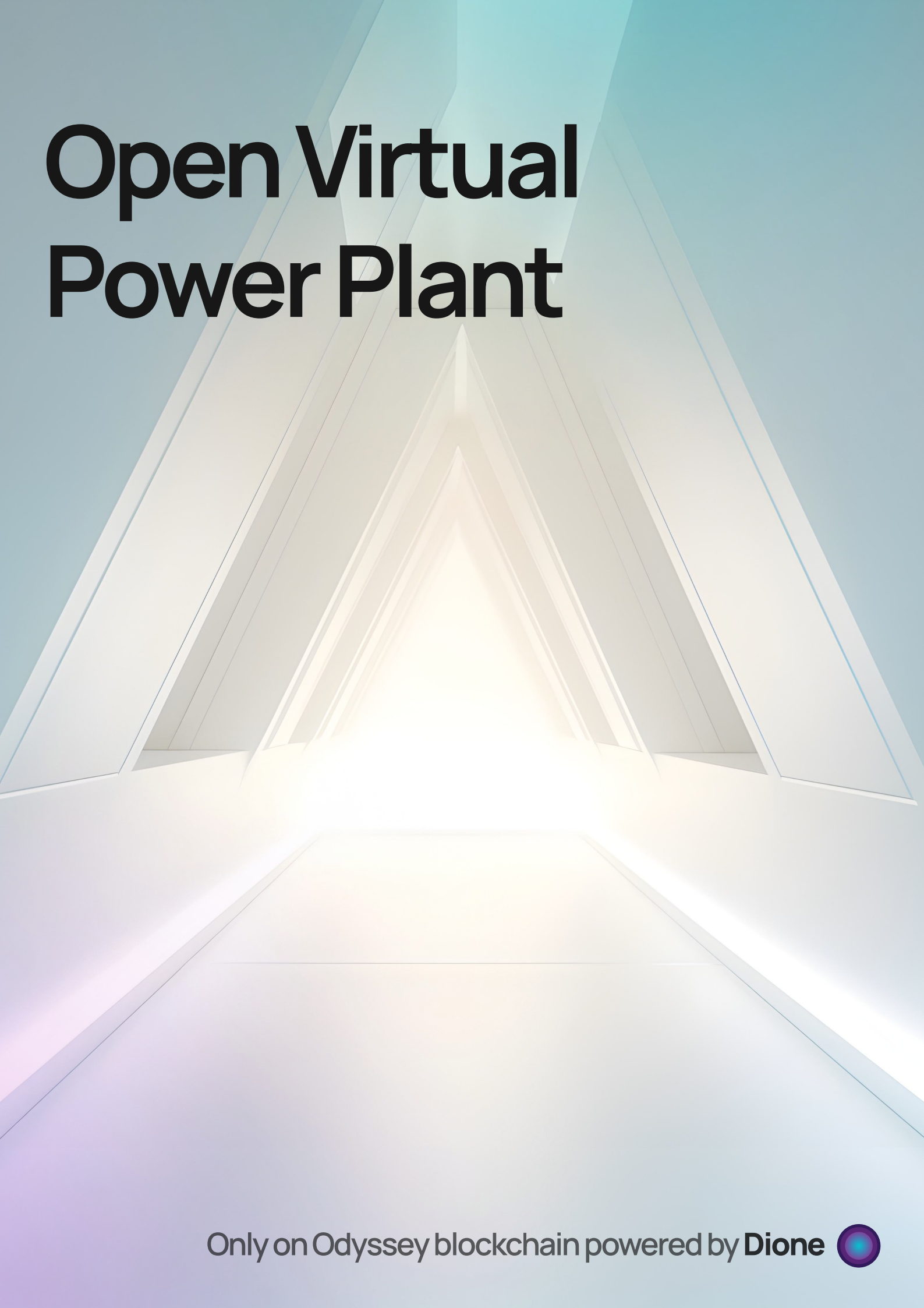
# Open Virtual Power Plant



Only on Odyssey blockchain powered by **Dione**

# Our Vision

OpenVPP is an open source routing and validation service that enables customers with energy devices (Distributed Energy Resources) such as solar, home batteries, and electric vehicles to connect directly with utilities and grid operators to generate value.

**Customers profit** from their DERs by charging, discharging, and moving electric load to times when the grid values it most.

**Utilities benefit** from avoiding expensive upgrades, by controlling customer owned devices, in aggregate, as if it was their own equipment.

**Investors gain** when transactions from staking (rewards) and customer connections (fees) occur on the platform.

**One integration** for device manufacturers and utilities unlocks the ability to participate in any market across the world.

**Utility grade cybersecurity** with blockchain, out of the traffic, only operating as a routing service, not in the operational flow.

We're creating the Internet of Energy, starting with OpenVPP – the Domain Name Service (DNS) of energy. Come join us.

# Mission

Develop a consortium of energy industry stakeholders to create the world's first **open source registry and routing service** of DERs – ready to be orchestrated into a Virtual Power Plant (VPP) anywhere on the globe.

- Connect any device to any utility
- Tracking of all the DERs in the world as they connect and participate in the energy economy
- Provide consensus and validation for onboarding and maintaining connectivity
- Pathway to energy marketplace compensation

# Problem and Opportunity

Our grid will need to double the energy it serves in the next 20 years to support the transition to electric vehicles and away from fossil fuels. Traditional utility approaches would require upgrading the electric grid in every location from the power plant down to the home, costing trillions of dollars globally, to support this electric growth.

**Solar, batteries, and electric vehicles could reshape electric loads, saving utilities money, and earning customers payments; but there is no scalable way to connect devices to utility energy markets today.**

### MANY-TO-MANY

There are 1,000s of utilities and 1,000s of device providers that would have to integrate one-to-one today, leading to millions of connections which each need to be established, debugged, and maintained.

- Utilities are forced to rely on aggregator APIs into DER provider clouds which are constantly in need of updates and maintenance, typically costing $1M plus per integration.
- DER providers offer various methods of commissioning assets into programs, none of which are standardized or scalable.

## UNTAPPED POTENTIAL

The biggest battery in the world is driving around our streets in millions of electric vehicles and it's completely inaccessible to the grid. The value is there, it's just not connected.

- Existing VPPs bring online 100-1,000 devices here or there, not enough to move the needle for energy markets, leading to a negative feedback loop with not enough value to justify expensive integrations.
- Lack of connectivity keeps an otherwise enormous energy market from being unleashed.

## EXPLOSIVE GROWTH

The same challenge driving increases in load today, is growing at an ever increasing rate.

- Growth rate of Electric Vehicles (EVs) and the transition off of fossil fuels is just starting.
- Will lead to a need for a massive market for energy device connectivity, almost overnight.

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Options have been proposed, such as a single centralized server where all traffic passes, but these concepts have repeatedly failed. They're too centralized, costly, unsecure, and ultimately unscalable.

**Single point of failure** | **Hosting fees and bandwidth bottleneck** | **Cybersecurity liability and risk**

A single system cannot handle all of the world's energy traffic, a failure of which could collapse entire nation's electric grids.

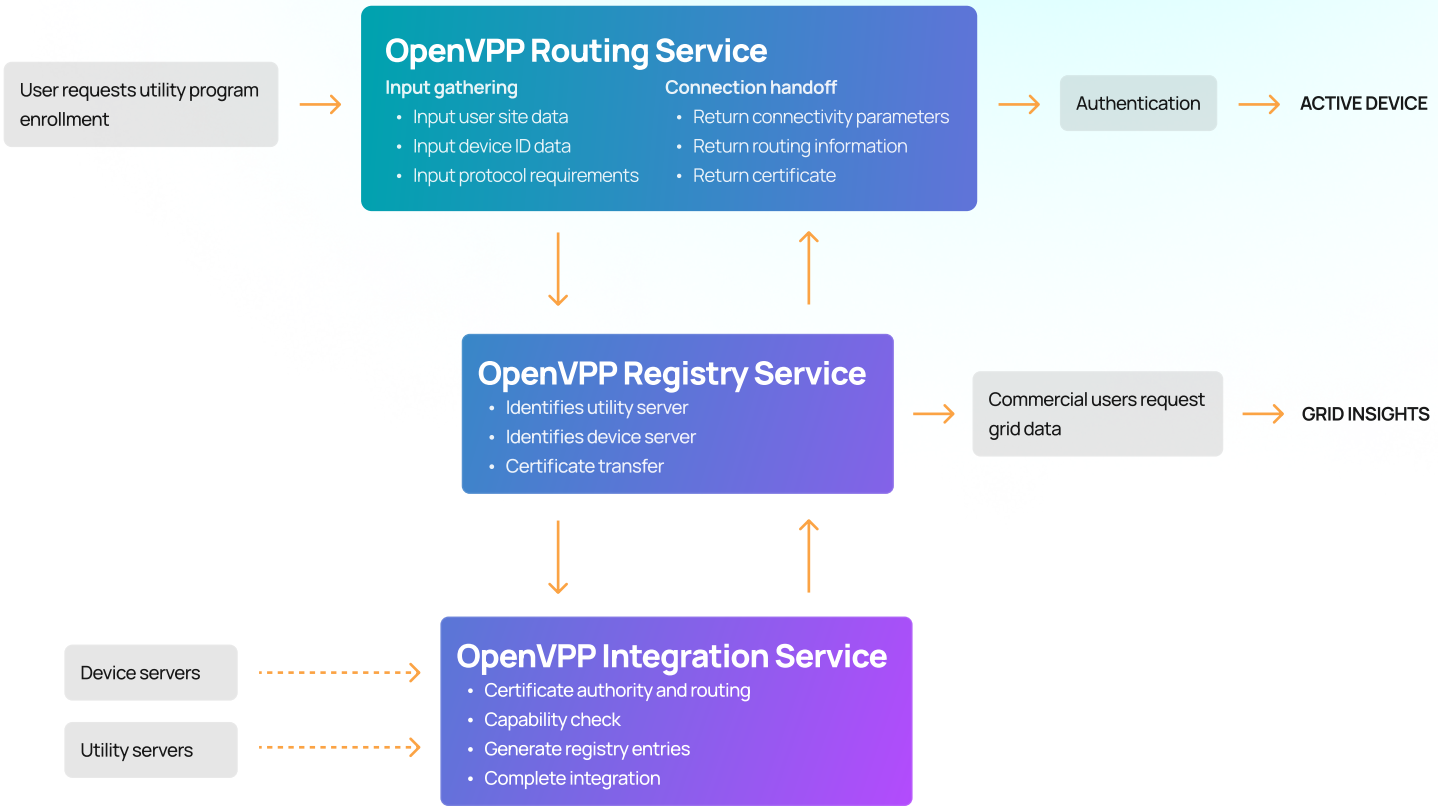
# OpenVPP

## DECENTRALIZED SOLUTION

OpenVPP is a decentralized registry of DERs combined with routing and integration services which allow for a customer with a DER to find and connect with their utility anywhere in the world. The OpenVPP chain validates immutable device attributes and facilitates secure authentication to utilities. The system allows for utilities and device aggregators to control DERs, over industry standardized protocols, directly once a connection is formed using the OpenVPP service.

This direct connection between devices and utilities allows for a distributed Internet of Energy to be formed, with no single point of failure in day-to-day operations. The OpenVPP service is consulted only when a device is added, removed, or connected to a new utility program, thereby solving the greatest challenge in scaling device-to-utility connections without an ongoing single point of failure.

# Services




## The OpenVPP system consists of three core services:

**Routing Service** which interacts with utility and device program enrolment services via a set of APIs to provide back device to utility connectivity parameters and routing data needed to form a secure connection.

**Registry Service** which acts as a decentralized storage, containing all of the necessary data required to identify, locate, and authenticate a device to utility connection.

**Integration Service** which onboards utility and device partners, manages certificates, validates the capability of utility and device end points, and updates the registry as needed.

# Routing

The Routing Service is an off-chain connectivity service with standardized APIs that allow for 3rd parties (typically device aggregators, utilities, or program administrators) to gather the necessary information to form a DER connection.

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## INPUT

A program enrollment page calls the Routing Service API and provides the following standardized information:

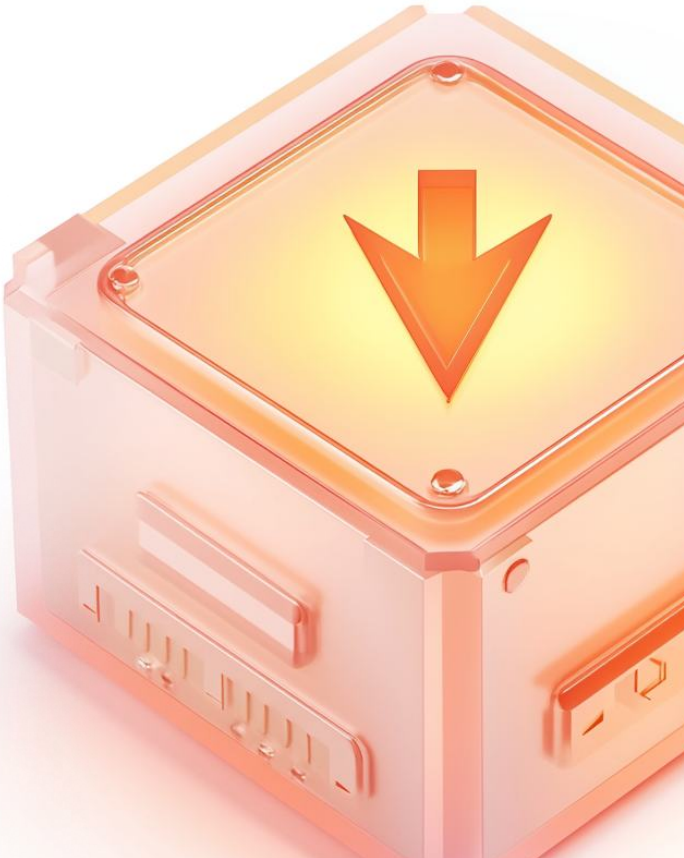
- Site address
- Utility
- Device make and model
- Device identifier (e.g. serial number)
- Desired connectivity protocol (e.g. OpenADR 2.0)
- Desired program identifier

A fee is assessed in OpenVPP tokens for connecting the device to the utility, and can be paid for in one of three ways:

Direct payment in native OpenVPP tokens from the customer's wallet

Indirect payment in native OpenVPP tokens from the program administrator's wallet

Direct or indirect payment in fiat via an onramp which automatically purchases the necessary OpenVPP tokens for the transaction



## FUNCTION

The Routing Service interacts with the Registry Service to fetch the device connectivity server and utility control server routing information based upon the input fields. The device and utility information is exchanged, and capability of the device and utility are checked, returning a result for readiness to connect.

If a valid result is obtained, the connectivity fee is charged, and the output stage is called upon.
If a valid result is not obtained, or there are insufficient funds, an error is returned to the program enrollment API and the connection is not formed.

## OUTPUT

Provided a successful input result is returned and the fee is collected, the routing information and certificates are made available to the respective device and utility servers thereby enabling them to form a secure connection. A response is sent back via the program enrollment API to the enrollment page informing the program administrator that a successful connection was formed.

# Registry

The Registry Service is an on-chain database which stores all of the device and utility addresses and attribute, capability, and program data. The service is updated any time a device connects or disconnects from a utility or when it enrolls or un-enrolls from a program. The service keeps a log of all of the active formed connections and represents a global picture of all device-to-utility links.

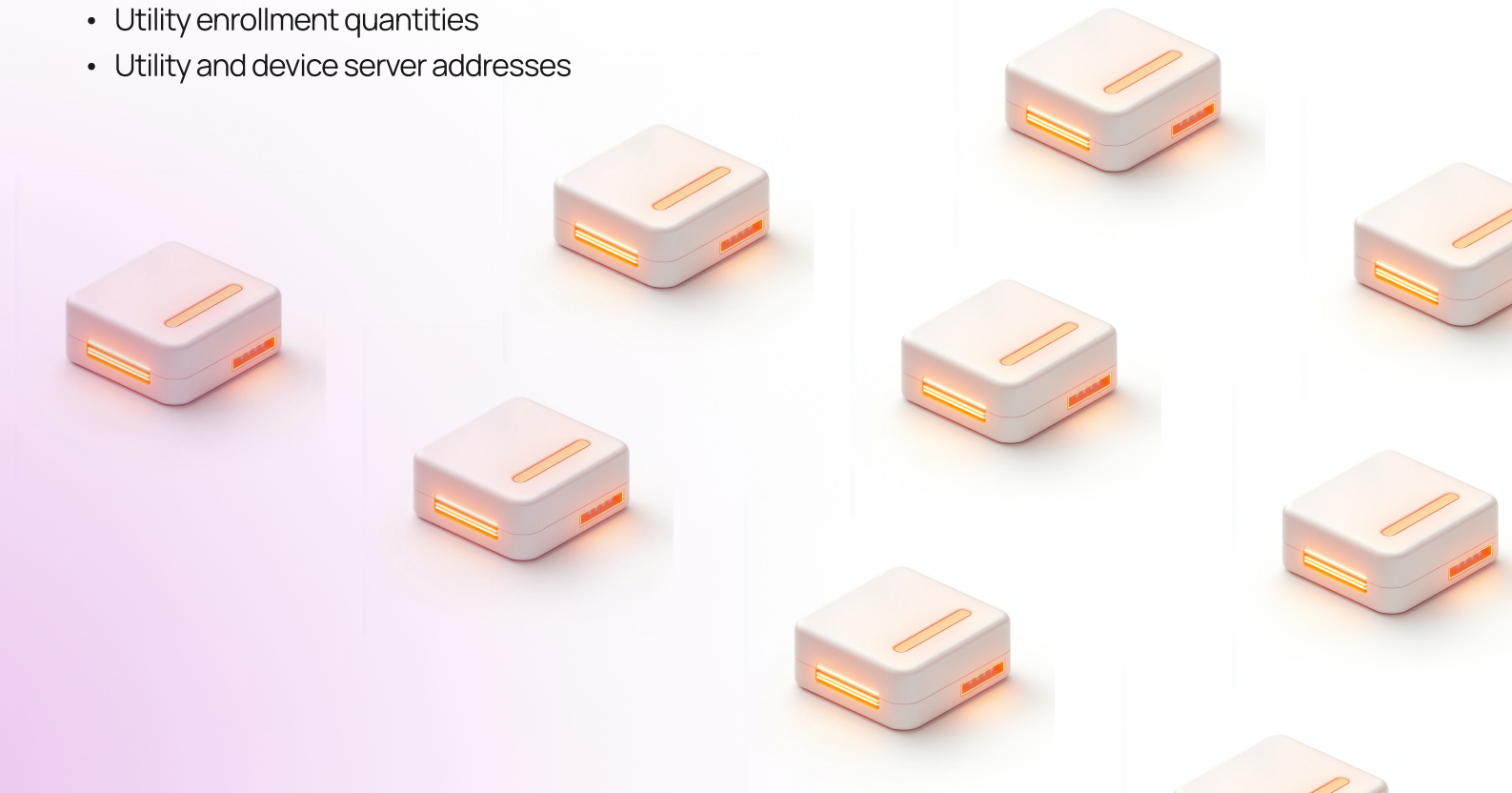
The Registry Service is only called upon when a device's connectivity status is changed and does not have knowledge or partake in the day-to-day traffic between a device and utility server.

A fee is assessed in OpenVPP tokens for commercial users (such as utilities, governments, or grid operators) who want to view "grid level device awareness" data. This data can be accessed via API.

### DATA TYPES

The registry service handles all device and utility data for example:

- Device make and model
- Device capabilities (e.g. kW, kWh, voltage, etc.)
- Device protocols
- Device enrollment and connectivity statuses
- Utility territory and program mapping
- Utility enrollment quantities
- Utility and device server addresses



# Integration

The Integration Service is an off-chain service which allows for device aggregators and utilities to integrate to the OpenVPP platform. This integration happens on a one time basis for each device aggregator and utility, unlocking the entire world of device connectivity. The Integration Service has multiple capabilities triggered when onboarding a new device or utility partner, and is referenced continuously as long as devices are connecting and the OpenVPP routing and registry services are being utilized.

## CERTIFICATE AUTHORITY & ROUTING

Standardized APIs allow for the exchange of device and manufacturer level certificates to the Registry Service which are used in routing of devices each time a connection is formed. These certificates form the basis for the authentication and trust in the secure connection, but the connection is formed at the device to utility level and not in the Integration Service itself.

## CAPABILITY CHECK

A set of standardized unit tests are created for each device type in each protocol. These standardized unit tests are run against every new device aggregator or utility connection to confirm at onboarding that a range of acceptable, standardized, and consistent responses are returned from every device and utility server. This ensures that devices and utilities behave in the way expected, utilizing the same unit tests, therefore greatly reducing the chance of an integration error between device and utility servers. Not all capabilities need to pass for every device and every utility, only the overlap between that specific device and utility pairing need to pass to permit a connection.

This capability check service ensures that any device can be routed to any utility with a single integration from each side with minimum ongoing maintenance. Checks can be re-run in an automated fashion as capabilities are updated or protocols are changed.

## REGISTRY UPDATE

The Integration Service continuously updates the Registry Service with the correct certificate, capability, and attribute data needed to facilitate the Routing Service for connecting devices.

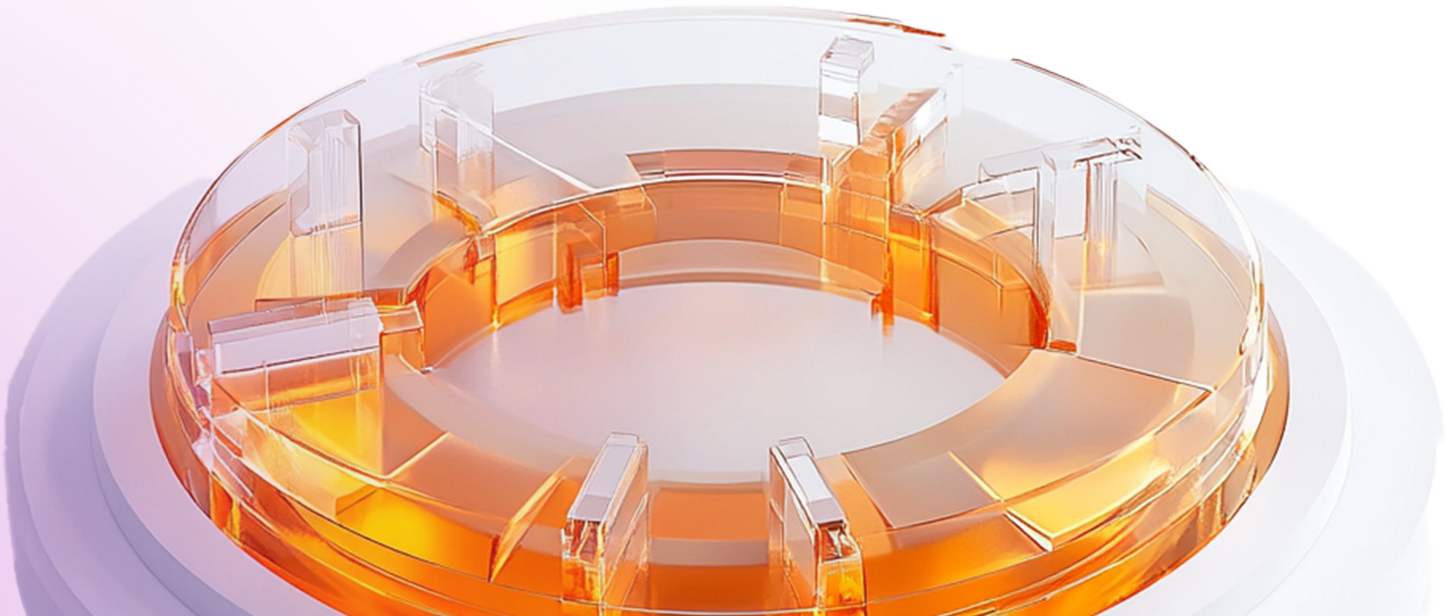
# Use of the Platform

## USER CONNECTION OF DERS

A typical user interaction for connecting a device to the utility:

1. **User lands on a utility or device vendor hosted web page**
2. **User enters qualification information into the web page**
    - Device make, model, and identifier (e.g. serial number)
    - Address and other site data if needed (may be pre-populated by the device vendor or utility)
    - Payment is gathered if needed (depending on program, the cost may be paid by the device vendor or utility instead of the user)
3. **Enrollment**
    - Enrollment request is passed to the OpenVPP Routing Service via API
    - Connectivity parameters, certificate, and any other data needed for authentication are returned
    - Device connects to utility server
4. **User successfully connected device to utility**
    - Any other utility side program enrollment continues
    - User device can now be controlled and compensated for based on terms of the program

It's expected the OpenVPP token cost to connect would be $1-20, with value to the user per device around $100-1,000/year depending on the program and capability of the device.



# Onboarding & Integration

## VENDOR AND UTILITY CONNECTION

A typical device aggregator or utility interaction for connecting to the OpenVPP Integration Service:

1. **Device aggregator or utility identifies which protocols their server can speak, server addresses and join requirements, and the capabilities within those protocols**
   - Device aggregators also share the device types, models, and certificate structures
   - Utilities share their territory and program mappings, and their program details

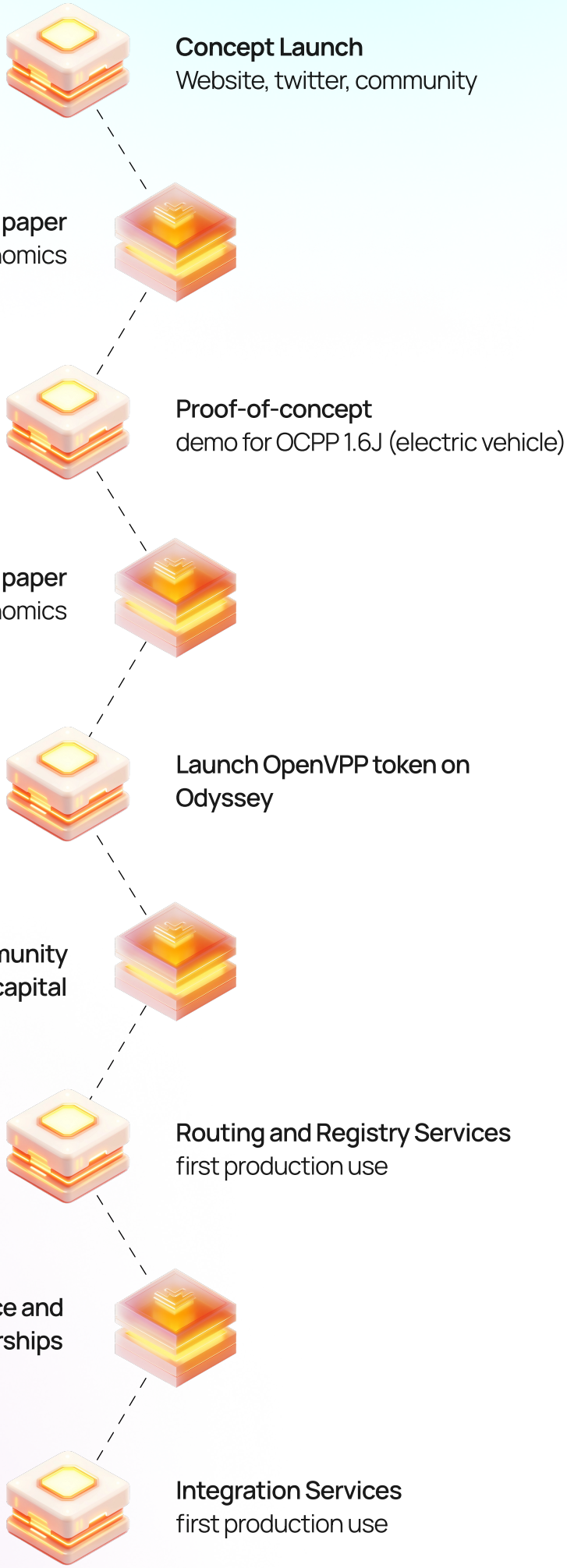
2. **The servers connect to the Integration Service using OpenVPP APIs**
   - Test exchange of Registry data
   - Test protocol and capabilities of the devices and utility control
   - Test exchange of certificates

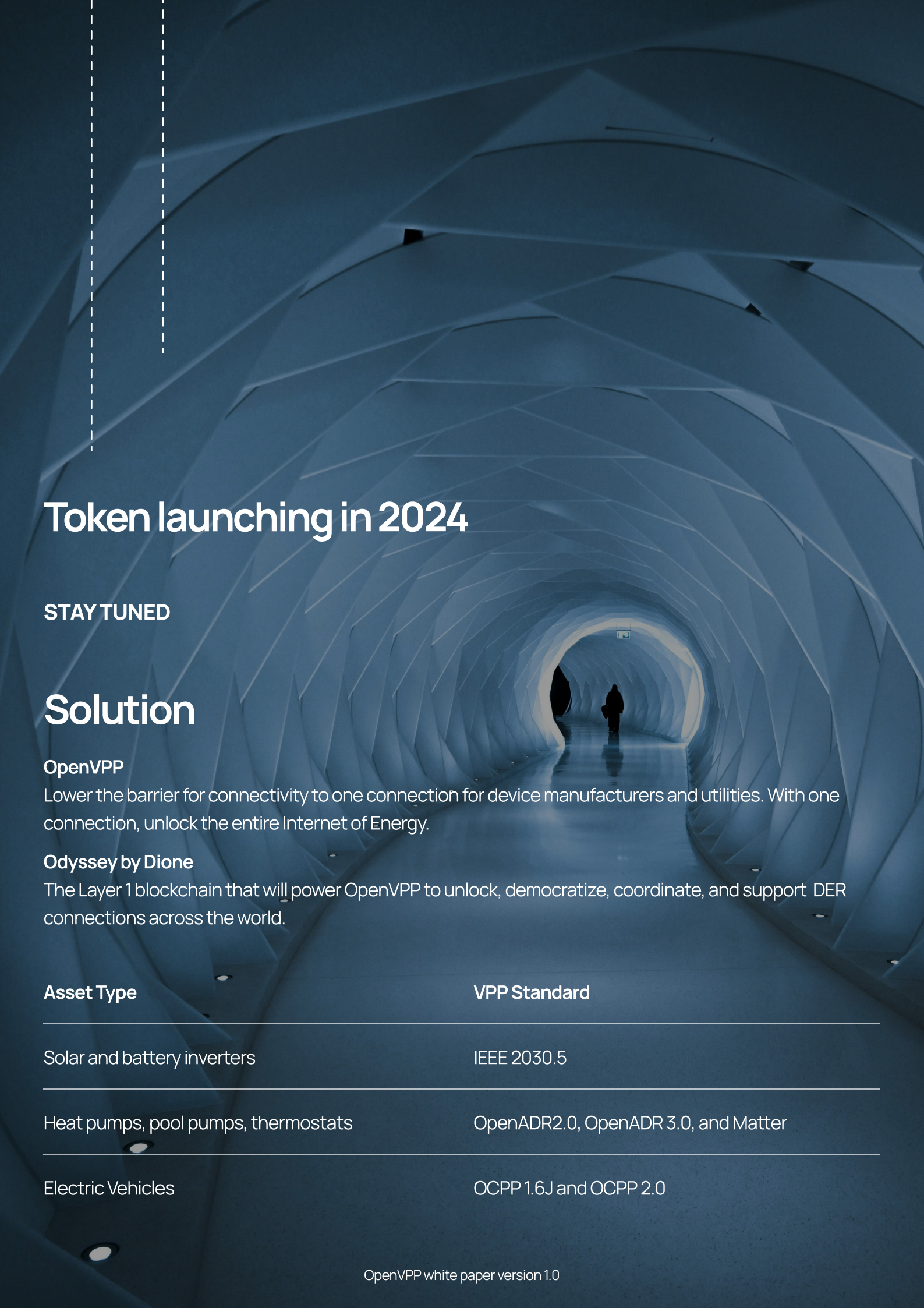
3. **Device aggregator and utilities integrate the Routing Service APIs to their program web pages allowing for the connection of a device to a utility**
   - The OpenVPP website will also have a routing page which would allow device aggregators and utilities to avoid this integration step if they do not want to invest in a branded experience

# Tokenomics

MORE TO COME...

# Roadmap


Concept Launch
Website, twitter, community
Publish white paper
without tokenomics
Proof-of-concept
demo for OCPP 1.6J (electric vehicle)
Update white paper
with tokenomics
Launch OpenVPP token on
Odyssey
Open Pre-sale for community
and venture capital
Routing and Registry Services
first production use
Announce first device and
utility partnerships
Integration Services
first production use



# Token launching in 2024

**STAY TUNED**

# Solution

**OpenVPP**
Lower the barrier for connectivity to one connection for device manufacturers and utilities. With one connection, unlock the entire Internet of Energy.

**Odyssey by Dione**
The Layer 1 blockchain that will power OpenVPP to unlock, democratize, coordinate, and support DER connections across the world.

| Asset Type | VPP Standard |
|---|---|
| Solar and battery inverters | IEEE 2030.5 |
| Heat pumps, pool pumps, thermostats | OpenADR2.0, OpenADR 3.0, and Matter |
| Electric Vehicles | OCPP 1.6J and OCPP 2.0 |