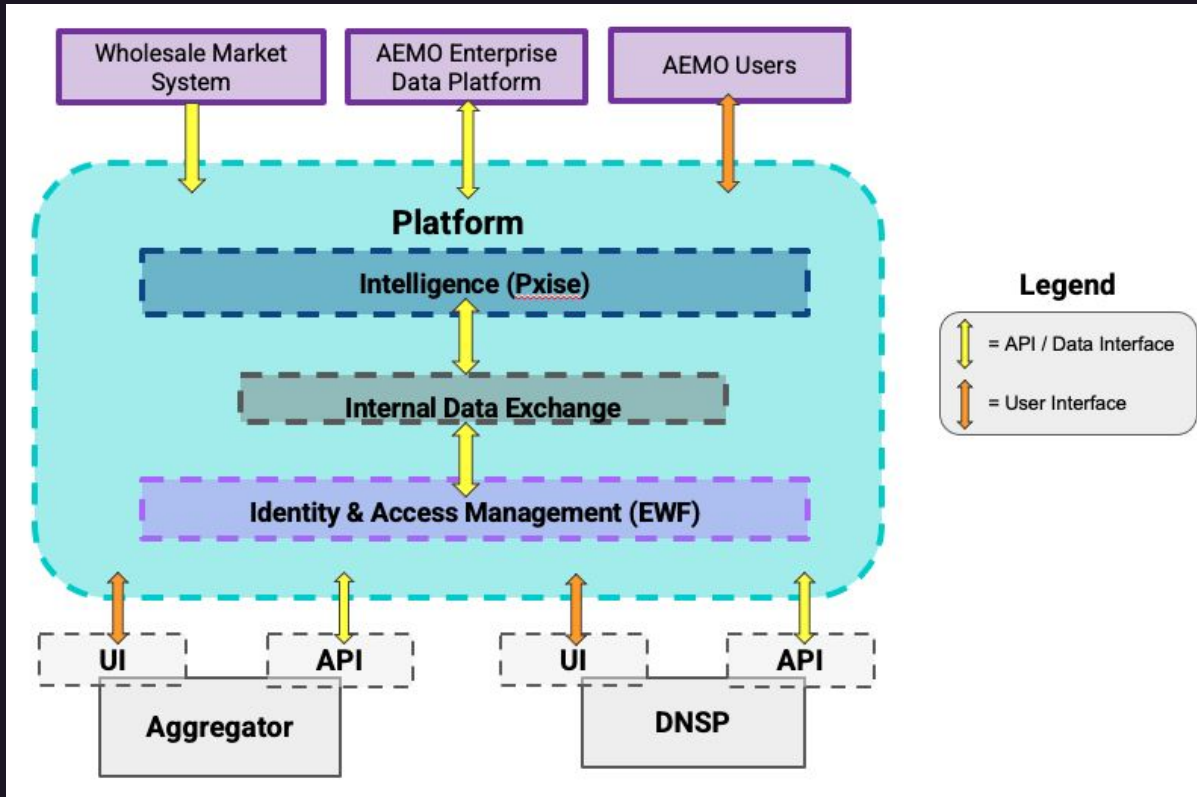
EDGE Platform Functional Architecture