Working Paper

Plenny: A Decentralized Capacity Market and Oracle Network that connects the Peer-to-Peer System of the Lightning Network with Ethereum.

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Abstract

Plenny connects the Bitcoin Lightning Network (LN) with the Ethereum ecosystem. The decentralized application (Dapp) provides connectivity and liquidity and allows Lightning Nodes to expand payment channel capacity through a non-custodial capacity market. The Dapp serves as an additional layer for the LN that enables interoperability through a Decentralized Oracle Network (DON), utilizing Proof-of-Stake (PoS) to reach consensus.

Plenny is a Decentralized Lightning Service Provider (DLSP) and supports Lightning Nodes to provide lightning services via smart contracts. Functionalities include an open-source add-on module and networking with Liquidity Providers (LPs) in decentralized markets designed to bridge use cases across blockchains.

Tokenizing the cost of inbound capacity is a key feature, allowing Lightning Nodes to earn Royalties and Channel Rewards for sharing transaction data via payment communication channels. At its core, the tokenization mechanism of Plenny emulates the value capture mechanism of participating Lightning Nodes within the LN, and leverages the underlying liquidity (i.e. Satoshi, sat).

Economically, Lightning Nodes generate another income stream for operating payment channels from an ERC-20 token (i.e. PL2) in addition to earning sat. To test this effect, an artifact (i.e. Plenny) was developed that applies decentralized use cases and investigates whether Lightning Nodes can operate more viably as a result. Moreover, the pilot analyzes the potential impact of regulatory measures.

Incentives are available for logging channel capacity, licensing channel capacity and oracle validation, oracle election, liquidity staking, replenishment of the treasury (i.e. decentralized cash management), delegation, and governance.

Plenny works permission-less on a Peer-to-Peer (P2P) and Peer-to-Contract (P2C) basis, empowering community governance through a Decentralized Autonomous Organization (DAO).

Contents

List of Acronyms

A
AMM: Automated Market Maker
APIR: Annual Percentage Income Return

B
BOLT: Basis of Lightning Technology
BTC: Bitcoin Trading Symbol

C
CABAC: Checks-And-Balances Committee
CAGR: Compound Annual Growth Rate
CBDC: Central Bank Digital Currency

D
DAO: Decentralized Autonomous Organization
Dapp: Decentralized Application
DDOS: Distributed Denial of Service
DeFi: Decentralized Finance
DEL: Delegators
DEX: Decentralized Exchange
DLSP: Decentralized Lightning Service Provider
DON: Decentralized Oracle Network
DPoS: Delegated Proof of Stake
DYOR: Do Your Own Research

E
ERC-20: Ethereum Token Standard
ETH: Ethereum Trading Symbol
ETUR: Election Trigger User Reward
EVM: Ethereum Virtual Machine

F
FAQs: Frequently Asked Questions
FF: Fish Farming

G
GDP: Gross Domestic Product
GR: Governance Rewards

H
HTLCs: Hash Time Locked Contracts

I
IOU: I Owe You
IoT: Internet of Things
ISP: Internet Service Provider

L
L1: Layer 1
L2: Layer 2
LApp: Lightning Apps
LM: Liquidity Maker
LN: Lightning Network
LOC: Lightning Ocean
LORCA: Lightning Oracle Validator
LPs: Liquidity Providers
LP-Token: Liquidity Token
LSP: Lightning Service Provider
LT: Liquidity Taker

M
M2M: Machine-to-Machine
MIT: Massachusetts Institute of Technology
MVP: Minimum Viable Product

N
NCCR: Non-Custodial Channel Rewards
NFT: Non-Fungible Token

O
ORU: Optimistic Rollups
OSS: Open-Source Software
OVR: Oracle Validator Rewards

P
P2C: Peer-to-Contract
P2P: Peer-to-Peer
PoC: Proof of Concept
PG: Plenny Governor
PL2: Plenny Ticker Symbol
PoS: Proof of Stake

POSDAO: Proof of Stake DAO
PW: Plenny Whaler

R
R&D: Research and Development
RBTC: Bitcoin T of RSK
RH: Reward HODL
RTGS: Real Time Gross Settlement
RTUR: RePLENishment Trigger User Reward

S
Sat(s): Satoshi(s)
SegWit: Segregated Witness
SWIFT: Society for Worldwide Interbank Financial Telecommunications

T
TGE: Token Generation Event
TH: Treasury HODL
TVL: Total Value Locked
UI: User Interface
UML: Unified Modeling Language
UTXO: Unspent Transaction Output
UX: User Experience

V
V: Voters

W
WP: Working Paper

Y
YOY: Year-Over-Year
YTD: Year to Date

Z
ZKP: Zero Knowledge Proof

1 Introduction

1.1 Online Field Experiment

This Working Paper is a non-institutional research paper on field trials with the Bitcoin Lightning Network and the Ethereum ecosystem. It characterizes the conduct of an online experiment in a multidisciplinary context. The given research manuscript is a pre-release, informally reviewed by a group of independent community members. It serves for educational purposes and allows the wider crypto community to provide feedback for the improvement of Plenny. This version was published at the time of research and development (R&D) but has not undergone the formal peer review required for final publication.

The Plenny experiment aims to investigate token economics applied to providing liquidity to the Lightning Network,[1] which is a layer-2 technology (L2) built on top of Bitcoin. The trial explores to what extent Lightning Nodes are ready to interact with the Ethereum ecosystem when incentivized with token rewards.

In the context of the crypto ecosystem, the study aims to answer the following primary questions:

1. To what extent can a decentralized application using Ethereum support decentralization and growth of the Bitcoin Lightning Network?

2. To what extent can cross-chain blockchain technology be applied to supplement the fee income of Lightning Nodes with token rewards to enable the active provision and expansion of lightning services?

3. On what transaction cost basis does Ethereum Layer 2 technology allow for developing a capacity market and oracle network that mirrors payment channel capacity and transaction fees on the Bitcoin Lightning Network to improve connectivity as well as liquidity allocation for Lightning Nodes?

4. On what technical, economic, and legal basis is it possible to combine decentralized financial services with the provision of payment channel capacity, when creating fungible tokens for the non-financial digital economy of a non-custodial decentralized application and permission-less network?

5. To what extent can rewards through hybrid tokens used in the regulation-free sector of the P2P and P2C paradigm generate active income comparable

to passive income of asset tokens such as earning interest or dividends (i.e. non-financial digital economy versus decentralized financial economy)?

The answers to these research questions are sought through the practical implementation of Plenny. Other factors shall be added to this general equation as they come to light during the online field experiment.

The initial focus of research and development is on the application phenomena triggered by decentralized applications in the context of technical, economic, and legal aspects. In this way, the open-source project addresses specific problems that include but are not limited to the impact of minting, burning, locking, staking and delegating, the influence of custodial vs. non-custodial wallets, consequences for the token economy in case of active income (i.e. service rewards) versus passive income (i.e. financial interest), and the fundamental effects of fungible items related to on-chain, off-chain, and cross-chain transactions.

With the deployment of Plenny, its features are being put to the test. The Dapp and the DON as well as the associated token must prove their usefulness in practice. Ultimately, the question arises as to whether the Ethereum ecosystem is capable of supporting the economics of the LN and its payment channels.

1.2 Design Science Research Methodology

The Plenny experiment applies the design science research methodology.[2] This research paradigm is understood as an applied research approach with a pragmatic nature. The focus is on the practical implementation of novel blockchain concepts to create innovative decentralized applications.

The pilot serves as the artifact to discover practical solutions and acquire knowledge with the intention of improving functional performance. Artifacts refer to the development of innovative systems and the design of corresponding business processes. The main purpose of design science research is to gain knowledge and understanding of a problem area through the construction and application of a designed artifact.

Design science research is applied in the disciplines of computer science and business informatics but is not limited to these fields. In the sense of this constructive method, hermeneutic approaches were made on interdisciplinary issues where the pilot study touches on economics (i.e. monetary economics) and law. Specifically, generally known concepts from finance and law (e.g. banking and securities laws as well as anti-money laundering laws) are applied and subject to interpretation in the context of the business cases at hand.

The research approach applies extensive try-out methods that consider the constructive and hermeneutic procedures employing a combination of quantitative and qualitative techniques. For evaluation of the experiment, the findings are

measured quantitatively by transaction volume. Basically, they arise in a conventional way based on the number of users and can also be measured by the token value. Moreover, the valuation methodology for tokens used is quantitative, applying the commonly accepted theory of money. Qualitative methods have been applied through the iterative development process by interviewing engineers and early adopters to extract interpretive phenomenological feedback throughout the design cycle. Feedback from initial users has been influential to the implementation of the pilot and for the generation of genuine test data.

The three cycles of design science research are recurring elements of the experiment as they are closely related activities. The relevance cycle covered the definition of the research areas, the review of available resources to put toward requirements, and acceptance criteria. At the same time, a trial-and-error approach was applied to uncover the new knowledge and evaluate interim results for further consideration. By continuously evaluating the findings and probing the implementation, as well as rigorously examining theories and testing existing practical concepts, the rigor cycle has been embedded into the procedure. The design cycle iterated between the research and testing process and the development of the artifact.

Starting from prior research, including the theoretical Proof of Concept (POC), this Working Paper outlines the practical relevant conditions for prototyping, describes the structures of the Minimum Viable Product (MVP), defines the implementation of the pilot project, and uses assumed data for initial live tests as well as initial user adoption via the decentralized web.

Following an iterative R&D approach, the experiment's purpose is to deepen the understanding of blockchain-driven computational systems and their implications from a functional perspective. This approach aims to realize and clarify the meaning of user experiences when building decentralized applications for cryptographic means of payment. As the experiment advances, the pilot might adapt other research methodologies to study the LN in order to gain insights for the ongoing development of Plenny.

It is worth noting that neither Bitcoin[3] nor Ethereum[4] emerged from academic research, but rather from the practical development of applications through open-source communities.[5] Beyond trading crypto, research gaps in crypto technology are mainly uncovered by independent groups of engineers working in small business environments outside of universities. Research, innovation, and field experiments in decentralized applications utilizing blockchains and smart contracts are mostly non-institutional.

The search for new knowledge in this field takes place in international open-source communities, which are often composed of software engineers from emerging economies. These unconventional researchers are driven by their pursuit of better

economic conditions to overcome the restrictions on freedom caused by monetary policy and regulatory systems in their countries. In this context, the research approach is not primarily on fulfilling academic standards and formalities, but on practical implementation of use cases to achieve economically beneficial outcomes and financial inclusion.

1.3 Research Gap

Although Bitcoin's second-layer protocol has attracted a number of academic researchers from the world's leading universities to publish scholarly papers[6] on the theoretical concepts of the LN, only a few computer scientists have conducted public online field experiments to explore the potential of lightning payments for real-time transactions in a blockchain interoperable environment. Until now, only a few analysts and programmers[7] have researched how interoperability with Ethereum smart contracts might benefit the LN, and how the two blockchains might cross-fertilize in practice.

Contemporary research has looked at network topologies for P2P, where fiat transactions are processed through centralized financial intermediaries. Researchers have investigated the social aspects of mobile payment applications,[8] user adoption, and the growth of transaction volume where participants are empowered to transact directly with their community.

To date, however, the impact of cryptocurrencies and the multilayered ramifications of blockchain topologies on the framework of conventional P2P payment systems have not yet been adequately studied. In many respects, existing theory regarding the LN has hardly been applied on a practical level and placed in a technical, economic, and legal context. In the fields of applied computer science, monetary economics, and law, the composability of Ethereum standards in interaction with the LN has not yet been thoroughly analyzed for functionality and compliance. Concretely, the characteristics of the LN and the behavior of Lightning Nodes within the broader crypto community is unexplored in terms of providing tools for transacting with other decentralized applications and blockchains.

Apart from Bitcoin, Litecoin, and RSK, there are currently no blockchains and no interoperable cryptographic coins or tokens to support the growth of the LN and leverage its capability for on-chain and off-chain payments. The impact of add-on services with product layers using complementary tokens is uncharted territory. The Plenny experiment addresses this research gap by looking for novel decentralized use cases and add-on application-level services utilizing tokenization.

From the user's perspective, decentralized networks like the LN are expected to offer value via the protocol and product layer. Currently, the protocol and product

layers of the Bitcoin Lightning Network are not yet sufficiently intertwined. This state is reflected in limited usability and consequently affects the utility of the LN. Sat works well as a native coin of the lightning protocol, but in practice offers limited opportunities and insufficient incentives for nodes to compose innovative product layers.

Plenny assumes, aside from payments and trading, there are additional ways to create value. To support the utility of the LN, the experiment enables Lightning Nodes to provide add-on services. The additional economic activity is intended to create value that can be captured at the protocol level of the LN as well as on the service level of Plenny by collecting transaction fees.

To sum up, the pilot explores new decentralized use cases on the LN and via decentralized applications to create further utility and additional value-capture mechanisms through interoperability with the Ethereum ecosystem.

1.4 Working Hypotheses

The Plenny experiment holds the working hypothesis (H) that the shift from centralized finance to decentralized finance (DeFi), where the traditional middleman is replaced with blockchain technology, cryptographic token, and smart contracts, is a key factor to advance financial services on a technical, economic, and legal basis. Hypotheses are made in the context of the experiment as follows:

- H1: The artifact (i.e. Plenny) supports the further decentralization and growth of the Bitcoin Lightning Network.

- H2: The cross-chain blockchain technology provided by the artifact with incentives over the Ethereum ecosystem supplements the fee income of Lightning Nodes and enables the active provision and expansion of lightning services.

- H3: Using the lightning services of the artifact and its components (i.e. capacity market and oracle network via Ethereum) enables participants to improve connectivity as well as liquidity allocation for Lightning Nodes as long as transaction costs on Layer 2 blockchains remain low.

- H4: The technological capabilities to log lightning payment channels combined with token rewards for providing channel capacity constitute fungible fundamentals for a non-financial digital economy of a decentralized application because the provision of channel capacity is a technical service but not a financial service.

- H5: Hybrid tokens ("utility" and "payment" tokens) used in the regulation-free sector of the P2P and P2C paradigm can generate active income (e.g. by providing services in a non-financial digital economy) as high as passive income generated by competing asset tokens (e.g. interest and dividends in a decentralized financial economy).

1.5 Allocation Problem

The LN was designed to decongest the blockchain and scale Bitcoin. The associated on-chain fees are reduced by taking transactions off-chain and processing them through a second layer. In short, the Lightning Network consists of Lightning Nodes with two-sided payment channels, and all the bitcoin are locked in these channels. The total amount of sat locked in a channel is called channel capacity. Inbound capacity limits the amount for receiving payments from a remote note, and outbound capacity limits the amount for sending payments by the local node. For the LN to function properly and to be usable, it needs to fulfill the following:

- Have enough Lightning Nodes connected
- Have enough payment channel capacity locked

However, establishing inbound capacity for Lightning Nodes is a known problem today. Inbound capacity refers to the ability of receiving payments to the extent of the remote balance. Having an insufficient remote balance available is a general issue for most Lightning Nodes. Today, it is difficult for users to fund payment channels in a cost-efficient way. The reasons for the shortage are the effort to obtain stable connectivity and the cost of providing liquidity.

Allocating bitcoin as working capital is a barrier for many Lightning Node operators.[9] In addition, the volatility of bitcoin leads to significant currency risk. Only a few large participants are willing to bear the cost of holding substantial amounts of bitcoin in their Lightning Nodes.

This Working Paper assumes that professional participants in the LN offset currency risk by earning fees and generating return on investment through other means (e.g. add-on services like wallet providers and trading operations). Such an approach is generally not available to retail users of the LN. Due to the lack of risk mitigation tools, small Lightning Nodes carry increased economic risk when processing micro-payments on a P2P basis.

The need to allocate funds to tie up liquidity in payment channels without sufficient incentive is an obstacle for professional and retail users alike. For instance, crypto exchanges are constantly looking for ways to limit their exposure. The capital requirements prevent exchanges from participating in the LN because the incentives paid by Lightning Nodes alone are not an attractive value

proposition compared to leveraging bitcoin by other means (e.g. operating margin trading facilities).

These capital requirements represent a critical resource allocation problem.

1.6 Allocation Solution

Plenny introduces a solution to the allocation problem. Its utility is tailored for stable Lightning Nodes to improve connectivity with peers. The core offering is a non-custodial capacity market for payment channels whereby participants pay and earn rewards and collect fees.

The solution enables Lightning Nodes to provide non-custodial lightning services and leverage decentralized markets. This approach supports payment processing use cases for a more efficient clearing and settlement mechanism and helps Lightning Nodes balance capital allocation through the Ethereum ecosystem.

Economically, the LN allows participants to pay and earn transaction fees (i.e. base fee and routing fee in sat) when they use and provide payment channels. However, these fees are usually extremely low (e.g. below 0.01c), making it hard for Lightning Nodes to cover their operational expenses. Plenny builds on this underlying compensation mechanism. To improve cash flow, Plenny's token enables Lightning Nodes to generate additional income while at the same time driving adoption of non-custodial payments processing on a larger scale.

Exchanges, trading operations, retail users, and miners benefit from Plenny when connecting their Lightning Node infrastructure with the liquidity of Plenny, thereby generating additional returns on their capital locked up in payment channels. Moreover, Plenny rewards Lightning Nodes that act as oracles for payment channel validation.

1.7 Centralization Risk

Operating Lightning Nodes requires stable connectivity and sufficient payment channel capacity. To control these prerequisites, a significant portion of present-day LSPs (i.e. Wallets, etc.) have started to cluster Lightning Nodes and build LN-hubs. This approach carries centralization risk. These counterparties act like traditional intermediaries, consequently representing custodial services that come with a high degree of regulatory risk.

Such LN-hubs maintain connectivity and payment channel capacity through their own infrastructure, often without making users sufficiently aware of the custodial setup. Furthermore, current implementations do not make the tracing capabilities for fund allocation, transaction flows, and decentralized cash management operations fully transparent. Therefore, potential fraud in LN-hubs represents permanent counterparty risk.

There are solutions on the market using Bitcoin multi-signatures and hash-time locked contracts for escrow transactions to grow the network and encourage renting and leasing of payment channel capacity. These solutions pool funds using Bitcoin scripts, which perform similar functions to sidechains (i.e. shadow chains[10]) but carry an immanent risk of centralization. Moreover, it is almost impossible for Lightning Nodes of retail users to get access to these business-driven services as they do not work permission-less but enforce whitelisting of selected nodes according to opaque criteria.[11]

The Plenny experiment, on the other hand, is permission-less and gives access to any Lightning Nodes that comply with the technical specification of the Dapp and the DON.

Plenny addresses trust issues by offering non-custodial solutions enabling Lightning Nodes to control access to their cryptocurrency through their own devices. To mitigate counterparty risk, Plenny does not cluster Lightning Nodes or operate LN-hubs. Instead, it decentralizes transactions over an oracle network and the Dapp.

In support of the notion of decentralization, the Plenny experiment builds on the non-custodial structure of the LN. Furthermore, by leveraging the Ethereum ecosystem, Plenny offers community-driven decentralized cash management. To practically test the potential and usability, checks and balances are introduced through traceability features. It also attempts to demonstrate comprehensive transparency to the community by providing governance parameters for voting.

1.8 Evaluation

The findings of the experiment are continuously evaluated and documented on Plenny.crypto. The data is available for peer review to anyone, including members of the crypto community, the open-source community, cybersecurity experts, and the scientific community. Since Plenny is permission-less, every Lightning Node can actively participate and help advance this practical study. In fact, anyone in the world can openly examine the setup online at any time. Furthermore, any token holder is allowed to comment and suggest changes for governance voting. Any input, whether academically qualified or coming from practice, can help to conduct the field experiment. This form of transparent ad hoc publicity enables free access to anyone, shortens feedback loops, delivers applied research results, and accounts for rapid advances in technology. This collective approach to R&D serves as self-regulation to ensure quality standards, improve performance, and establish credibility.

2 Implementation UI/UX

2.1 The Dapp

The implementation of the User interface (UI) of the Dapp, and the User experience (UX) when interacting with its components, is designed as follows:

2.1.1 Core Service

The core service of Plenny is a capacity market for payment channels branded as Lightning Ocean (LOC). The capacity market is a permission-less, non-custodial, Peer-to-Peer service targeting Lightning Nodes. The service-level provided by Plenny focuses on technically secure and economically viable operations across both the Bitcoin Lightning Network and on the Ethereum blockchain. By leveraging the capacity market, Lightning Nodes gain additional channel capacity on the LN and access to additional liquidity through the Ethereum ecosystem. Expanding the reach of Lightning Nodes leads to improved connectivity and better transaction routing overall. As a result, Lightning Nodes optimize economics for potential fee income in Sat while earning additional income in Plenny (PL2).

2.1.2 Domains and Blockchain Domains

- Plenny.link gives access to the blockchain domains of Plenny over Web 2.0.
- Plenny.crypto is a decentralized website providing information about the Plenny-Dapp over Web 3.0.
- Dplenny.crypto is a decentralized website to access the UI and the smart contracts of Plenny.

Web 2.0 uses the traditional Domain Name System (DNS). The decentralized websites use the Crypto Name Service (CNS), which is based on smart contracts on the Ethereum blockchain.

2.1.3 Decentralized Storage

Data and content of the websites of Plenny are stored and shared over a distributed file system[12] using a protocol and Peer-to-Peer network. This means data remains both decentralized and is always publicly available without using central servers or cloud platforms. Neither the data nor the blockchain domains can be removed from the Web by third parties. Distributed file systems improve censorship resistance and reduce the probability of DDOS attacks.

2.1.4 Participants

There are several participants in the Plenny ecosystem, each of which play an essential role in its economic and monetary policies, including the following:

- **Lightning Nodes**: Verified nodes on the LN that log outbound capacity (i.e. sending payments limited to local balance) to Lightning Oracles.
- **Lightning Oracle Validator (LORCA):** Lightning Nodes operating as oracles that validate the opening and closing of payment channels on the LN to reach consensus via the oracle network.
- **Liquidity Makers (LM):** Lightning Nodes operating as liquidity makers via the capacity market and provide inbound capacity over the LN (i.e. receiving payments limited to remote balance) on a P2P and P2C basis.
- **Liquidity Takers (LT):** Lightning Nodes that consume inbound capacity on the LN via the capacity market.
- **Plenny Whalers (PW):** Liquidity Providers (LPs) who use automated market maker (AMM) protocols on decentralized exchanges and engage in Liquidity Mining and staking liquidity token (LP-token) over the Dapp.
- **Plenny Governors (PG), Delegators (DEL) and Voters (V):** Token holders who participate in DAO (decentralized autonomous organization) Governance.
- **Community Members:** Any token holder, whether participating Lightning Node operators, early adopters actively contributing to Plenny at the technical level, any new token holder involved in the crypto ecosystem, including any Liquidity Providers in DeFi, and Ethereum-users who trigger the replenishment of the treasury or oracle election, are all considered members of the community, as token ownership comes with voting rights.

2.1.5 Components

The components of Plenny play an essential role and include the following parts:

- **Plenny-Dapp:** A decentralized application consisting of smart contracts that coordinate transactions between the LN and the Ethereum blockchain.
- **Plenny-DON:** Decentralized Oracle Network of oracle validators running on Lightning Nodes and using Proof-of-Stake (PoS) to reach network consensus on payment channel activity. Participating Lightning Nodes form the DON of the Plenny-Dapp.
- **Plenny Token (PL2):** An ERC-20 token serving as a hybrid token, and is deployed on two blockchains, namely the Ethereum Mainnet and Arbitrum One (Ethereum L2). The token is for licensing channel capacity, rewarding participants, making payments, locking and staking liquidity, and for governing Plenny.
- **Capacity Market:** A non-custodial Peer-to-Peer capacity market for payment channels to license liquidity (i.e. inbound capacity) from participating Lightning Nodes.
- **Plenny DLSP Module:** Multifunctional open-source software for providing the decentralized lightning services of the Dapp and to operate the DON.

The Lightning Nodes using the DLSP module compute transaction data off-chain (i.e. locally). This add-on module is a microservice for Lightning Nodes to connect with Ethereum and operate as Liquidity Makers and Lightning Oracle Validators.

- **Royalties and Channel Rewards:** Incentive schemes that support Royalties and Channel Rewards for payment channels. Technically, these functionalities are based on Non-Custodial Channel Rewards (NCCR). The NCCR-mechanism is integrated into the smart contracts interacting with the DLSP module. In this process, channel capacity in sat is logged and linked to PL2, which is a unique procedure to leverage bitcoin and allows Lightning Nodes to participate the Ethereum ecosystem.
- **Treasury HODL (TH):** A smart contract with token inventory locked to manage rewards for Lightning Nodes, capacity market participants, and oracle validators.
- **Reward HODL (RH):** A smart contract with token inventory locked that manages rewards for liquidity staking and governance.
- **RePLENishment Trigger:** Technical function for periodically triggering the allocation of funds. This component distributes the fees collected by Plenny back to the Treasury HODL and performs burning and buyback over the DEX.
- **Locking:** Features to lock PL2 balances in smart contracts. For instance, down payments when requesting inbound capacity in the capacity market and the Proof of Stake (PoS) for the validator threshold.
- **Fish Farming:** Functions for liquidity staking in smart contracts that generate rewards. For example, LP tokens from the liquidity mining program supported by a particular DEX are used for fish farming on the Dapp.
- **Oracle Election Trigger**: Community-driven trigger enabling users to periodically elect new validators.
- **Plenny Audit Bot**: A monitoring and analytics feature that provides insights into fund allocation and cash management operations.
- **Plenny Explorer:** A block explorer and transaction search feature that tracks the activity on Plenny.
- **DAO Governance:** This module supports staking PL2 for governance voting and ensures decentralized management by allowing community members to vote on and change parameters.
- **Delegation**: Feature to delegate voting rights for decentralized governance based on Delegated Proof of Stake (DPoS).

2.1.6 Plenny Token

To link the LN with Ethereum, the Plenny Community has implemented a token called “Plenny” using the ticker symbol “PL2.” It is vital to note that the Plenny-

token is not a replacement for bitcoin. Instead, Plenny is a complementary currency to enable interoperability with Ethereum. Considered across both chains, the users of Plenny are embedded in a dual token structure that relies on bitcoin in lightning payment channels while utilizing PL2 in the Ethereum ecosystem. The token contains utility and payment features that facilitate the following:

- Rewards for providing lightning services and payments for using lightning services.
- Rewards for running the Decentralized Oracle Network (DON) through its auxiliary component (i.e. DLSP module).
- Locking of token for down payments in the capacity market and for locking token as PoS.
- Staking of tokens for Fish Farming and DAO Governance to receive rewards.
- Payments of fees.

In general, the token is used to incentivize participation. Specifically, PL2 is the default payment option on the capacity market. In this regard, the token adds specific utility by being the payment method for licensing transaction data services via payment communication channels on a P2P basis (i.e. non-financial digital goods and services). Moreover, the token serves as a reward on the decentralized oracle network and for the different use cases via the Ethereum ecosystem on a P2C-basis, including governance.

Categorically, the legal clarifications indicate that PL2 is neither an investment in a company nor a share to participate in potential profits from the efforts of others. According to the distinguishing features of the Howey Test,[13] three out of four relevant criteria are not applicable. Therefore, Plenny cannot be classified as an asset token or a "security token." Instead, PL2 is classified as a "hybrid token" with utility and payment features as its central functions.

In terms of legal compliance, it nevertheless remains worth mentioning that PL2 is used differently by Lightning Nodes and LPs as well as governors. For one, Plenny is a hybrid token that provides utility and payment functions; for another, PL2 is a payment and governance token deployable on decentralized applications and markets. Within given circumstances, each has different regulatory implications. Fundamentally, Liquidity Makers and Lightning Oracles operate in the non-financial digital economy. These participants provide lightning services on the one hand by licensing channel capacities and on the other hand by validating payment channels. In contrast, Liquidity Providers (LPs) are related to the decentralized financial economy. LPs allocate cryptocurrency via AMM-protocols to enable decentralized financial activity. The token's governance functions also fall into this category. These two types of economies (i.e. non-

financial digital economy versus decentralized financial economy) differ from a functional and consequently from a legal point of view.

Plenny interconnects the various token classifications and use cases. In this respect, the Plenny experiment seeks to discover and bring together synergies so both economies benefit from each other. By using PL2 as the default payment method, participating Lightning Nodes can achieve economic benefits, as is potentially possible for LPs via decentralized markets. Since the volumes of the non-financial digital economy are lower compared to the volumes of the decentralized financial economy, Plenny features are designed to balance the different conditions to support the services provided by participating Lightning Nodes.

2.1.7 Incentives

Plenny rewards Bitcoin Lightning Nodes as well as users of the Ethereum ecosystem. Fundamentally, in parallel to the transaction activity over the LN, participating users earn rewards for using PL2 in the Ethereum-driven smart contracts of Plenny. The following types of incentives are given:

- For logging channel capacity: Lightning Nodes receive LN Channel Rewards for logging payment channel capacity on a non-custodial basis utilizing the NCCR-mechanism.
- For licensing channel capacity: Liquidity Makers earn Royalties and receive LOC Channel Rewards for the provision of inbound capacity.
- For oracle validation: Lightning Oracles receive Oracle Validator Rewards (OVR) for rendering validation services.
- For the staking of LP-token: LPs using the liquidity mining program receive liquidity token for Fish Farming via the Dapp and are incentivized with PL2.
- For the replenishment of the Treasury HODL: Users who trigger the rebase mechanism allocating fees and inflation for burning and buybacks receive a percentage of the replenished amounts.
- For initiating the oracle election: Users who trigger the election for new validators receive a fixed amount of rewards.
- For delegating to Plenny Governors: Delegators receive rewards for staking.
- For governance voting: Governors and Voters who stake PL2 and participate in the DAO receive rewards.

2.1.8 Community-driven Triggers

Key operational elements of Plenny are community driven. Administrative action items are shared through the decentralized design of the system with periodic public calls to action. Cash management operations that are centralized in traditional apps have been implemented as open-access triggers, allowing Plenny

to divide administrative tasks among community members. These tasks can be performed by any Ethereum-user who is free to trigger the event manually. As a result, users compete on triggering specific economic events that have the following characteristics:

- They need to happen periodically.
- They are potentially gas-intensive.

To foster decentralization and keep the cost of operating low, those actions are defined as functions any user can call at a specific frequency.

Community-trigger functions and their respective parameters include the following:

- RePLENishment Trigger: Triggering the replenishment of the Treasury HODL by re-distributing the fees collected by Plenny as well as performing burning and buybacks over the liquidity contract on the Sushi V2 DEX using Arbitrum One (Ethereum L2).
- Oracle Election Trigger: Triggering the election of new validators from qualified candidates.

As for the RePLENishment Trigger, the user who calls the function is rewarded a percentage of the monetary value the trigger facilitates. In this way, if the cost for triggering the event is higher than the reward, users might opt not to call the trigger. However, since the reward is cumulative and the cost is fairly fixed, calling the same function at a later point in time results in a reward that is higher than the cost. This implementation ensures there is always a time in which calling a trigger function is economically viable.

In terms of the Oracle Election Trigger, the user who calls the function is rewarded with a fixed amount.

2.1.9 Plenny DLSP Module

Liquidity Makers and Lightning Oracles download the same open-source software, namely the Plenny DLSP module. This specifically designed add-on module for Lightning Nodes supports the provision of lightning services on the capacity market via the Dapp as well as the provision of validation services via the DON.

For integration, participants install an executable application on their Lightning Node. Depending on the basic settings, the operating system, the service level and user type are recognized. The DLSP module provides a sample .ENV file that allows the operator to configure their own environment variables. It retrieves the information from the smart contracts to check the use case (i.e. Liquidity Maker or Lightning Oracle Validator) for connection to Plenny. The setup is completed over the UI of the Dapp. In the process, the Ethereum wallet's mnemonic phrase of the user always remains secret and under the user's control.

Running the DLSP module allows Lightning Nodes to perform transactions via the Bitcoin and Ethereum network. Computation functions log off-chain data from payment channels with on-chain data sources, thereby linking Lightning Nodes with the Dapp and the currency pair sat/PL2.

Through these additional functionalities, Plenny extends the perspective for the emerging digital economy within the broader crypto ecosystem by providing use cases across chains. Liquidity Makers and Lightning Oracles are supported in expanding their scope for transaction processing to better handle the expected increased market demand. Due to the exponential growth of the LN and the resulting economies of scale, Lightning Nodes using Plenny DLSP can generate income from token rewards in addition to sat income. Reduced capital cost, lower expenses, and higher income are achieved through increased volume provided via the additional liquidity of the Ethereum ecosystem.

2.1.10 Lightning Compatibility

In general, any compatible Lightning Node can run the Plenny DLSP module. The hardware and software requirements for Lightning Nodes correspond to the standard specifications.[14] In fact, only a BOLT-compliant Lightning Node is required (BOLT stands for Basis of Lightning Technology) to join the Plenny Dapp and DON.[15] Unlike other DONs, it is not necessary to install Ethereum nodes.[16]

2.1.11 OSS Licensing

Plenny grants data access through open-source software (OSS). The intellectual property released by Plenny is in the knowledge commons. The decentralized application with its native token and the DLSP module is a digital public utility maintained by a global community. Plenny serves as a shared resource for the common good of all users. The code is licensed under the MIT License for free and open-source software (open-sourced on GitHub).

2.2 Nodes & Rewards

2.2.1 Initial Verification

To claim ownership of a node, Lightning Nodes must connect to a Lightning Oracle and open a payment channel with a randomly generated verification amount. This method is commonly used in the LN-community and works as follows:

- The value of the random verification is set to an amount between 50k and 130k sat.
- By default, a Baseline Reward is granted to the Lightning Node for the initial verification of the random amount.
- Newly connected Lightning Nodes become eligible for Channel Rewards once the initial verification has been completed.

2.2.2 NCCR-mechanism

Lightning Nodes are fundamental for Plenny and its underlying decentralized infrastructure. Their participation in the decentralized application and the decentralized oracle network is supported in different roles and based on a key concept called Non-Custodial Channel Rewards (NCCR). The NCCR-mechanism is specifically designed for Lightning Nodes to incentivize participation via Plenny and for boosting the growth of the LN. In this process, channel capacity is logged in sat and linked to PL2. The concept provides a unique procedure to leverage bitcoin and allows Lightning Nodes to participate in the Ethereum ecosystem. Technically, the generation of Channel Rewards works as follows:

- Each time outbound capacity is logged, the NCCR-mechanism is used to generate incentives for Lightning Nodes.

In simple terms, Lightning Nodes hold sat in their payment channels and receive Channel Rewards for logging their capacity with Plenny, thereby linking the currency pair sat/PL2. The balance sitting in the payment channel serves as "bait" for "fishing" PL2, however, sat stay under control of the Lightning Nodes and remain non-custodial at all times.

The NCCR-mechanism does not result in bitcoin wrapped in an Ethereum contract. Through the use of oracles, the existence of sat in the payment channel is validated. The oracles log the data so that the proof of funds can be used for backing the arrangement between the nodes regarding channel capacity without the Lightning Nodes materially relinquishing control over sat. The Lightning Nodes only give each other indications about the control of the funds held in the payment channels. This procedure is not a Bitcoin script or Ethereum smart contract to explicitly lock sat or peg sat with another token, but a logging of transaction data in communication channels for validation purposes. The concept ensures that sat is utilized Peer-to-Peer and on a non-custodial-basis. NCCR does not refer to an allocation of money but instead to a validation of non-custodial collateral across chains. Using the NCCR-mechanism by logging channel capacity on Plenny leads to rewards which are locked on a P2C-basis.

By utilizing Non-Custodial Channel Rewards (NCCR), Lightning Nodes improve their connectivity and channel capacity on the LN while tapping into the liquidity on the Ethereum ecosystem. In parallel to holding capacity in sat on the LN, PL2 are locked in an Ethereum contract. In this way, the Bitcoin value in the payment channel implicitly supports the monetary value of Plenny's Ethereum-based token. The term "implied collateral" expresses the type of collateralization more precisely. Essentially, the NCCR-mechanism measures the topology of the underlying lightning economy by assessing the value of participating Lightning Nodes and generates token rewards accordingly. The procedure extrapolates transactional data sets of Lightning Nodes wherein channel capacity serves as the

benchmark for Channel Rewards. Effectively, outbound capacity is accredited as an inherent building block that facilitates connectivity on the LN. To support network effects, outbound instead of inbound capacity is validated. Notably, outbound capacity is not collateralized through holding sat in Bitcoin smart contracts, but supplemental tokens are locked in an Ethereum smart contract. The mechanism works similar to virtual payment vouchers. Based on the implied collateral in sat, Lightning Nodes receive rewards in PL2, making the NCCR-mechanism a unique procedure to leverage bitcoin and allow Lightning Nodes to participate the Ethereum ecosystem.

2.2.3 General Channel Rewards Formula

The General Channel Rewards Formula is applied to LN Channel Rewards as well as LOC Channel Rewards. The general formula to calculate the two types of Channel Rewards uses the same general scheme, but the parameters can be set differently for each type.

The general formula to calculate the value of Channel Rewards for logging outbound capacity is a fixed amount or a percentage amount depending on which is lower:

$R = min(F \times C_M, TH_R \times P \times C_M)$

- R is the reward received in PL2.
- F is a fixed reward.
- C_M is the capacity multiplier.
- TH_R is the current Treasury HODL reserves.
- P is a percentage-based reward.

Simply put, Lightning Nodes receive Channel Rewards in proportion to the capacity (i.e. amount of sat) and relative to the duration of the payment channel, depending on Plenny's reserves.

- The fixed amount (F) is set to X* PL2.
- The percentage (P) is set to X%.
- The percentage-based variable (known as the Time Lock Reward in the Nucleus release**) defines the % of PL2 to be unlocked relative to a given time period (e.g. 1d is ≈6,500 blocks) from the total locked PL2 amount based on the bitcoin (i.e. sat) available in the payment channel.
- Also, the percentage-based variable to calculate the value of rewards depends on the amount reserved for distribution in the Treasury HODL (TH_R).
- The general reward threshold is set to X sat (e.g. 500,000), meaning Channel Rewards require this minimum amount of capacity in payment channels before LN Channel Rewards or LOC Channel Rewards can be generated.

The decisive factor in the general formula is the capacity multiplier. By using a capacity multiplier, higher capacities are rewarded above-average. This exponential growth calculation is intended to favor the participation of high-volume payment channels provided by stable nodes. Channel Rewards grow exponentially depending on the outbound capacity in sat. The original setup is based on the following values:

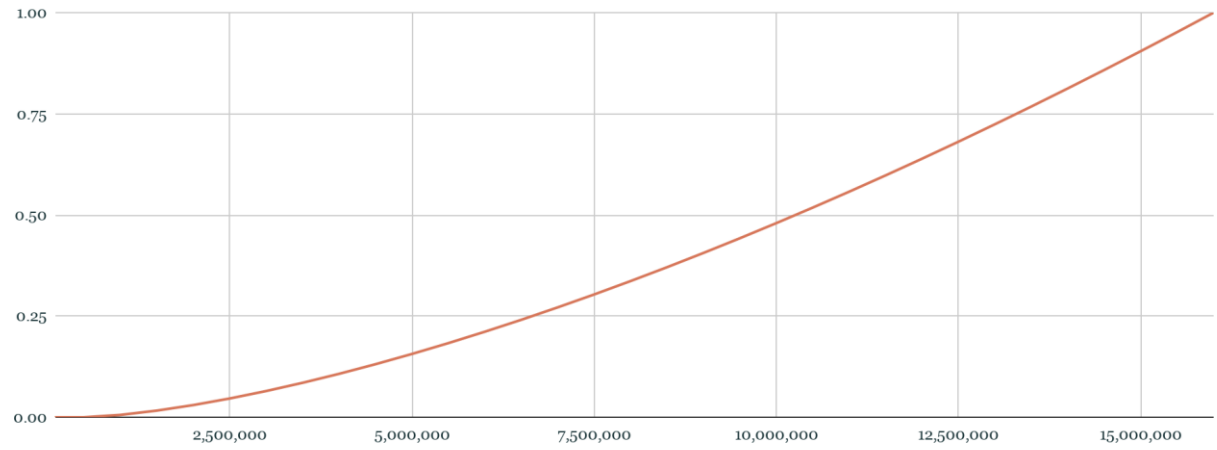
- P = 500,000 (minimum size in sat).
- C_{max} = 16,000,000 (maximum size in sat).
- N = 1.5 (i.e. this constant is a pre-defined value referring to the square root function in Solidity)

The capacity multiplier is further defined as:

$$C_M = Max((\frac{C_S - P}{C_{max} - P})^N, 0)$$

- C_S is the capacity provided in Satoshi (sat).
- P is a threshold value (to discourage smaller channels).
- C_{max} is the maximum permissible channel size in Satoshi (sat).
- N is a power exponent for token rewards.

Applying these numbers results in the following reward multiplier curve based on the channel size in Satoshi (sat):



The values for the actions quoted above follow the high-level logic that F equals P given the token inventory of 250M PL2 (the primary size of the Treasury HODL).

*X serves as a placeholder specifying a variable in the Smart Contract. Most of the variables and parameters used are visible through the Dapp user interface. Variables can be adjusted if the community votes by majority to change a setting.

**See Release and Version History.

2.2.4 General Channel Reward Types

There are two types of general Channel Rewards depending on the role of the Lightning Node as follows:

- The first type (i.e. LN Channel Rewards) is for standard Lightning Nodes that log payment channels with Lightning Oracles.
- The second type (i.e. LOC Channel Rewards) is aimed at Liquidity Makers who participate in the capacity market.

The two types of general Channel Rewards can be distinguished on the application level. On the base level, LN Channel Rewards require manual logging of outbound capacity, while participants on the capacity market receive LOC Channel Rewards automatically through logging payment channel capacity by using the DLSP module.

2.2.5 Specific Baseline Reward

In addition, standard Lightning Nodes and Liquidity Makers receive a specific type of reward for channel capacity, the Baseline Reward. It is given as a minimum reward for standard Lightning Nodes that log payment channels with Lightning Oracles and is also granted to Liquidity Makers in the capacity market.

This specific type of reward serves as a basic compensation in addition to the Channel Rewards to make up for blockchain transaction costs. The Baseline Reward is a fixed amount (e.g. 250 PL2) and based on estimated average exchange rates. It offsets the cost of both Ethereum transaction fee (gas) and the Bitcoin on-chain transaction fee.

The fixed amount in PL2 is designed to be equal or higher than the estimated total cost of gas and bitcoin fees and is supposed to include a +20% bonus. The bonus covers currency risk to which the transaction-related costs of the Lightning Nodes are exposed.

Average exchange rates are used for the conversion to PL2. The costs for both blockchains are estimates that are regularly calculated off-chain by community members and can be adjusted by the community at any time. If exchange rates fluctuate, causing cost compensation to fall out of balance, the Baseline Reward is changed through calling for a governance vote.

2.2.6 LN Channel Rewards

LN Channel Rewards require manual intervention by Lightning Node operators. Following the maritime theme of Plenny, in this scenario standard Lightning Nodes operate by hand like fishermen using a fishing rod. They “fish” in the port for Channel Rewards. This feature works as follows:

- As a prerequisite for claiming LN Channel Rewards, Lightning Nodes must complete the initial verification.
- Users apply manually for LN Channel Rewards, which are incentives for logging outbound capacity of Lightning Nodes when opening payment channels with Lightning Oracles.
- Incentives depend on the duration and amount of sat locked up in non-custodial payment channels over the LN.

LN Channel Rewards serve as a free entry bonus for standard Lightning Nodes. In effect, this feature acts like a discount to facilitate participation in Plenny. In particular, the incentives encourage Lightning Nodes to join the capacity market as Liquidity Takers. Rewards can be used to license inbound capacity at a lower cost or be used for other use cases on the Dapp and crypto ecosystem. In detail it works as described below:

- Lightning Nodes log their outbound capacity utilizing the NCCR-mechanism.
- By default, each channel qualifies for the Baseline Reward. This incentive applies even to low-volume channels with capacity ranging from X sat (e.g. +20,000) to X sat (e.g. 500,000).
- Above the general reward threshold of X sat (e.g. 500,000) the General Channel Rewards Formula is applied, resulting in additional rewards known as LN Channel Rewards. Below this general reward threshold, payment channels can be opened, but only the Baseline Reward is granted.
- Once Lightning Oracles have validated the capacity in the payment channel, LN Channel Rewards get locked on Plenny on a P2C-basis and released over time.
- Participating Lightning Nodes generate LN Channel Rewards until the total rewards are collected or the payment channel is closed.
- To avoid transaction spamming, no rewards are due if the payment channel is closed within 24h (e.g. ≈6,500 blocks per day), encouraging connectivity with stable nodes.

The rewards period for channels and the minimum amount for initial verification are configurable and subject to governance voting.

2.3 Capacity Market

2.3.1 Lightning Ocean (LOC)

The capacity market is branded as Lightning Ocean (LOC). It facilitates the licensing of inbound capacity and enables Lightning Nodes to collect licensing fees and earn LOC Channel Rewards in PL2 for rendering lightning services.

The capacity market of Plenny builds on fundamental properties of the Lightning Network. The inbound capacity of a Lightning Node plays a decisive role because this amount determines how much money can be received. Briefly explained, when a payment channel is opened via the LN, a certain amount of sat is locked. This is referred to as channel capacity. Both connected peers own their funds allocated to the channel capacity. The amount of sat Lightning Nodes can receive is limited by the remote balance and is referred to as inbound capacity. The amount of sat Lightning Nodes can send is limited by the local balance and is referred to as outbound capacity.

Often, Lightning Nodes do not have enough inbound capacity. Therefore, there is a demand for inbound capacity, which can be obtained from other Lightning Nodes in various ways. However, finding channels with suitable inbound capacity to receive lightning payments can be challenging. Plenny's capacity market solves this problem by providing a decentralized solution for licensing inbound capacity.

The roles of the participants in the capacity market are clearly defined: Liquidity Makers act as licensors to share their capacity with Liquidity Takers who act as licensees and pay Royalties for the same. The value exchange mechanism underlying the economics of the capacity market is based on capturing the time value of money through leveraging the capital tied up in payment channels as a benchmark to determine the licensing cost.

To clarify, the capacity market is not an exchange with a matched order book. Instead, it is a P2P marketplace. Makers quote their available inbound capacity in sat, taking the amount of time into consideration for licensing inbound capacity. Royalties are customizable and indicated in PL2 relative to bitcoin, but there is no fixed formula per sat as Makers are free to set the licensing fee and negotiate with Takers according to market conditions. PL2 is the payment method on the Dapp while sat is used in parallel to provide payment channel capacity.

Lightning Nodes utilize both cryptocurrencies (sat and PL2) for payments over both networks (the Bitcoin Lightning Network and the Ethereum blockchain). These two value exchange mechanisms work hand-in-hand, one via the LN and the other via Plenny. Alongside the payments over the LN, however, Makers quote Royalties in PL2 and Takers can opt to take the offer or not.

In practice, Royalties for transaction data services via payment communication channels are tokenized by billing the cost of inbound capacity in PL2, and by concluding the licensing agreement through the payment transaction with Plenny tokens.

In summary, the capacity market works as follows:

- Lightning Nodes act as Liquidity Makers or Takers.
- The cost for inbound capacity is reflected in the Royalties (i.e. licensing fees paid by Takers).

- Royalties are subject to market demand and are therefore negotiable: Makers are free to post an asking price, Takers can accept or offer a bid price.
- Royalties are paid in PL2 serving as the payment token of the capacity market.
- Inbound capacity is provided in sat over the LN.

2.3.2 Channel Licensing

Channel Licensing refers to the nature of transactions and the business activity taking place in the capacity market. In terms of compliance, Lightning Nodes providing inbound capacity are software service providers but do not qualify as financial intermediaries subject to regulation. Considered under contract law, the purpose of the payments among Lightning Nodes is to address the cost of channel licensing or, more precisely, the fees for licensing transaction data services that occur in PL2. In legal terms, channel licensing is an arrangement through which a licensor licenses transaction data services via payment communication channels to a licensee.

In computer science, channel capacity is the rate at which data can be transmitted over a communication channel. Such data services are commonly known and offered by an Internet Service Provider (ISP) or mobile network carrier for providing connectivity at a specified unit. With that said, the licensing of channel capacity is a technical service that constitutes renting out bandwidth (i.e. data transfer rate) for communication channels. The data transfer rate refers to the amount of digital data that is moved from one place to another in a given time. Traditionally, these services are licensed to users, who are compensated with royalty payments referring to the non-financial digital economy. Transactions via the capacity market on Plenny are of the same nature because they refer to the same activity.

Using Plenny, Lightning Nodes provide connection access to payment communication channels which allow for sharing transaction data. Transaction data consist of information about node ID, channel ID, channel capacity and licensing fees.

The arrangement among users concerns the right to use channel capacity but does not include custody or transfer of third-party funds. Channel licensing occurs on a non-custodial basis and is based on P2P and P2C transactions between Lightning Nodes using the Lightning Network for channel capacity and their Ethereum wallet for payments in PL2. No money transfer and no payments processing arise. Also, no borrowing or lending of funds, or other services (i.e. no payment of interest or dividends for deposits) relating to the decentralized financial economy are involved. Users only settle licensing fees among themselves. These transactions represent payments for non-financial digital services.

Consequently, providing channel capacity cannot be classified as a financial service. In practice, participating Lightning Nodes license channel capacity from and to others by utilizing open-source software, decentralized smart contracts, and blockchain services. As Royalties are invoiced in PL2, Plenny's licensing model for inbound capacity is technically understood to represent a tokenized licensing agreement for transaction data services via payment communication channels.

2.3.3 Royalty Calculation

Liquidity Makers earn Royalties from Liquidity Takers and receive LOC Channel Rewards from Plenny. Royalties are collected by Makers for licensing transaction data services via payment communication channels. These licensing fees are paid on a usage basis. Takers only pay for consumption expressed in terms of inbound capacity for as long as they use the services provided.

Royalties are customizable and freely determined by the Liquidity Maker offering inbound capacity. Makers quote the cost and the service level over the capacity market. In general, it is assumed that there are costs associated with licensing transaction data services through payment communication channels. The fully absorbed costs relate to expenditures for the maintenance of payment channels, including the capital cost for inbound capacity in sat and cost of capital in PL2, LN transaction fees, the gas fee in ether, the expenses for hardware and software, other overhead, and the net margin of the Lightning Node. Ultimately, these costs are covered by the LM. Consequently, licensors must add their net margin when licensing inbound capacity through the capacity market. The recommended net margin to be included in the Royalties is +20% in addition to the primary costs. Liquidity Makers may perform their price calculation independently and set the licensing fees in PL2 at their own discretion.

2.3.4 LOC Channel Rewards

Besides receiving Royalties from LTs, Makers receive LOC Channel Rewards from Plenny for opening payment channels and logging the liquidity of Lightning Nodes over the capacity market. As a prerequisite for claiming LOC Channel Rewards, Lightning Nodes must operate as Liquidity Makers on the capacity market. This use case is recognized by the Plenny DLSP module, which supports automated operations. In this scenario, Lightning Nodes operate automatically like vessels with professional fishing equipment. They "fish" in the Lightning Ocean for Channel Rewards. This feature works as follows:

- Users claim LOC Channel Rewards and the Baseline Reward automatically via the DLSP module when opening payment channels over the capacity market.
- These incentives are for Lightning Nodes that act as Liquidity Makers based on their outbound capacity (i.e. local balance of Maker for sending

sat) when licensing inbound capacity (i.e. increasing the remote balance of Taker for receiving sat).
- Incentives depend on the duration and amount of sat locked up in non-custodial payment channels over the LN.
- The general reward threshold for Channel Rewards applies to the Capacity Market, which means that LOC Channel Rewards start at a minimum capacity of X sat (e.g. 500,000).
- Consequently, payment channel capacity below the general reward threshold cannot be licensed through the capacity market. This parameter ensures that primarily high-volume channels are made available through the capacity market.
- As a result of the parameter, no Baseline Reward is due below the general reward threshold (unlike the incentive scheme for standard Lightning Nodes logging payment channels with Lightning Oracles outside of the capacity market).
- For clarity, Liquidity Makers receive LOC Channel Rewards and in addition the Baseline Reward, when the general reward threshold is exceeded.
- If payment channels are closed within 24h (e.g. ≈6,500 blocks), the Maker receives only the Fixed Royalty to cover the initial cost of the meta-transaction initiated by the Taker when requesting inbound capacity, but otherwise no LOC Channel Rewards and no Baseline Reward are due.

As distinguished from Lightning Oracles, Liquidity Makers do not have to lock token for PoS to participate in the capacity market.

2.3.5 Transaction Flow

Transactions related to providing inbound capacity over the capacity market happen one after another on two blockchains, Ethereum and the Lightning Network. As a basic requirement, Lightning Nodes handle payment channels over the LN as usual and set transaction fees in sat at their own discretion. Also, gas fees on Ethereum are dealt with by Lightning Nodes.

However, building on the underlying transactions in sat, participating in the capacity market involves the use of PL2. To clarify, payment channels are maintained over the LN in sat while the capacity market transacts in PL2. This procedure handles fees and rewards incurred in PL2 separately via Ethereum.

To summarize, the transaction flow, interaction, and setup of Lightning Nodes on the capacity market works as follows:

- As a prerequisite, Lightning Node users register an Ethereum wallet and address (e.g. MetaMask).

- The newly connected Lightning Node uses the capacity market and chooses its role: Liquidity Maker or Taker or both.
- Makers use the Plenny DLSP module for computing data off-chain.
- Makers offer the opening of payment channels with inbound capacity over the LN in sat while quoting the Royalties over the capacity market in PL2.
- The Royalties for opening a channel via Plenny is freely determined by the LM. This cost is expressed as X PL2 per sat per 24 hours (e.g. ≈6,500 blocks).
- Liquidity Takers can join the capacity market without using the DLSP module. However, Takers only need to lock PL2 for down payment of Royalties. They choose from various offers and opt for the desired inbound capacity.
- To obtain inbound capacity, Takers lock the quoted Royalties in PL2 in the capacity market.

The interactions in this process consist of several operations highlighted below:

I. First operation on-chain for reservation via P2C: Takers populate and sign their transaction data to request inbound capacity in sat via HTTPs. This locking event is an on-chain transaction using Ethereum. It is gas-less as the Taker relays this meta-transaction fee for prepayment to the LM.

II. Second operation off-chain for opening the payment channel on the LN via P2P: As a result, the DLSP module of the Liquidity Maker automatically opens a payment channel and provides transaction data services while providing inbound capacity via the LN over their Lightning Node in sat.

III. Third operation on-chain for authorization via P2C: In this operation, the DLSP module automatically triggers the smart contract for Channel Rewards in PL2, which get locked in the capacity market contract. This event is a blockchain transaction that requires gas fees to be paid by the LM. These expenses are partly compensated through an immediate payment (i.e. fixed amount) to the LM.

During these operations, Lightning Oracles validate payment channel capacity on the LN and payment details on Plenny as soon as the activity becomes apparent on both sides. The validation requires a blockchain transaction and gas fees to be paid by Lightning Oracles. These costs are offset by the amount of Oracle Validator Rewards that are immediately paid as part of the validation transaction. In the process, Lightning Oracles monitor the opening and closing of the payment channel and trigger the smart contract to release to the Maker the previously locked rewards, which originate from the down payment of the Taker.

Royalties and rewards are distributed gradually. The Fixed Royalty is paid immediately, then the LOC Channel Rewards are distributed daily and the Baseline Reward distribution is split over time. Reaching the total amount of royalties and rewards due is thus aligned with the duration of the payment

channel. This means that Liquidity Takers receive a pro-rata refund of their down payment if the payment channel is closed early. The implemented distribution method is a security mechanism to avoid transaction spamming and to ensure users do not close payment channels right after opening them. In summary, this process works as follows:

- Royalties and Channel Rewards are calculated in 24-hour increments based on the capacity provided. Settlement payments are done at the end of each increment to ensure the channel remains available.
- To start with, Plenny distributes an immediate initial payment (i.e. Fixed Royalty) of the PL2 locked by the Taker to partly compensate the Maker for expenses. The remaining Royalties and Channel Rewards are distributed proportionally over time for as long as the payment channel is kept open.
- Royalties and Channel Rewards are automatically distributed among the participants. However, accrued rewards can be collected manually after 1 d (e.g. ≈6,500 blocks). At this point, the amount of collected Royalties and Channel Rewards is deducted from the running balance.
- When the total Royalties and Channel Rewards are reached, Makers stop earning rewards.
- Upon payment channel closure, the Taker gets back the remainder of their unspent down payment.

2.3.6 Liquidity Maker (LM)

Liquidity Makers use the DLSP module to provide non-custodial inbound capacity. This tool enables Lightning Nodes to participate in the capacity market while acting independently on the LN. Makers earn Royalties for licensing transaction data services via payment communication channels on the one hand while receiving rewards from Plenny on the other. Rewards are given for operating Lightning Nodes, providing channel capacity to other Lightning Nodes, and for participating in the network. In the process, Makers transact with Takers directly using both sat and PL2. The features include the following functionalities across the LN and Ethereum ecosystem:

- Makers specify both of their rates independently, including the regular transaction fees in sat for providing inbound capacity over the LN and the Royalties in PL2 for rendering services to Takers over the capacity market.
- In addition to earning Royalties over the capacity market, Makers receive the Baseline Reward and Channel Rewards from the Treasury HODL according to the given formula.
- In addition, Makers receive the first payment (i.e. Fixed Royalty) right after the channel has been opened (to partially offset the costs of the meta-transaction passed on by the Taker).

- Makers realize earnings in PL2 when the total Royalties and the Channel Rewards are collected.

2.3.7 Liquidity Taker (LT)

The LT licenses inbound capacity from the LM. In this role, there is no further verification required, and no need to download the Plenny DLSP module. The cost represents the Royalties paid in PL2. This feature works as follows:

- Takers lock a suitable balance of PL2 in the capacity market contract for down payment of quoted Royalties when requesting inbound capacity.
- To obtain inbound capacity, Takers request it manually. This transaction is gas-less as it is relayed to the LM.
- Transactions occur one after another, first on Plenny and then on the LN.
- Takers pay Royalties to Makers.
- There are no rewards for Takers in this use case.

2.3.8 Maker and Taker Fees

Both, Liquidity Makers and Takers are subject to the following fees:

- Makers pay a Maker Fee. This liquidity fee is based on the channel capacity and is a percentage of the total Royalties and Channel Rewards.
- LTs pay a Taker Fee. This liquidity fee is based on the channel capacity and is a percentage of the total Royalties and Channel Rewards.
- The Maker and Taker Fee are directed to the Treasury HODL through the rebase mechanism.
- The Taker Fee is paid in PL2 and due as soon as the request is fulfilled.
- The Maker Fee is paid in PL2 and due on a transaction basis (deducted from the LOC Channel Rewards).

2.3.9 Semi-Automated Operations

Liquidity Makers operate with little manual intervention as long as they maintain a sufficient balance of sat on their Lightning Node to open payment channels and keep enough ETH in their Ethereum wallet for transactions.

The DLSP module runs continuously, computing transaction data off-chain and transmitting transaction details to the Dapp automatically. The tool assists the Maker in managing operations via Plenny 24/7. There is no need for reopening the channel manually on the Lightning Node when the Liquidity Taker closes the channel. Also, there is no need for reposting the offer as it remains open on the capacity market in any event, becoming available for new requests automatically after closing.

Makers only need to check regularly whether the maximum performance period is still in line with the Royalties. Profitless channels can be closed and re-offered. In

addition to deposits and withdrawals in bitcoin, ether, and PL2, cash management is also carried out by the operator itself. Users control their wallets independently and set their own transaction fees in sat on their Lightning Nodes.

Channel Rewards are locked for at least as long as the payment channel is open. PL2 locked in Plenny's smart contracts is subject to currency risk. For this use case, manual collection of rewards is required to get tokens into the user's wallet.

Apart from that, Lightning Oracle Validators continuously feed data into the network, so most operational tasks on the capacity market are fully automated. The LM simply needs to monitor current market conditions over the Dapp to adjust Royalties and capacity as needed.

2.3.10 Scoring

Initially, no rating feature is implemented or thresholds defined for users of the capacity market. However, a score list for participants is subject to an informal governance proposal. The allocated node liquidity, the uptime of the payment channels, and the earned or paid Royalties and Channel Rewards are crucial metrics for demonstrating operational stability and scoring Liquidity Makers and Takers.

2.4 Lightning Oracle Validator (LORCA)

2.4.1 Concept

Simply put, Lightning Oracles validate and observe payment channels activity. This component ensures connectivity and liquidity when Lightning Nodes interact with the Bitcoin Lightning Network and the Ethereum ecosystem. In the broadest sense, these specific oracles work like lighthouses highlighting transaction data of payment channels, thereby allowing Plenny to safely navigate across chains.

In community jargon, Lightning Oracle Validators are abbreviated as LORCA. The term follows Plenny's maritime theme and ties in with the killer whale or orca,[17] known as the guardian of the ocean.

2.4.2 Decentralized Oracle Network (DON)

Plenny reaches channel consensus over a sophisticated trust-building mechanism using a Decentralized Oracle Network (DON). Participating oracles serve as a chain link to connect Lightning Nodes to Plenny and form the network that logs and links off-chain data from Lightning Nodes with on-chain data sources.

In general, Oracle validators safeguard the connectivity of Lightning Nodes and payment channels. In the process, they monitor the channel activities of participating Lightning Nodes on Plenny, including the capacity market, and in return they are incentivized for their work.

Both channel capacity and consensus among Lightning Oracles are validated based on Proof of Stake (PoS). Only elected lightning oracles provide validation services, with multiple oracles ensuring data integrity. During the validation cycle, they compete against each other on a transaction basis. The oracle who correctly validates the fastest wins and earns the highest amount of rewards. The others confirm the validation, and the remaining rewards are shared proportionately among all.

The DON is neither a lightning hub nor a sidechain. It is an independent network interconnected with the LN and the Ethereum ecosystem. Off-chain computations are collected by oracle validators in a cryptographically secured manner and transmitted on-chain to Plenny's smart contracts. The consensus mechanism ensures data integrity and mitigates evidently valueless information from entering the DON.

2.4.3 Proof of Stake (PoS)

Oracle validators reach consensus on-chain over a Proof-of-Stake (PoS) mechanism. This set of smart contracts, also known as POSDAO, uses a Proof-of-Stake (POS) algorithm implemented as a decentralized autonomous organization (DAO). POSDAO is designed to provide a decentralized, fair, and energy-efficient consensus. The protocol incentivizes actors to behave in the best interests of the network.

2.4.4 Validator Threshold

The validator threshold requires Lightning Nodes to lock PL2. As a prerequisite to participate in the DON, Lightening Oracles lock a minimum amount of token. This collateral serves as a Proof-of-Stake (PoS) to secure the Decentralized Oracle Network (DON) and ensures Lightning Oracles hold a stake in the network.

Oracle validators must lock a threshold while they act as validators. They cannot remove this fixed amount of token from the smart contract during operations. In this regard, the threshold value of the oracle validator serves as a kind of bail.

LORCAs can increase their balance to exceed the validator threshold and as a result reach a better score to increase the likelihood of their services being elected more frequently.

Conceptually, the threshold value represents an option for penalties. In the future, potential misbehavior of LORCAs could be penalized. However, this feature was not enabled in the early versions of the DON. Penalties could be imposed if oracle validators provide false information and corrupt the channel consensus mechanism.

Applying penalties is also known as slashing. The two key misbehaviors that would lead to slashing are downtime and double signing. If oracle validators

misbehave, their balance will be reduced. Penalties are a function of the effective balance, which triggers exit from the DON when the balance falls below the threshold. In essence, slashing is intended to deter and exclude bad actors while also incentivizing node security, availability, and network participation.

The validator threshold is subject to governance voting.

2.4.5 Consensus Mechanism

To participate in the consensus mechanism, Lightning Oracles download the Plenny DLSP module. In detail, the validation process to reach consensus works as follows:

- All elected validators are linked to each other via the DLSP module to share data and confirm consensus over HTTPS connections, which enables communication among oracles off-chain.
- When a new channel is opened or closed, the elected validators try to obtain enough cryptographic signatures for reaching consensus.
- The signatures are generated off-chain using the DLSP module, which connects the Lightning Node of the oracle validator to its Ethereum wallet.
- When a payment channel needs to be validated, the oracles get the data from the Bitcoin Lightning Network and compete with each other to obtain a sufficient number of signatures from other validators.
- The validator who obtains enough cryptographic signatures first is the consensus winner and authorized to post the validation data, confirming consensus on-chain on the Ethereum blockchain.
- The signature is a hash key of the channel info and channel data signed with the oracle's private key.
- The validators' signatures are matched against the channel data already stored in the smart contract. If the signatures are valid, the opening or closing of the channel is confirmed.

2.4.6 Oracle Validator Rewards (OVR)

The transaction volumes for LORCAs and Plenny Whalers (PW) have different ratios, so the incentives also differ. To compensate for various economic conditions, rewards are given proportionately. The formulas applied on Plenny balance the volumes of the non-financial digital economy in the capacity market and the oracle network with the volumes of the decentralized financial economy in decentralized markets.

As a guiding principle, Lightning Oracles receive higher rewards than Plenny Whalers due to their greater technical engagement and higher operational cost. PWs allocate cryptocurrency to provide liquidity on decentralized markets and stake liquidity token on the Dapp without handling technical maintenance of the

decentralized infrastructure of Plenny. In contrast, LORCAs operate Lightning Nodes and provide technical services to ensure the functionality and security of Plenny.

Basically, LORCAs receive Oracle Validator Rewards for the validation of opening and closing payment channels. In detail, the reward scheme for oracle validators works as follows:

- LORCAs benefit from a specific remuneration scheme different than Channel Rewards for regular Lightning Nodes.
- LORCAs receive OVR for the initial verification of Lightning Nodes according to the OVR transaction calculation.
- OVRs are distributed automatically on a transaction-basis once the validation is successfully completed. This means OVRs are given by the Treasury HODL as soon as the oracle validator has submitted the data to confirm the consensus on-chain. This event happens within the channel opening or closing validation transaction. Once the consensus is reached and the final state of the channel is confirmed, rewards are distributed.
- OVR is due as soon as consensus is reached and the final state of the channel is confirmed, ensuring LORCAs are compensated in real-time and not exposed to currency risk.

The token economy allows Lightning Oracle Validators to earn fees for providing validation services. To incentivize early adopters, LORCAs earn more OVR at first. Once the experimental phase is completed and critical mass has been reached, OVR might be lowered by governance vote.

2.4.7 OVR Formula

The rewards due are calculated on a transaction basis as follows:

- OVR is either a minimum fixed number of token (F) or a percentage (P) of the amount reserved in the Treasury HODL (depending on which is lower).

Based on the formula for reserve sustainability, the reward percentage is multiplied by the Treasury HODL reserves and divided by 100. If the result of this calculation is lower than the fixed amount, the percentage is applied, otherwise the fixed amount is used.

2.4.8 OVR Distribution Formula

The compensation model for oracle validators creates permanent incentive circles and accounts for participants' costs of providing services. In general, consensus winners earn significantly more because they pay the gas fee for submitting data on-chain and thus have higher expenses. The distribution of Oracle Validation Rewards (OVR) works as follows:

- OVR = X% of the smart contract controlling consensus.

- The reward of the functions is P (percentage) of the rewards.
- The oracle validator who submits the data to confirm consensus first on-chain earns ≈85% of the OVR.
- The other oracles who signed the data off-chain share the remaining rewards (≈15%).

2.4.9 Validation Cycle

For each validation cycle, a group of validators (e.g. 3 to ∞) is elected. The validation cycle lasts for 1 week (e.g. approximate corresponding block period is ≈45,500 blocks) and consists of several distinct steps as described below:

- Election of new validators from all the potential LORCA candidates based on their score.
- The election is based on a snapshot of the current validator score using the following criteria: number of PL2 locked and the number of OVR earned.
- After the validators have been elected, their balances of PL2 token locked and earned are snapshotted and used throughout the whole validation cycle.

LORCAs may adjust their locked balance during the current validation cycle, but this adjustment will not take effect until the beginning of the upcoming validation cycle to allow oracles enough time to review and their figures if necessary.

Both the number of validators and the duration of the validation cycle are subject to governance voting.

2.4.10 Operative Use

The DLSP module runs continuously. It assists Lightning Oracle Validators in managing operations on the Dapp around the clock. This use case is recognized by the Plenny DLSP module, which supports automated operations like subscribing to events and trigger functions. As a result, Lightning Oracle Validators operate with little manual intervention as long as they lock the validator threshold and keep enough ETH in their Ethereum wallet for transactions.

2.5 Oracle Election Trigger

2.5.1 Concept

This community-driven trigger initiates a new oracle election. The end of the validation cycle (and the beginning of the new one) is periodically triggered by users. Any Ethereum-user can trigger the new election cycle and earn rewards as follows:

- Users trigger the new election cycle manually at their own discretion (i.e. at the earliest after X blocks), and as a result the trigger user is incentivized with the Election Trigger User Reward (ETUR) which is a fixed reward.

The parameter for ETUR is subject to governance voting.

2.5.2 Leaderless Consensus

The DON uses a leaderless consensus mechanism. It includes an integrated automatic failover mechanism to systematically maintain operational effectiveness. The failover mechanism mitigates downtime of oracle validators, ensuring off-chain data is submitted on-chain continuously. Electing new oracle validators works as follows:

- The function can be called at most once every week (e.g. ≈45500 blocks), is parameterized, and subject to governance voting.
- If no election cycle is triggered manually, the DON continues with the previously elected oracle validators.

In the experimental phase, the DON is pursuing a progressive decentralization approach with the aim of improving scalability through expected technological progress.

- Maximum validators during the experimental phase (i.e. BETA release): ≈100 Lightning Oracles.
- Maximum number of validators in later versions: Infinite (although the gas limit on Layer 2 suggests utilizing a limited number of validators for the early versions of the DON).

2.5.3 Validator Score Formula

The performance of LORCAs is continuously measured by Plenny. Their score is determined by several parameters indicating reputation and stability. The criteria include the amount of Plenny locked for Proof-of-Stake and the amounts earned. The frequency at which a particular validator is elected depends on their score. Below is the formula for the score:

$Score = S \times PoS + A \times AM$

- S is the number of PL2 locked.
- PoS is the PoS-multiplier.
- A is the OVR (i.e. actual amounts earned).
- AM is the reputation multiplier for the OVR.

2.6 Token Balances

2.6.1 Locking

Locking is supported at different levels to lock PL2 in smart contracts. It is used for down payments in the capacity market and for the PoS of the oracle validator. The locked balance of the user is displayed on the UI of the Dapp.

2.6.2 Staking

Staking for rewards is supported through smart contracts at two different levels. On the one hand, users allocate ETH and PL2 to the specific liquidity contract of the particular decentralized exchange, which supports Plenny's liquidity mining program. LP-tokens are then staked for Fish Farming via the Dapp. PL2, on the other hand, is staked via DAO Governance. The staked balance of the user is displayed on the UI of the Dapp.

2.7 Fish Farming

2.7.1 Concept

Plenny's liquidity mining program offers liquidity staking with rewards paid from the Reward HODL. LPs receive LP-token when providing liquidity over the liquidity contract on the Sushi V2 DEX using Arbitrum One (Ethereum L2). As a next step, LPs engage in what is called "Fish Farming" on the Dapp. This term is community jargon and refers to Plenny Whalers who stake LP-token. Whalers (more specifically, LPs) "fish" for rewards, receiving PL2 when staking LP-token.

Compliance-wise, liquidity staking on Plenny pays token rewards to compensate users for contributing liquidity on a non-custodial basis using decentralized smart contracts rather than paying interest on custodial deposits.

2.7.2 Staking LP-Token

In general, liquidity token serve as the wildcard used to secure cryptocurrency over the DEX. LP-token work like a coupon or a receipt (i.e. an "I owe you" or IOU), allowing Liquidity Providers (LPs) to reclaim their funds. In other words, the LP-token represents a voucher.

LPs receive LP-token when allocating cryptocurrency (i.e. ETH) together with PL2 to the liquidity contract on the Sushi V2 DEX using Arbitrum One (Ethereum L2). LP-token is minted when joining and burned when withdrawn. Corresponding rates are always proportional to the contribution made.

LPs earn a fee from the AMM-protocol for the transactions executed through the liquidity contract on the DEX. In addition, LPs are incentivized for staking corresponding LP-token on the Dapp.

In the case of Ether, wrapped Ether is utilized and the currency pair is denominated as WETH/PL2. Since Plenny's liquidity staking contract is linked to the liquidity contract on the Sushi using Arbitrum, the liquidity token is explicitly referred to as SLP. However, on the Dapp the LP-token is displayed as "SLP-PL2" to indicate the value is linked to Plenny.

Simply put, the amount of SLP-PL2 represents the value of the funds put into the liquidity staking contract on the DEX that are then used for further staking on Plenny in exchange for rewards. This event is referred to as “Fish Farming” and occurs via the Dapp on a non-custodial basis using the Peer-to-Contract model (P2C). In short, LPs receive LP-token on the DEX for staking via the Dapp and are eligible for periodic rewards paid in PL2.

Rewards due for “Fish Farming” represent a percentage of the Reward HODL in proportion to an LP’s weight and the total weight. The LP’s weight is calculated by the number of SLP-PL2 staked with an additional multiplier based on the staking duration. This formula measures the share of the LP dynamically in relation to the total amounts in the Reward HODL. To prevent dethroning, LPs must manually collect rewards after every distribution period, or increase the amount of staked tokens.

2.7.3 APIR Fish Farming

In this context, APIR stands for Annual Percentage Income Return for Fish Farming (FF). The formula refers to daily rewards (e.g. ≈6,500 blocks) to calculate the income return per year (e.g. ≈2,372,500 blocks).

Based on the formulas of the Reward HODL, the formula for Annual Percentage Income Return (APIR) is defined as follows:

APIR-FF = R x D / P-LP x 2

- *APIR-FF* is the annualized income return a Plenny Whaler receives from Fish Farming.
- R is the reward received per day (e.g. reward period is ≈6,500 blocks).
- D is the number of days in the current year.
- P_{LP} is the amount of tokens provided as liquidity allocated to the DEX smart contract.

The APIR does not apply compounding to rewards. For clarity, Fish Farming supports LP-token (SLP-PL2) for Plenny (PL2) but does not calculate compounded returns as this is not technically possible. In practical terms, compounding would only be possible if the liquidity token used for staking on the Dapp and the token used for rewards were one and the same. Plenny’s Fish Farming, which interacts with the liquidity mining program on the DEX, does not accrue compounding interest, meaning in traditional financial terms that no compounding Annual

Percentage Yield (APY) is paid, and no Annual compounding Percentage Rate (APR) is charged.

2.8 Treasury HODL (TH)

2.8.1 Concept TH

The Treasury HODL incentivizes Lightning Nodes and manages reserves. Initially, a fixed amount of PL2 is allocated to the TH. These reserves capitalize the Decentralized Oracle Network (DON) as well as the capacity market for rewards.

25% of the original token inventory (i.e. 250M of 1B PL2) are reserved for maintaining operations in the long run.

Token reserves locked in the treasury are used to incentivize participants as follows:

- LORCAs for the validation of payment channel opening and closing receiving Oracle Validation Rewards (OVRs).
- LN Channel Rewards: Standard Lightning Nodes for logging outbound capacity with LORCAs.
- LOC Channel Rewards: Makers for successfully opening a payment channel and licensing inbound capacity to Takers over the capacity market.
- In addition, the Baseline Reward is paid by the Treasury HODL.

2.8.2 Reserve Sustainability Formula

The Treasury HODL uses a mathematical formula to maintain reserves and ensure rewards are sustained over time and cannot be fully consumed.

When the reserves in the TH are above a certain threshold, participants receive fixed rewards F (where F is different for each type of user) weighted by the capacity multiplier. Once the TH reserves fall below this threshold, the rewards become a percentage P (again with each type of user applying P accordingly) of the TH reserves, similarly weighted by the capacity multiplier. Essentially, if the Treasury HODL is full, participants receive a fixed reward. If the reserves run low, fewer rewards are distributed based on a percentage. This configuration makes the TH technically inexhaustible since after the threshold is reached, all rewards become a % of the remaining TH reserves.

In addition, the reserves in the Treasury HODL are constantly replenished with fees earned by Plenny as well as periodic inflation amounts when the rebase mechanism is triggered.

2.9 Rebase Mechanism

2.9.1 RePLENishment Trigger (RT)

The RePLENishment Trigger serves as a rebase mechanism. This feature causes the smart contract to collect fees and replenish the Treasury HODL with liquidity from token income. In addition, the smart contract initiates cash management operations by interacting with the liquidity contract on the Sushi V2 DEX using Arbitrum One (Ethereum L2).

Any Ethereum-user can activate the RePLENishment Trigger in a decentralized manner if the reward for completing this task makes economic sense for the trigger user. However, certain conditions must be met, such as the cool-down period of 24h (e.g. 1d is ≈6,500 blocks) and the thresholds for burning and buybacks must be reached. The community-driven trigger incentivizes the user who calls the function. The respective trigger user receives a percentage of the distributed fees. When the trigger is activated, both the fees are replenished and the rewards are distributed.

The rebase mechanism controlled through the RePLENishment Trigger performs burning of LP-token and buybacks. The component affects the token price on decentralized markets because with burning and buybacks, the value of PL2 potentially increases. In this way, supply and demand for services emanating from Lightning Nodes are reflected in the token economy, as the token income generated by Plenny comes mainly from the activity of Lightning Nodes. The applied algorithm attempts to balance inflationary and deflationary effects between the non-financial digital economy related to the LN and the decentralized financial economy influenced by decentralized markets. Essentially, the RePLENishment-Trigger is understood as a decentralized tool for achieving economic equilibrium.

Thresholds for PL2 and LP-token to initiate the rebase mechanism are parameterized and subject to DAO Governance.

2.9.2 Minting Inflation

Plenny utilizes continuous issuance while keeping the maximum supply of tokens proportional and in line with organic growth. Minting new token results in additional supply that adds inflationary effects to the token economy but also mutes deflationary impact. To ensure organic growth, there is a fixed daily inflation added to the Treasury HODL. The annual inflation is equal to 2.5% of the token supply.

Inflation is a triggered event controlled via smart contracts. The RePLENishment Trigger interacts with a built-in minting mechanism to generate additional token. This means, for example, that the value of 2.5% per year is newly minted when

the replenishment of the Treasury HODL takes place. The value is prorated to the block time of Ethereum L1 (e.g. an average block time of ≈13 seconds is ≈6,500 blocks per day). New token is minted only for the time period determined via the RePLENishment Trigger. In summary:

- To ensure organic growth, minting inflation is complemented with providing liquidity (i.e. burning and buybacks). In this scenario, the circulating supply is extended pro rata.

The replenishment function refills the treasury and offsets the potential risk of exhausting the reserves. It is essential to point out that given the mechanics of the reward distribution, inflation might never reach circulation. For example, if the fees collected in the Treasury HODL are higher than the rewards paid out, the formula for reserve sustainability prevents newly minted token from reaching circulation. If the reserves are low, a percentage but not a fixed amount is given, and fewer rewards are distributed overall. Mathematically, the percentage can never go to zero, so the Treasury HODL can never exhaust.

The inflation amount per block can be adjusted as it is subject to governance voting.

2.9.3 Fee Allocation

All fee income is collected via the community-driven RePLENishment Trigger and used to replenish the Treasury HODL. From there, token income is further split into sub-allocations as follows:

- Burning of X% of all fees.
- Liquidity providing of X% via buybacks.
- RePLENishment Trigger User Rewards: X% of the amounts replenished.

Fee allocation is subject to governance voting.

2.9.4 Burning and Buyback

With AMM-protocols in the Ethereum ecosystem, buyback allocations and liquidity-providing mechanisms have emerged. They all have the advantages of the standard burn mechanism along with some added liquidity.

Instead of burning all fees, token originating from regular income becomes available for both burning and buybacks. Initially, the split is set to a 10/90-ratio: 10% burning and 90% buyback.

Plenny supports the token price through burning of LP-token and buybacks of PL2. A percentage of all collected fees is used for reclaiming liquidity and gaining reserves. PL2 is posted back to the DEX, enabling Plenny to exchange a percentage of its token income for ETH and buyback PL2 while increasing liquidity over decentralized markets and facilitating token circulation.

The replenishment flow works as follows:

I. First operation: Burning LP-token and Buyback of PL2
   - Checks if the current fees in LP-token (i.e. SLP) are greater than the threshold for burning.
   - If the threshold for the pending fee distribution in LP-token is reached, 10% of LP-tokens are removed (i.e. burned) on the DEX to gain liquidity for the WETH/PL2 currency pair and perform further cash management operations.
   - Buybacks are executed using 90% of PL2 to swap tokens via the liquidity contract on the Sushi V2 DEX using Arbitrum One (Ethereum L2).
   - Calculates the RePLENishment Trigger User Reward (RTUR) and distributes PL2 to the trigger user, with the rest going to the Treasury HODL.

II. Second operation: Buyback PL2 and allocation of LP-token
   - Checks if the current fees in PL2 are greater than the threshold for buybacks.
   - If the threshold for the pending fee distribution in PL2 is reached, the buyback of WETH is executed using 5% of PL2 (the remaining 5% being the token amount in PL2 and constituting the total value of the liquidity contract), thus providing additional liquidity for the WETH/PL2 currency pair on the DEX.
   - Receives LP-token and allocates LP-token to the TH.
   - Calculates the RTUR and distributes PL2 to the trigger user, with the rest going to the Treasury HODL.

III. Third operation: Minting
   - Mints the inflation (of which a percentage is used for the RTUR, along with the percentage that comes from the fees collected).
   - Importantly, inflation amounts are not used for burning and buybacks. Newly minted token go exclusively to the Treasury HODL.
   - Calculates the RTUR and distributes PL2 to the trigger user, with the rest going to the Treasury HODL.

During these operations, Plenny earns liquidity provider fees. When the Dapp swaps tokens, the fee income (e.g. ≈X%) generated by the Liquidity Provider (i.e. the Dapp) is automatically collected and added to the Dapp's amounts in the liquidity contract on the decentralized exchange and thus included in the rebase mechanism.

This process is a community-driven triggered event occurring periodically. Users triggering the fee allocation are rewarded for executing the smart contract. These events do not occur with each transaction. It is done through bundled transactions to achieve cash flow and gas cost optimizations.

Each time the RePLENishment Trigger is applied, proportional amounts of token enter or exit, taking into account the transaction activity and token income. Characteristically for Plenny, a significant proportion of the underlying activity comes from Lightning Nodes offering services over the capacity market or participate in the DON. In this way, the token economy controls the value ratios between the activities associated with the LN-based non-financial digital economy and the activities related to the Ethereum-based decentralized financial economy, with the aim that the different ratios of the economies are proportionally balanced over time and complement each other for mutual benefit.

2.9.5 RTUR

Ethereum users can trigger the rebase mechanism to receive RePLENishment Trigger User Rewards (RTUR). It works as follows:

- Can be called after 6,500 blocks.
- RTUR = X% (e.g. 0.1%) of the amount for replenishment consisting of collected fees and the inflation amount.

Statistics regarding the activity of this component are displayed on the UI of the Dapp.

2.10 Reward HODL (RH)

2.10.1 Concept

The Reward HODL incentivizes Plenny Whalers (PWs) and Plenny Governors (PGs), including Delegators (DELs) and Voters (V). Initially, the fixed amount of tokens allocated to the RH is intended to attract early liquidity through the Ethereum ecosystem and accelerate token distribution to as many participants as possible. Once the token reserves locked in the RH are exhausted, 15% of the original token supply will be decentralized (i.e. 150M of 1B PL2). The RH thus helps to qualitatively expand the ownership structure of the token through rewards for active community members.

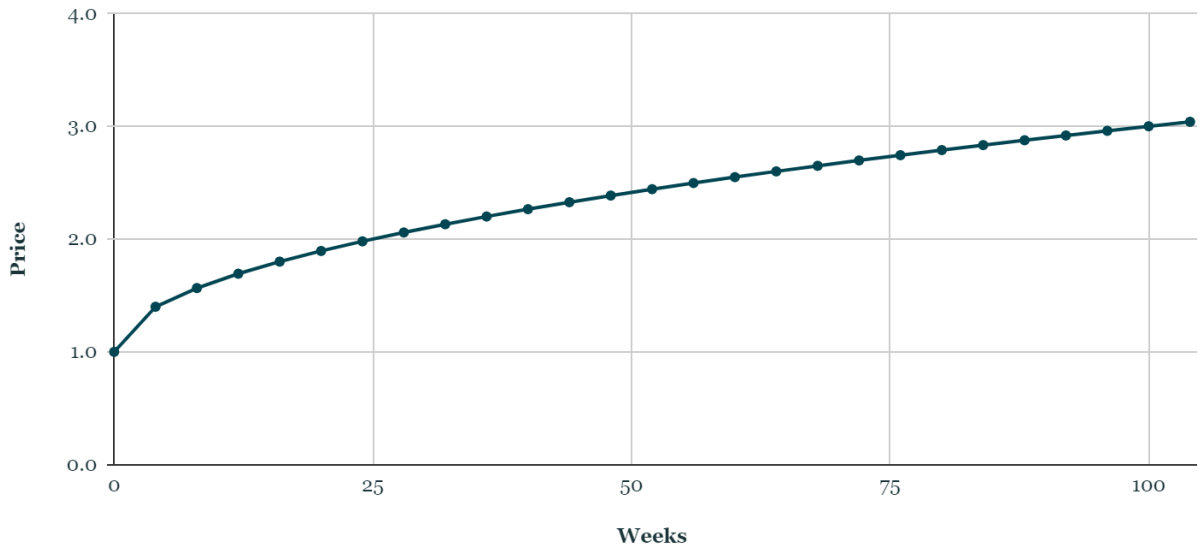
2.10.2 Rewards Allocation

The rewards allocation is used to reward the following:

- Plenny Whalers (PWs) providing liquidity over the DEX and engaging in liquidity staking on the Dapp.
- Plenny Governors (PGs) who stake PL2 and create proposals to actively vote on parameters and proposals, and DELs who stake PL2 to passively exercise voting rights by delegation, as well as Voters (V) who stake PL2 for voting.

2.10.3 Reward Formula

The reward formula applies to all rewards from the Reward HODL, including fish farming and governance rewards. PGs, DELs, Vs and PWs are subject to the same reward multipliers (M) based on the duration (D) as specified by the user (e.g. weeks).



$M = 1 + 0.2 \times D^{\frac{1}{2}}$ (Duration in Weeks).

Then define the reward received R as follows:

$$R = RH_R \times P \times \frac{T_U \times M_U}{\sum_{n=1}^{U_{max}} T_n \times M_n}$$

- RH_R are the current Reward HODL reserves.
- P is the percentage reward, with PGs, DELs, Vs and PWs having their values for this variable.
- T_U are the number of (liquidity) tokens stacked for a particular user.
- M_U is the multiplier for a particular user.
- $\sum_{n=1}^{U_{max}} T_n \times M_n$ are the multiplier weighted (liquidity) tokens for all users (calculated separately for the different types of users).

The reward formula is explained as follows:

Tu x Mu represents the staking weight of the user. For instance, a user stakes 10 PL2 for 4 weeks: M = 1 + 0.2 x 4^0.5 --> M = 1.4; the multiplier for 4 weeks staking is 1.4, so the weight of the user for 10 PL2 is 14.

2.10.4 Refill of RH

The Reward HODL can only be replenished if a majority of the community votes to collect token donations from community members or acquire tokens through decentralized markets.

2.11 Audit Bot

2.11.1 Concept

This monitoring and analytics feature provides insights into the allocation of funds and turns the Dapp user interface into an auditable service. The Audit Bot tracks the smart contracts and provides evidence about decentralized cash management operations. It gives an overview regarding the token inventory in the Treasury and Reward HODL and allows users to review the solvency of Plenny at any time. Specifically, token supply, token distribution, token rewards, logged channel capacity, the number of Liquidity Makers and Takers, and the Total Value Locked (TVL) associated with liquidity mining and staking (i.e. Fish Farming), as well as other key metrics are summarized on an ongoing basis to demonstrate good use of funds.

2.11.2 Integration

To cater to the concept of the Audit Bot, the addresses related to a variety of the smart contracts of Plenny are tagged publicly. The actual balances are displayed as a pie chart on dplenny.crypto. The publication of tagged smart contracts over the Audit Bot caters to transparency as follows:

- To demonstrate the good use of funds, the Dapp displays smart contract details that give proof of the funds being appropriately assigned.
- Reserves are earmarked in the Reward HODL and the Treasury HODL.
- Shows actual transaction activity of Lightning Nodes on the capacity market.

2.12 Plenny Explorer

2.12.1 Concept

This block explorer and transaction search tool tracks transaction activity on the Dapp user interface. The feature gives users another way to monitor the activity and follow a digital trail. Specifically, the Plenny Explorer summarizes statistical information about the actual number of Lightning Oracles, logged payment channels, and details about participants in DAO Governance.

In addition to using Plenny Explorer, users can trace the Dapp's transactions via the Ethereum blockchain by using Arbiscan.

Moreover, Lightning Nodes can verify payment channels on the Bitcoin blockchain and track the activity on the LN over online directories.[18]

2.13 DAO Governance

A decentralized autonomous organization (DAO) is a stateless digital organization represented by rules encoded as an open-source computer program governed by community members at multilateral levels. Effectively, DAOs are socio-technical communities transparently executing governance of smart contracts on-chain.

2.13.1 Concept

In addition to being a standard ERC-20 token, PL2 also allows token holders to participate in governance. For this purpose, PL2 are stacked and in return participants receive rewards.

Plenny empowers community governance over a Decentralized Autonomous Organization (DAO). Community voting rather than centralized decisions by an organization is what manages operations and shapes the direction of Plenny.

Participation in governance is possible in different roles with different levels of commitment. There are Plenny Governors (PG), Delegators (DEL) and Voters (V).

2.13.2 Plenny Governors (PG)

Plenny Governors (PG) are subject to a Governor Threshold (i.e. PoS to demonstrate commitment). Also, all proposals by PGs are subject to a Proposal Threshold. In summary, to act as a Plenny Governor, the following conditions must be met:

- PG must stake tokens for the governor threshold: X PL2.
- PG must stake tokens for the proposal threshold: X PL2.
- PG cannot have voting rights delegated to others.

To reach the proposal threshold, the Plenny Governor must stake an amount that is equivalent to at least 1% of the total token amounts staked via DAO Governance. This minimum amount represents the proposal threshold and results in sufficient voting rights allowing the PG to propose governance actions.

2.13.3 Voting Procedure

Any address with voting rights can vote for or against the proposal. A three-day voting period (e.g. ≈19,500 blocks) is applied to any governance proposal.

The proposal receives consent if the minimum number of votes (i.e. quorum) is reached and the majority (i.e. 50.01%) of the votes cast is achieved (i.e. based on the staked token amounts). Otherwise, the proposal is dismissed.

2.13.4 Governance Actions

Governance actions are sets of activities such as changing parameters of Plenny that no one else can modify. An accepted proposal is queued in the time-lock and can be implemented after two days (e.g. ≈13,000 blocks).

Typically, there are no proposals that need to be implemented by a team or foundation, as the adjustment of parameters runs fully automated via the governance module. Any governance vote on parameters triggers executable code that is automatically changed.

However, Plenny also supports voting on generic proposals without executable code. Generic proposals that fall outside the scope of parameters can be made through this specific proposal feature. If voted for by a majority, more complex changes may temporarily require the appointment of technical maintainers to work on behalf of the community.

Generic proposals are intended to foster innovation, prevent technical roadblocks, and keep pace with technical progress in the context of the larger crypto ecosystem.

During the experimental phase, a portion of token inventory is distributed among community members to enable governance voting.

2.13.5 Governance Rewards (GR)

Token holders who wish to participate in governance stake PL2 on the Dapp and are incentivized with Governance Rewards (GR). Users are eligible to receive a percentage of the Reward HODL in proportion to the amount of PL2 staked with an additional multiplier based on the staking duration. Depending on the staking duration, a multiplier is applied to calculate the staking weight that corresponds to the voting power (e.g. 10 PL2 staked for ten weeks result in more votes than 10 PL2 staked for two weeks).

Rewards for participating in governance can be calculated as an Annual Percentage Income Reward (APIR) as in the formula below:

$APIR\text{-}GOV = R \; X \; D \; / \; L$

- $APIR\text{-}GOV$ is the annualized income return received by participants.
- R is the reward received per day (e.g. reward period is ≈6,500 blocks).
- D is the number of days in the current year.
- L is the amount of tokens staked in the DAO Governance.

The DAO Governance of Plenny works similar to the governance contracts of Compound.[19]

2.13.6 Checks-And-Balances Committee

In rare cases, a proposal can still be cancelled. This is done by a guardian address that has the power to cancel any kind of malicious proposal. The guardianship is an emergency functionality.

In certain cases, any token holder may cancel a proposal. For example, if a Plenny Governor makes a proposal but removes the amount of tokens needed to create proposals immediately after the proposal is made, any token holder can perform a cancellation to ensure the integrity of the voting system. In general, however, only the guardian address can cancel proposals during the voting period and up to implementation.

In the early phases, the guarding address is held by informally elected members of the community who regularly alternate. Once the experimental phase is complete, the guardianship will be transferred to a multi-signature address, where multiple signatories must agree before an accepted proposal is cancelled. These signatories will be part of a group of experts who will be formally elected to serve as the Checks-And-Balances Committee (CABAC) once DAO Governance is fully activated. Setting the guardian address to the multi-signature address of the Checks-and-Balances Committee will further decentralize and ensure Plenny's security. Eventually, guardianship will be abandoned to achieve full decentralization, thereby dissolving the committee.

2.14 Delegation

2.14.1 Concept

Plenny's DAO Governance is based on the concept of Delegated Proof of Stake (DPoS). Delegation is used to improve the quality of governance decisions. This feature enables community members to become Delegators and back governors. DELs receive Governance Rewards (GR) in return. Simply put, to participate in delegation and catch more “fish” token holders stake PL2 to delegate their voting rights. As a result, Plenny Governors increase their voting power.

The purpose of the delegation function is to sponsor governors who actively explain improvements and ask for support prior to creating proposals for voting. It encourages governors to conduct informal surveys in the community before critical or complex changes are proposed. This process favors governors with good communication skills, good relations with community members, and a good understanding of factual issues.

In practical terms, delegation supports PGs to reach the Proposal Threshold in case they do not own sufficient PL2 to propose governance actions and potentially win the vote. Governors with a high balance are considered more relevant by the algorithm. In short:

- The higher the voting power, the more likely a Plenny Governor wins a vote on a proposal.
- Token holders exercise their voting rights passively by delegating their power to active PGs.

In summary, delegation is the process by which token holders delegate their voting rights to Plenny Governors of their choice. A specifically designed smart contract enables users to stake token for this purpose without losing control of it. However, they waive their right to vote and pass it on to a governor until the end of the delegation. The delegation function is intended to support informed as well as long-term oriented decision-making for the greater good of Plenny.

2.14.2 Incentives

Token holders who stake PL2 to delegate voting rights to Plenny Governors receive incentives. For Delegators (DELs), the formula to calculate Governance Rewards (GR) is applied. In short:

- DELs receive Governance Rewards (GR, the same type and amount of rewards as Plenny Governors from the Reward HODL.
- In addition, delegation is incentivized as DELs are not subject to the Governor Threshold.

2.15 Voters

2.15.1 Concept

Voters (V) can stake token to receive voting rights. There is no threshold for voting or any other condition for participation in DAO Governance other than the staking of tokens. Voters receive Governance Rewards (GR), the same type and amount of rewards as Plenny Governors and Delegators.

2.15.2 Ownerless

Ultimately, Plenny is ownerless because it is a digital public good maintained by a global community and driven by the votes of community members participating through DAO Governance.

2.16 DAO Governance Parameters

Below is an incomplete list of references to configurable variables of parameters (par) that are subject to voting via DAO Governance:

2.16.1 Par Node & Rewards

- Minimum Channel Capacity: 20,000 sat
- Maximum Channel Capacity: 16,000,000 sat

- General Reward Threshold: 500,000 sat
- Capacity Fixed Reward Amount (LN Channel Rewards): 50,000 PL2
- Capacity Reward Percentage Amount (LN Channel Rewards): 0.03% of Treasury HODL
- User Channel Reward (amount of total pending reward): 0.4%
- Baseline Reward: 250 PL2
- User Channel Rewards Period (interval of pending): 6,500 blocks
- Channel Rewards Capacity Multiplier: 1

2.16.2 Par Lightning Oracle Validator

- Validator Threshold (i.e. "Default Locking Amount" for PoS) = 100,000 PL2
- OVR Fixed Amount: 5,000 PL2
- OVR Percentage: 0.004%
- PoS-Multiplier: 1
- Reputation Multiplier: 1
- Oracle Validator Reward (OVR) for Consensus Winner (transaction-based): 85% and 15% for others
- LORCA Exit Fee: 1%

2.16.3 Par Capacity Market

- Minimum Channel Capacity: 500,000 sat
- Maximum Channel Capacity: 16,000,000 sat
- Fixed Royalty: 50 PL2
- Capacity Fixed Reward Amount (LOC Channel Rewards): 50,000 PL2
- Capacity Reward Percentage Amount (LOC Channel Rewards): 0.003% of Treasury HODL
- User Channel Rewards Period: 6,500 blocks
- Cancel Request Period for Inbound Capacity: 6,500 blocks
- LT Exit Fee: 1%
- Taker Fee: 0.5%
- Maker Fee: 2.5%

2.16.4 Par Oracle Election

- Oracle Election Cycle Period: 45,500 blocks
- Maximum Validators to be elected (i.e. BETA release): 4
- Minimum Number of cryptographic signatures for validation: 70%
- Election Trigger User Reward (ETUR): 1,000 PL2

2.16.5 Par Fish Farming

- Fish Farming Reward Period (distribution): 6,500 blocks
- Average Block Count Per Week: 45,500

- Max. Week Period: 521 (10 years)
- Reward for staking LP-token: % of Reward HODL: 0.01%
- FF Liquidity Staking Fee in PL2: 5%
- FF Fishing Fee in LP-token: 0.5%

2.16.6 Par RePLENishment Trigger

- Threshold for Burning: 10 LP-token
- Threshold for Buybacks: 100 PL2
- LP-token burning percentage: 10%
- Buyback Percentage using PL2 for WETH: 90% of fees collected
- Allocation of PL2 for Buybacks of WETH: 5%
- Inflation Amount per Block: ≈10.5 PL2 = 2.5% per year
- Maintenance Block Limit (i.e. cool-down period): 6,500 blocks
- RTUR: 0.1% of the amount for replenishment

2.16.7 Par DAO Governance

- Governor Threshold: 20,000 PL2
- Proposal Threshold: 1% of total staked token for governance
- Set Proposals Execution Delay: 13,000 blocks (≈2d)
- Voting Duration: 19,500 blocks (≈3d)
- Voting Delay: 6,500 blocks
- Voting Quorum: 33.87% (temporary)
- Next Distribution Blocks: 6,500 blocks
- Rewards for liquidity staking PL2: % of Reward HODL: 0.01%
- GOV Staking Fee: 5%
- GOV Exit Fee: 0.5%

As the experiment progresses and decentralized markets evolve, the effects of these parameters will become apparent. The variables in this Working Paper may be changed initially through informal governance votes and later through formal governance votes to ensure operational stability and keep Plenny economically viable.

3 Smart Contracts

3.1 Implementation

Plenny is made of open-source software and a set of smart contracts written in Solidity. This programming language is designed for developing smart contracts that run on the Ethereum Virtual Machine (EVM).

Plenny provides smart contracts for empowering Lightning Nodes to extend their connectivity to other nodes, offer decentralized lightning services, and expand the capacity of payment channels on the Lightning Network through the Ethereum ecosystem.

The smart contracts of the Dapp and the DON are deployed on Arbitrum One (Ethereum L2).

Plenny consists of 26 smart contracts in total. The following *16* are the most important to understand:

1. PlennyContractRegistry: Contract address registry for all Plenny-related contract addresses.
2. PlennyDistribution: Contains the logic for the initial token generation and distribution and uses an upgradable beacon pattern for managing the upgradability of the PlennyERC20 token.
3. PlennyERC20: PlennyERC20 representation on Ethereum Mainnet L1.
4. PlennyArbERC20: PlennyERC20 token on Arbitrum Optimistic Rollups (ORU). Representation of the PlennyERC20 token on L2 mapped to L1 token.
5. PlennyCoordinator: Coordinator contract between the Bitcoin Lightning Network and the Ethereum blockchain. Coordination and storing of payment channel data. Allows users to provide info about their Lightning Nodes and channels and manages the specific Baseline Reward and the general Channel Rewards (i.e. NCCR-mechanism).
6. PlennyDappFactory: Contract for storing information and parameters about Lightning Oracle Validators, calculates the oracle score, locking of Royalties and Channel Rewards, manages channel fees collected by the Dapp, and contains the PoS-Multiplier and Reputation Multiplier.
7. PlennyOracleValidator: Runs channel validations (for opening and closing) and contains the logic for reaching consensus among the Lightning Oracle validators (a.k.a. "LORCA") participating in the Decentralized Oracle Network (DON). This smart contract uses data from the Plenny DLSP module. In this role, Lightning Oracles compute transaction data off-chain and transmit it to the smart contract.
8. PlennyValidatorElection: Contains the logic for the election cycle and the process of electing validators based on Proof of Stake (PoS) and transfers the Election Trigger User Rewards (ETUR).

9. PlennyOcean: Manages the capacity market. This smart contract refers to the non-custodial Peer-to-Peer marketplace for payment channels to license liquidity of Lightning Nodes (i.e. inbound capacity). PlennyOcean uses data from the DLSP module, enabling Lightning Nodes to obtain the information that contains the payment channel data.
10. PlennyLockingPoSLT (named PlennyStaking in. BETA release): Manages locking of oracle validator thresholds for Proof-of-Stake (PoS) and down payments by Liquidity Takers in the capacity market.
11. PlennyLiqStaking (named Plenny LiqMining in BETA release): This liquidity staking contract allows LPs (a.k.a. "Plenny Whalers") to stake LP-token (i.e. SLP-PL2) from the liquidity mining contract on the Sushi V2 DEX using Arbitrum One (Ethereum L2) for "Fish Farming" on the Dapp and earn periodic rewards (i.e. PL2).
12. PlennyRePLENishment: This contract collects all the fees, mints new tokens for inflation, manages the replenishment of the treasury, distributes the reward for the trigger user (RTUR), and performs automatic burning and buybacks via the Treasury HODL and over the liquidity contract on the Sushi V2 DEX using Arbitrum One (Ethereum L2).
13. PlennyTreasury: Stores Plenny reserved for rewards (i.e. LN Channel Rewards and LOC Channel Rewards) via the Treasury HODL given within the capacity market and for oracle validations (OVR).
14. PlennyReward: Stores token rewards reserved in the Reward HODL to reward staking of PL2 via DAO Governance and to reward staking of LP-token via the liquidity staking contract on the Dapp.
15. PlennyStakeGovDelV (named PlennyLocking in BETA release): Manages staking for governance and the delegation of voting rights.
16. PlennyDao: Governs Plenny via voting on community proposals.

In addition, Plenny uses several interface contracts that have no functionality implemented. Plenny also uses libraries with functions that can call smart contracts. Moreover, storage contracts are also used.

3.2 Security Audits

Plenny's smart contracts are secured as follows:

- Utilizing secure libraries based on OpenZeppelin ERC standards.[20]
- Reviewed using Slither,[21] an open-source static analysis framework for Solidity.
- Audited with MythX™ security analysis tools[22] from ConsenSys.

3.3 Safeguarding Inventory

The experimental phase of Plenny is initially funded with a limited amount of tokens released from the original token inventory (i.e. Nucleus release). The following measures are taken to prevent regulatory risk, market risks (e.g. rug pull or pump-and-dump schemes), and mitigate other risks such as technical security risks (e.g. hacking of modules and attacking application-level features, or

compromising the functionality of the consensus mechanism through deliberate malicious behaviour):

- Early adopters donate seed inventory to Plenny based on the concept of progressive decentralization.
- Further token inventory is only released gradually over time.
- Proceeds by Plenny are automatically made available for burning and buyback to support the token price.
- LP-token of early adopters acting as Liquidity Providers (LPs) are staked via the Dapp's liquidity staking contract and repeatedly blocked for longer periods of time.
- Access to the token inventory in the Treasury HODL and the Reward HODL is assigned to a multi-signature smart contract wallet (e.g. Gnosis Safe Multisig) in due course. This measure is taken to avoid single point of failure. In the further process, ownership of token inventory is transferred to DAO Governance.
- Token to cover the development costs of Plenny and the expenses of early adopters are held in a multi-signature smart contract wallet on Ethereum and used exclusively for project funding.
- Tokens of early adopters are reserved for governance and are staked via DAO Governance.

3.4 Release & Version History

Plenny Nucleus release: Birthday of ERC20 on Ethereum Mainnet. Design of smart contracts is subject to multi-layered scrutiny, and the project is created open-source, donated to all interested in Bitcoin and Ethereum by "Charon's Viaticum".	June 17th 2021
Plenny Alpha release: Smart contracts for the capacity market deployed on Arbitrum One (Ethereum L2) by early adopters, Lightning Nodes join, the community grows in emerging markets.	Sept 29th 2021
Plenny UI v1 on Dplenny.crypto	Sept 29th 2021
Plenny Alpha Release: Deployment on Arbitrum One (Ethereum L2) with smart contracts for liquidity mining on the Sushi V2 DEX, and staking for Fish Farming on the Dapp.	Oct 25th 2021
Plenny UI v1.0.1 on Dplenny.crypto	Dec 15th 2021
Plenny BETA release: Smart contracts for the consensus mechanism including the oracle election and instant rewards for Lightning Oracle Validators. New use cases for Lightning Nodes with viable income opportunities.	Feb 4th 2022
Plenny UI v1.0.2 on Dplenny.crypto	Feb 7th 2022

4 Calculations

4.1 Decentralized Issuance

4.1.1 Token Generation Event, TGE

Tokens have been pre-mined during the TGE (i.e. Nucleus release). Further tokens will be minted programmatically in sequences over the course of time. The original allocated token amounts in the genesis wallet constitute reserves as follows:

1 billion = 1,000,000,000 PL2

4.1.2 Founder-less

Since the original token inventory was donated by "Charon`s Viaticum" along with some other technical stuff before he/she/they left the project behind (i.e. Nucleus release), Plenny is founder-less. It operates as a field experiment conducted by an open-source community, with vast amounts of token being released programmatically.

4.1.3 P2P Distribution

Initially, the original token inventory was issued as part of the Nucleus release. No initial offering was made by a token issuer. Eventually, a group of developers took over the Nucleus release and launched the online field trial.

At this point non-monetary bartering between early adopters took place based on the original token inventory. During this experimental phase, early adopters who provided technical services were compensated on a nonprofit basis through seed inventory allocations.

Further distribution to early adopters was done on P2P basis. Early adopters are active community members who have made useful contributions to the experiment.

As the experiment progressed, market making was conducted on permission-less and decentralized exchanges by members of the community (i.e. early adopters). In the process, token were distributed through decentralized markets on a P2P and P2C basis*.

The Dapp is a community-driven open-source project, and as such does not aim for a central initial offering, nor does it target controlling token majority but instead shares token over time. In the process, community members are free to distribute token over decentralized markets on a Peer-to-Peer basis, ensuring the free float reaches majority and is controlled by community members. This approach supports decentralization and is designed to mitigate risk.

*Token holders do not receive a financial claim. No peg to any other cryptocurrency is maintained. Plenny does not guarantee value or credit. The token serves as a utility and payment token, but not as an asset or investment. Token ownership is transferred via decentralized smart contracts on a non-custodial basis. Ownership rights only apply to tokens, not to ownership of company shares or the like.

4.1.4 Community Engagement

During the experimental phase, token allocation is executed by early adopters who donate seed inventory to Plenny. The ownership structure becomes progressively decentralized through community members who provide liquidity over various DEXs voluntarily. Until the full deployment of DAO Governance, votes will be held informally with early adopters, key contributors, and actively engaged community members being entitled to vote.

4.1.5 Level Playing Field

Plenny aims to provide a level playing field for all users so everyone benefits from the same economic conditions as reasonably practical. In the initial phase, this principle must be reconciled with security issues. It is generally understood that the technical contributions of early adopters should be adequately rewarded while ensuring the input of newcomers is not disproportionately disadvantaged.

Specifically, the contributions of the innovators must be considered, such as early adopters who added their technical know-how as well as took the risk of prefunding the project. They must be indemnified appropriately, in keeping with the idea of a truly fair launch that accounts for the different quantity and quality of the work done by the participants. As compensation for the risk taken, active community members have received seed inventory at the beginning. However, these early adopters have donated a significant amount of tokens to Plenny's reserves and have also provided token inventory for new community members to engage through DeFi.

The reserves are spread out programmatically throughout the lifecycle of the experiment. This procedure ensures, above all, the technical participants driving the project (i.e. Lightning Nodes) benefit from the same economic conditions.

4.1.6 Progressive Decentralization

Plenny adheres to the concept of progressive decentralization. As a basic security measure, the smart contracts of Plenny are rolled out gradually. The system is designed with configurable rules and thresholds that intentionally limit the functionality of Plenny based on governance voting.

At the beginning of the experiment (i.e. Alpha release), early adopters took over the original token inventory (i.e. Nucleus release) left behind by the inventors, and only used limited amounts of token to test the Dapp. Contracts were deployed in a guarded launch with a conservative set of parameters, allowing users to interact with Plenny in a limited scope. This de-risking approach followed best-practice procedures to protect both users and Plenny.

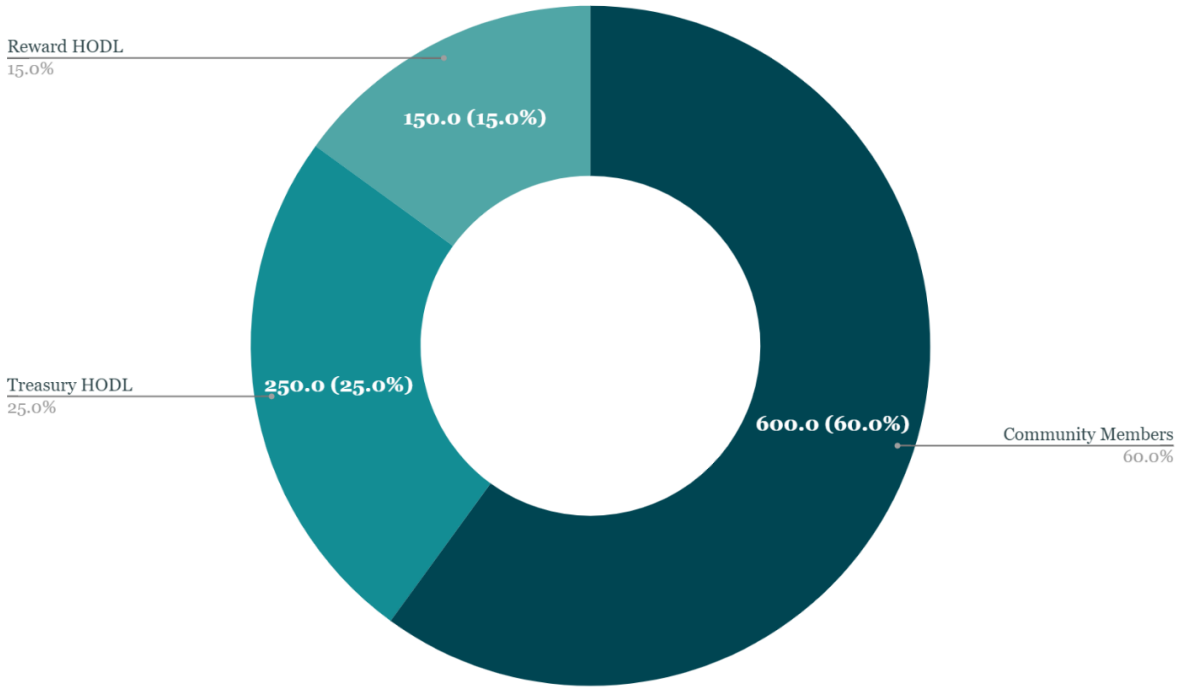
The beginning phases (i.e. Alpha and BETA release) are experimental to explore the Product-Market-Fit with sandbox-style token distribution to early adopters. Once Plenny gains traction, the community will expand via open-source development and start adding token incentives for users within the larger ecosystem.

The final stage is to seek widely distributed token adoption, to spread source code and technical control, share voting powers with peers, and donate the remaining elements to the public domain. At this point, the development of Plenny will be transferred to the community through a specific deployment procedure whereby access to wallets and token of Plenny are surrendered in favor of the smart contracts (including irrevocably locking down admin keys for use by DAO Governance in perpetuity). At this stage, the allocated supply will be locked up irreversibly as proven cryptographically and publicly over the blockchain.

4.1.7 Token Allocation

The original token inventory (i.e. 1B PL2) was donated to the Dapp based on the following allocations:

- 150M PL2 (15%) Reward HODL
- 250M PL2 (25%) Treasury HODL
- 600M PL2 (60%) Community Members.



In summary, the original token inventory (i.e. total supply of Nucleus release) was made available to the community to bring Plenny to maturity.

Meanwhile, 150M PL2 for the Reward HODL and 250M PL2 for the Treasury HODL totalling to 400M PL2 (40% of the original token inventory) was locked as reserves and will be distributed programmatically over time. Topping up these reserves and irrevocable locking is subject to governance voting.

The 600M (60%) allocated to community members is spread across different automated market maker (AMM) protocols to provide liquidity via decentralized markets. During the early phases (i.e. Alpha and BETA release), early adopters have already reserved half of the 600M PL2 for new community members. In the process, 300M PL2 (30% of the original token inventory) was allocated to the following liquidity contracts:

- 240M PL2 = Up to 24% allocated to Uniswap Mainnet V3.
- 50M PL2 = Up to 5% allocated to Uniswap V3 Arbitrum One (Eth. L2).
- 10M PL2 = Up to 1% allocated to Sushi V2 Arbitrum One (Eth. L2) that interacts with the rebase mechanism and the liquidity staking contract for Fish Farming on the Dapp. The LP tokens associated with this allocation were used for fish farming on Plenny and remain staked on the Dapp.

The remaining 300M PL2 (30%) of the original token inventory (1B PL2 = 100%) will be granted to key contributors to cover the project's upfront funding, to finance further development, maintenance, growth hacking, and the launch of decentralized governance. As a result, a total of 600M (60%) represents the circulating supply.

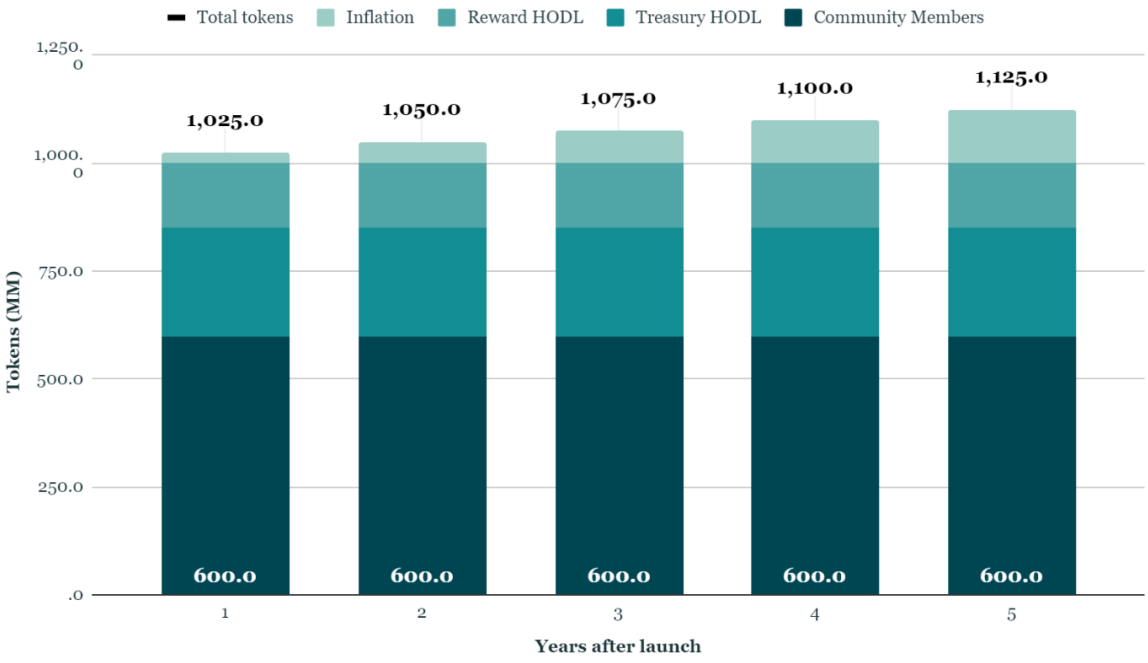
4.1.8 Inflation Distribution

Total supply varies as it is influenced by inflation over time. Assuming annual inflation of 2.5% (i) using the constant base level of 1B (K), 44 (n) inflationary years remain until the total supply cap of 2.1B (E) is reached. As a result (n = (E-K) / (K x 100/i), the year 2065 is expected to be the last year in which new token are minted.

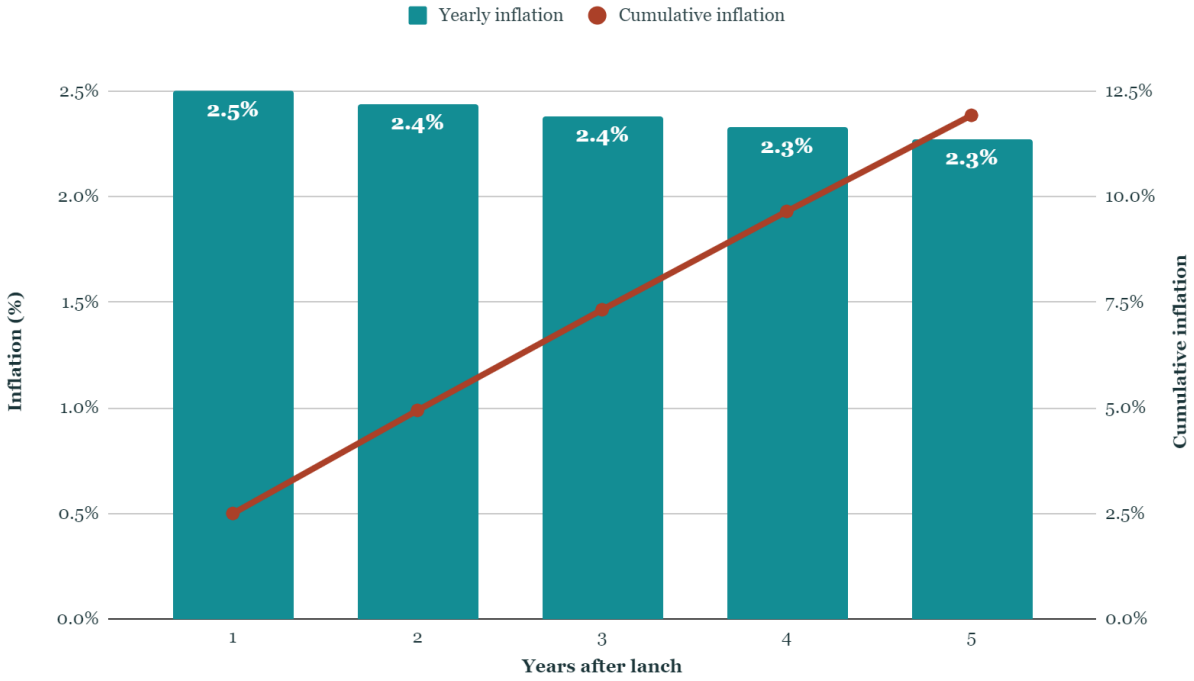
Inflation is programmatically minted over time to replenish the treasury on a demand-driven basis and keep the locked token inventory in line with economic activity on the Dapp.

For simplicity, the original parameter for inflation is based on the general value of 2.5% per year, which is assumed to be optimal by most economists.

The annual inflation is added continuously to the token allocation until the total cap (2.1B) is reached. For example, ≈2.5% (= 25M) of the base amount (1B) is added annually to the Treasury HODL.



This model works out to decreasing the percentage of inflation for the token year-over-year (YoY), as shown on the chart below:



The distribution of the inflation is managed via the RePLENishment Trigger. This smart contract contains the parameter and formula for the inflation amount per block. The following sample calculation outlines the details:

- The yearly inflation amount is 25M PL2 divided by 2,372,500 blocks (e.g. L1 average block number of 6,500 per day x 365d) equals the inflation amount per block which equals the minting amount per block = 10.537408 PL2.

The inflation amount per block is subject to governance voting.

4.2 Value Capture Mechanisms

4.2.1 Value Generation

Plenny generates income through its value capture mechanisms. Transaction fees are integrated in multiple services resulting in multiple income streams. Fees compensate Plenny for providing resources and giving access to services. Inherently, fees stem from the transaction-based incentives that users receive when using Plenny. Thus, Plenny filters its income from the transactions done by users. This mechanism captures a portion from the values generated and enables the ownerless decentralized application to cover operational costs.

The token economy is designed so that Lightning Nodes can make more money on the bottom line by using Plenny than by relying solely on the incentives of the Lightning Network. If the effort and cost to use Plenny is sufficiently compensated

in the context of the non-financial digital economy, both Lightning Nodes and Plenny will benefit. In interaction with the built-in continuous replenishment of token income for the payment of rewards, a self-preservation system is created. As the RePLENishment Trigger and the burning and buyback activities via the Treasury HODL are tied to decentralized markets, the value of the token represents another economic variable. In this way, the value-capture mechanisms of the decentralized financial economy and the non-financial digital economy influence each other, giving Plenny the combined potential to sustain operations based on its income and the token value.

4.2.2 Token-related interactions

Unified Modeling Language (UML) was used to design the system to create sequence diagrams and visualize the interactions.[23] For prototyping the nucleus, digital twin technology (i.e. virtual representation of Plenny components) has been applied. To simulate and predict potential token flow and turnover, the following token-related interactions were simulated:

- Capacity market transactions by Makers and Takers.
- Bailment of PoS, LORCAs lock a minimum balance (validator threshold).
- Treasury HODL rewards standard Lightning Nodes, LORCAs, and LMs.
- LPs allocate cryptocurrency on decentralized markets to stake LP-token in the liquidity staking contract on Plenny and earn PL2.
- Reward HODL rewards liquidity staking (Fish Farming) and governance actions related to Plenny Governors, Delegators, and Voters who stake PL2.
- RePLENishment Trigger performs minting, fee collection, distribution, burning, and buybacks by interacting with the Treasury HODL and the liquidity contract on the Sushi V2 DEX using Arbitrum One (Ethereum L2).
- RePLENishment Trigger incentivizes trigger users.
- Oracle Election Trigger incentivizes trigger users.

4.2.3 Income Streams

Plenny's income streams consist of several types of fees based on token rewards earned by various participants and shared with the Dapp. Below is a provisional list of the built-in fees that compensate Plenny for providing decentralized services:

- LN-related income:
  - Plenny earns fees from LN Channel Rewards collected from standard Lightning Nodes.
- DON-related income:
  - Plenny earns exit fees paid by oracle validators.
- LOC-related income:

    - Plenny earns fees from the Royalties collected from Liquidity Makers through the capacity market.
    - Plenny earns fees from LOC Channel Rewards collected from Liquidity Makers.
    - Plenny earns when PL2 is removed from the capacity market: (e.g. % of the payment amount).
    - Plenny earns the Taker Fee.
    - Plenny earns the Maker Fee.
- RePLENishment income:
    - Plenny earns fees by providing liquidity in decentralized markets and supports the token value through burning and buybacks while organic growth is ensured by minting inflation.
- Fish Farming income:
    - Plenny earns liquidity staking fees when LPs collect rewards from fish farming.
    - Plenny earns fishing fees when LPs exit Fish Farming.
- DAO Governance income
    - Plenny earns staking fees when GR is collected.
    - Plenny earns exit fees when removing token from governance.

4.2.4 Fee Collection

Locked and staked token balances are subject to fees collected by the Dapp when tokens are removed from the corresponding smart contracts. The following fees are collected (i.e. BETA release):

- Locked Balance:
    - LT Exit Fee paid by Liquidity Takers: X% of the locked amount in the capacity market.
    - LORCA Exit Fee paid by Lightning Oracles: X% of the locked amount.
- Staked Balance:
    - FF Liquidity Staking Fee: Paid by Plenny Whalers, due in PL2 based on the accrued rewards (i.e. X% of all rewards received) when collecting rewards for Fish Farming.
    - FF Fishing Fee: Paid by Plenny Whalers, due in SLP-PL2 based on the total staked balance when exiting the Fish Farming (i.e. X% of the amounts removed).
    - GOV Staking Fee: Paid by PGs, DELs and Vs, due in PL2 based on the accrued rewards (i.e. X% of all rewards received) when collecting rewards for DAO Governance.

- GOV Exit Fee: Paid by PGs, DELs and Vs, due in PL2 based on the total staked balance when exiting DAO Governance (i.e. X% of the amounts removed).

All fees are collected via the community-driven RePLENishment Trigger and are directed to the Treasury HODL.

4.2.5 Competitive Edge

The competitive edge stems from the provision of services with rewards for the users and the collection of fees by the Dapp. The key advantages of the value chains applied by Plenny can be distinguished as follows, depending on the type of economy:

Non-financial digital economy:

- Using Plenny allows participating nodes to provide channel capacity at a viable cost-benefit ratio while earning income as Liquidity Makers and Oracle Validators.
- Exchanges, retail users, trading operations, and miners benefit from Plenny when connecting their Lightning Nodes infrastructure, and thus benefit from additional liquidity to generate additional returns on their capital locked up in payment channels on the LN.

Decentralized financial economy:

- Liquidity Providers (LPs) use automated market maker (AMM) protocols to provide liquidity via decentralized markets and benefit from liquidity staking (i.e. Fish Farming) on the Dapp while supporting the token price.
- Cash management operations via the RePLENishment Trigger and the Treasury HODL (i.e. burning and buybacks) support the token price.

4.2.6 Cost-Benefit-Analysis for Lightning Nodes

Plenny provides income opportunities for Lightning Nodes. The estimated income depends on the use case. Sample calculations show the following cost-benefit analysis:*

1. Use Case LN Channel Rewards: If a Lightning Node logs 3.9M sat of outbound capacity for 1 year, the cost-benefit analysis looks as follows:

+5,636.78 PL2 LN Channel Rewards

- Baseline Reward for verifying Lightning Node (one-time) and for claiming channel rewards: 2 x 250 PL2 = 500 PL2.
- Claim Channel Rewards: 5,136.78 PL2.

-1,320.00 PL2 Expenditure (gas fee and other cost)

- Verify Lightning Node (one-time): 2 transactions with gas fee: USD 4.30 and 1 Bitcoin on-chain transaction: USD 3.00 = USD 7.30 = 730 PL2.
- Claim Channel Rewards: 1 transaction with gas fee: USD 2.90 and 1 Bitcoin on-chain transaction: USD 3.00 = USD 5.90 = 590 PL2.

Estimated Income = +4,316.78

2. Use Case Capacity Market: If a Liquidity Maker provides 3.9M sat of inbound capacity for 1 year to a Liquidity Taker, the cost-benefit analysis looks as follows:

+5,436.78 PL2 Royalties and Channel Rewards

- Fixed Royalty: 50 PL2.
- Customizable Royalty: X PL2 (this licensing fee is freely determined by the Liquidity Maker).
- LOC Channel Rewards: Baseline Reward of 250 PL2 + 5,136.78 PL2 = 5,386.78 PL2.

-661.25 PL2 Expenditure (gas fee and other cost)

- 1 transaction with gas fee: USD 3.60 and 1 Bitcoin on-chain transaction: USD 3.00 = USD 6.60 = 660 PL2.
- Maker Fee of Fixed Royalty Amount and Customizable Royalty Amount: 2.5% = 1.25 PL2 + X PL2 = 1.25 PL2.

Minimum Estimated Income = +4,775.53 PL2

3. Use Case Decentralized Oracle Network (DON): If a Lightning Oracle validates the opening and closing of a payment channel of 3.9M sat, the cost-benefit analysis looks as follows:

+4,250.00 PL2 Oracle Validator Rewards (OVR)

- OVR for the Consensus Winner: 2 validations: 2 x 2,125 PL2 = 4250 PL2.

-1,641.00 PL2 Expenditure (gas fee and other cost)

- 2 transactions with gas fees for opening and closing of the channel: USD 16.41= 1,641 PL2.

Estimated Income = +2,609.00 PL2

*The calculations are meant only as examples. Such calculations can vary widely depending on transaction fees, exchange rates of BTC, ETH, and PL2, fee and reward parameters on Plenny, and the reserves in the Treasury HODL. The exchange rates and parameters used here are for illustrative purposes only: 1 PL2 = USD 0.01; 1 ETH = USD 2,300.00; TH = 250,000,000 PL2.

4.3 Lightning Economics

4.3.1 LN Total Value Locked

In late 2021, the public bitcoin capacity on the LN has grown to hold a bitcoin capacity of around 3,000 BTC which is more than USD 120 million at the time of writing. Estimates show the LN processed 663,000 transactions into and from commonly used wallets, with around 10 million lightning-enabled wallets in September 2021 (Arcane Research Report, 2021).

Year-Over-Year Bitcoin Lighting Network Overview

Metric	1/1/21	Current Reading	YoY Delta
Network Capacity (USD)	$30.7M	$153.5M	+400%
LN Node Count	15,440	32,363	+110%
LN Node Count with Active Channels	8,120	19,201	+136%
Channel Count	36,410	84,149	+131%
Average Channel Capacity	₿0.03	₿0.04	+36%
Average Node Capacity	$3,784	$7,995	+111%

Source: Kraken Intelligence, 1ML

The number of Lightning Nodes has been growing so fast that there are now more than 2x more nodes than conventional Bitcoin full nodes. In January 2022, there were over 32,000 nodes counted (referring to the second column under the tab "Current Reading" displayed in Table I[24] above).

Speaking to the massive adoption the LN saw in 2021, the total number of LN nodes more than doubled, LN channels increased by roughly +130%, the average channel capacity increased by about +35% in bitcoin terms, and the average node capacity increased around +110% to nearly USD 10,000.00 (Kraken Intelligence Report, 2022).

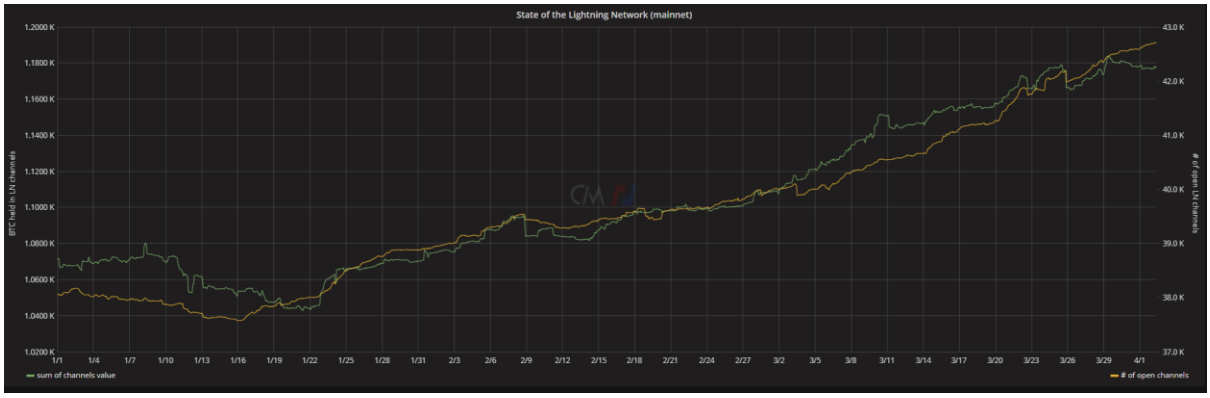
From the beginning of 2021 to the end of August, lightning wallet payment volume grew by 20% monthly with the equivalent number for public channel capacity being 10% (Arcane Research Report, 2021). In September, "the discrepancy widened further, with payment volume almost doubling relative to a 26% increase in public channel capacity." Research shows "an estimated 27.8% of all lightning channels were private in January 2020." Industry-leading experts assume the share of private channels on the LN could be even higher now (Arcane Research

Report, 2021).

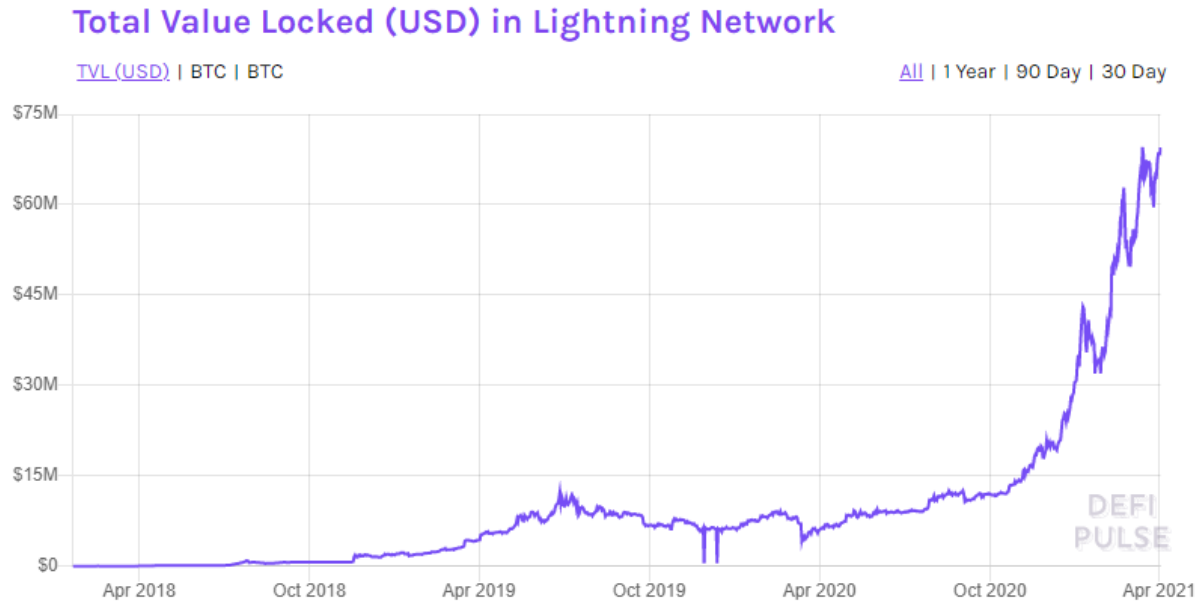
Comparing the various recent data sources, the average numbers suggest the following:

- An average channel size between 0.03 and 0.04 BTC (i.e. 3M–4M sat).
- A Compound Annual Growth Rate (CAGR) of 34.49% (based on the YTD growth rate of the total sat locked in the LN).

The number of payment channels on the LN has been steadily growing in correlation to the total bitcoin amount locked (suggesting a constant channel size in BTC).[25]

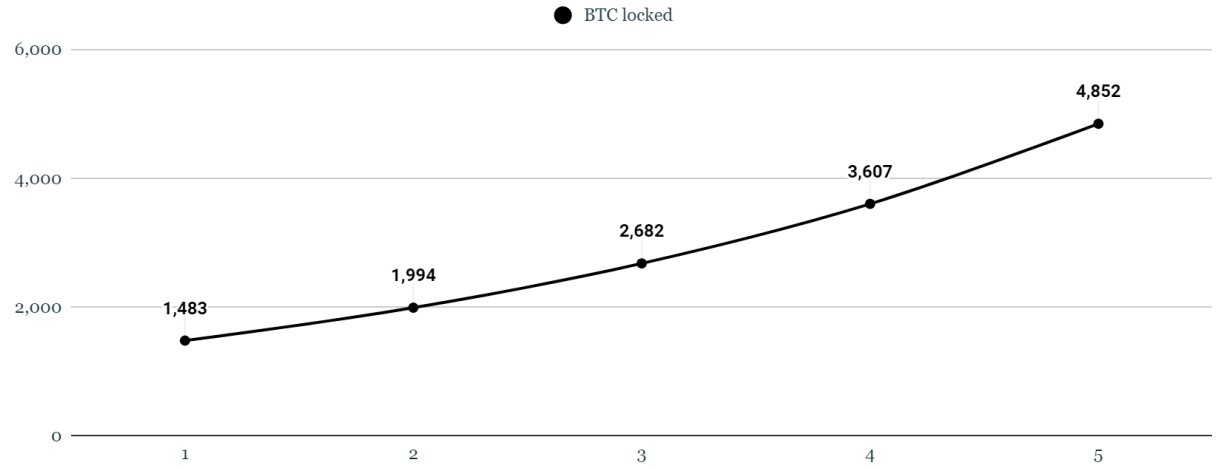


Looking at the figures more closely in retrospect, the strong growth can already be seen in the first quarter of 2021.



The Total Value Locked (TVL) of the LN was over USD 70M by end of April 2021, double the amount compared to the beginning of 2021.[26]

It can be stated that the increase in value is substantial and tends to be faster than generally expected.



If the multiyear uptrend continues, it would not be unreasonable to see nearly 5,000 BTC locked in the LN in by 2026.

Estimates show the potential of almost "700 million users on the LN from gaming, video, and audio in 2030." With streaming of lightning payments through these services, researchers project an estimate that equals "no less than 364 trillion lightning transactions per year" (Arcane Research Report, 2021).

4.3.2 Bitcoin L2

Plenny's token economy calculations are based on Lightning Network fundamentals. The LN is a second-layer technology using micro-payment channels (i.e. P2P state channels) to scale the Bitcoin blockchain. Off-chain capabilities are used to offer an instant-payment experience. Transactions conducted over lightning are faster and less costly compared to those conducted directly on the bitcoin blockchain (i.e. on-chain).

In principle, the Lightning Network is supposed to solve the scalability problem. Lightning payments do not use proof-of-work consensus, require no mining, and have no 10-minute confirmation time, thus enabling instant transactions at the speed of light. The difference between the Bitcoin and Lightning protocol is that Bitcoin broadcasts each transaction to the chain, whereas Lightning verifies a channel status against the chain.

It is a network of Lightning Nodes and payment channels, which means every node with channels is connected to at least another node. When two counterparties decide to open a channel on the LN, they need to fund the channel through a transaction on the Bitcoin blockchain. In the opening transaction, each node commits an amount of bitcoin recorded on-chain that funds their side of the channel.

For example, Haley and Adam each commit one bitcoin to their side of the channel in the opening transaction. They do this by both signing a multi-signature UTXO (Unspent Transaction Output). In simplistic terms, they have now locked up one

bitcoin each that can only be moved by a new input from the channel on the LN.

The above is an example of a bi-directional channel, which is limited to two transacting parties. However, the payment network is not only built on bi-directional payment channels. Instead of establishing a direct payment channel to every other party participating in the network, a technique called Hash Time-Locked Contracts (HTLCs) allows payments to be routed to other Lightning Nodes and sent through a path of payment channels on a non-custodial basis.

The P2P architecture makes lightning transactions structurally more centralized than on-chain bitcoin transactions. Well-connected nodes (or hubs) are an essential part of the LN. Thus, while clustered nodes in some sense lead to increased centralization of the LN, the network itself is not inherently centralized, it's merely a property of the network users may opt to take advantage of.

Practically, the LN offers almost free, instantaneous, and private (off-chain) payments. Users always have the option to open their own channels, both private and public.[27]

In 2021, researchers observed a declining clustering coefficient,[28] indicating peers on the LN make increasingly more rational decisions when opening new channels. In general, payment channels tend to be opened with nodes that are connected to a minor group of nodes, "which the Lightning Node has not opened a channel with." The opening of this channel gives the node a route to this subgroup of nodes and "the ability to route transactions to these payment channels." Given these nodes also tend to be connected to another subset of nodes, the node gains the ability to route a transaction more efficiently on the broader network (Arcane Research Report, 2021).

Moreover, the LN is chain-agnostic and works on any blockchain that uses the same algorithm for the hash lock (e.g. Litecoin), but Bitcoin is its main protocol. While SegWit made on-chain transactions cheaper in 2017 by solving transaction malleability and bringing the LN to life, Taproot makes them indistinguishable from normal transactions to the Bitcoin protocol and Lightning Network. The Taproot Soft Fork upgrade adds another layer of privacy for participants and was activated in November 2021.

Using Taproot technology, Bitcoin can host massive smart contracts with tens of thousands of signatories but retains the size of a single signature transaction. Moreover, some contend that Taproot, combined with Lightning Network, will advance BTC's utility from primarily a "store of value" to an efficient "medium of exchange" by upgrading the network's core cryptography to ensure network security. Taproot is assumed to inspire more developers to work on Bitcoin by enabling complex DeFi smart contracts.

Diving into the details, key aggregation allows Bitcoin to compete with higher throughput blockchains such as Ethereum, which is the primary breeding ground

for DeFi projects. By the end of 2021, more than 40 hardware wallets, software wallets, web wallets, and exchanges have adopted Taproot for deposits or withdrawals (i.e. adopting the corresponding bitcoin address format, meaning Bech32 and Bech32m).[29]

4.3.3 Lightning Nodes

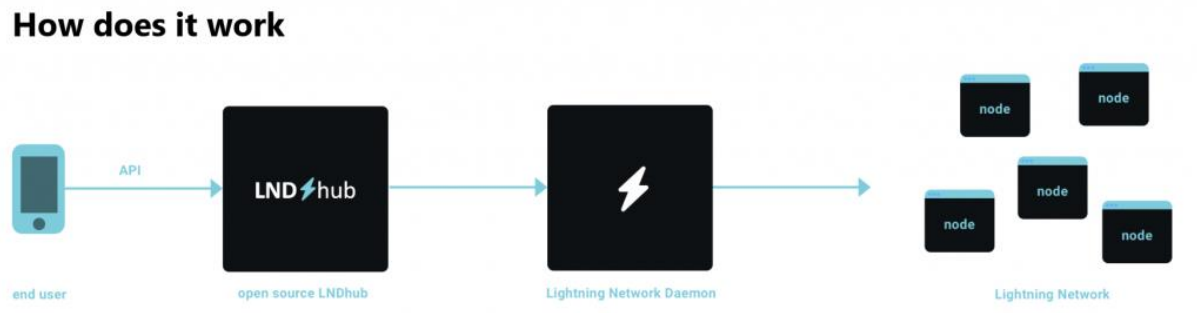
Since Plenny's DON is based on the Bitcoin Lightning Network with +32k Lightning Nodes as of January 2022),[30] it builds upon an existing decentralized infrastructure with further potential for growth. The Ethereum Network consists of lesser nodes (almost 5,500 in January 2022).[31]

Existing Decentralized Oracle Networks based on the Ethereum infrastructure only use a small number of these nodes (e.g. +130 clients at the industry-leading Oracle provider, as of July 2021).[32] Given these proportions, it can be concluded that Plenny's DON is bound to achieve a plausible degree of decentralization with a participation of ≈1% of the existing Lightning Nodes.

4.3.4 P2P Payments

The Lightning Network leads as the overlay micro-payment network for Peer-to-Peer (P2P) payments using Bitcoin, with strong potential to move into other layer-1 consensus protocols.

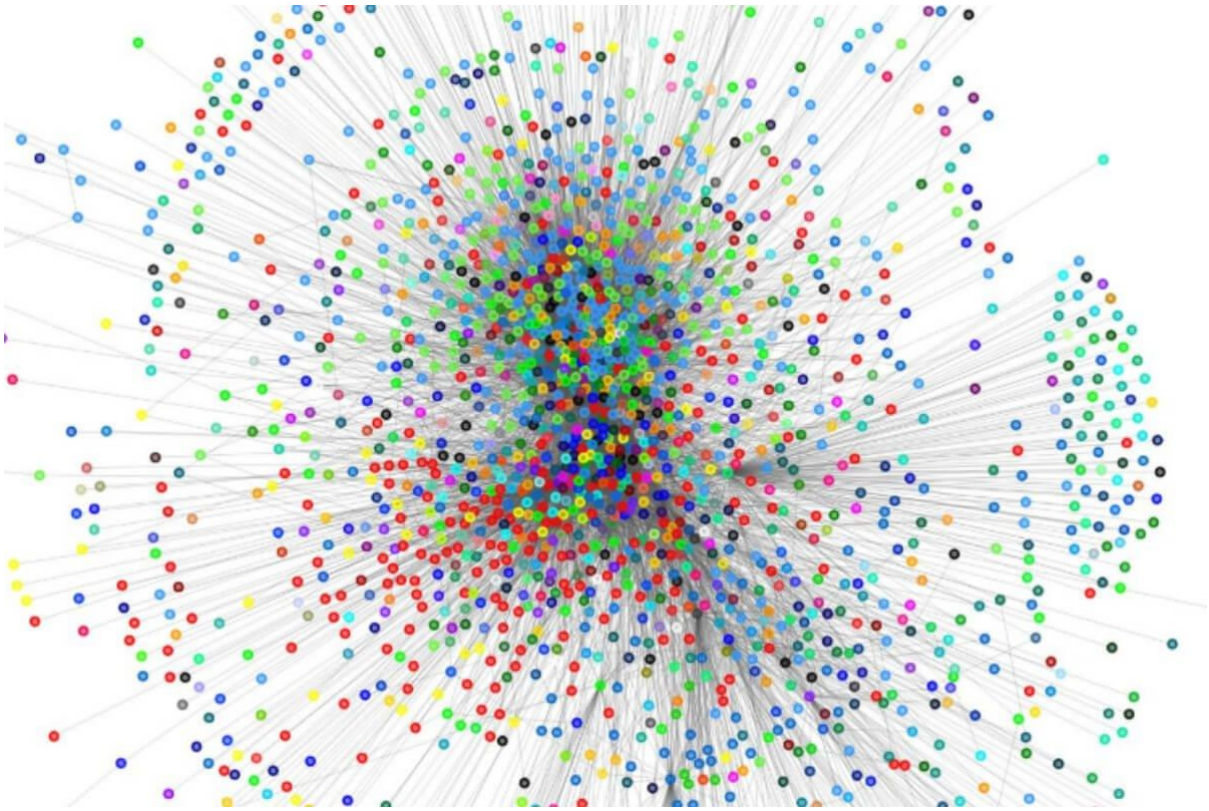
The emergence of so-called "Lightning Apps" (Lapps) creates the economic basis for processing transactions via decentralised applications on the LN. Lightning Service Providers (LSPs), whether centralized or decentralized, regulated or unregulated, or a mix of all, are creating new opportunities for transaction-based services such as P2P payments that can be offered by Lightning Nodes or lightning hubs.



Re-imagining how money flows over P2P systems in the future helps convey the potential of lightning payments and its ecosystem. There are many use cases for instant, high-volume, low-fee payments in cryptocurrency. Technological trends such as machine learning and artificial intelligence can be easily linked to

lightning transactions. Metered payments for machine-to-machine (M2M) payments amplify the value proposition of the Internet of Things (IoT).

Furthermore, micro-payments are useful when streaming content over the Internet. Lightning-enabled cryptocurrencies allow for innovation in payments and make the streaming of money possible. The graphic below shows the Lightning Network in 3D and illustrates how a decentralized infrastructure with fluid transaction flows mesh.[33]



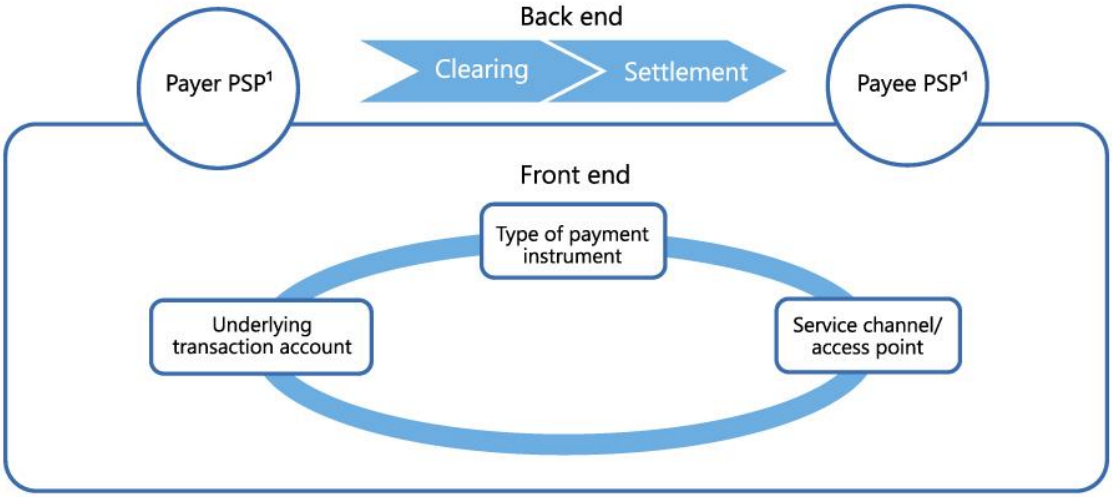
In general, P2P networks can be distinguished on the architecture level. The first type refers to structured P2P networks, the second to unstructured P2P networks. Payment systems with a P2P messaging layer but a centralized settlement layer are structured. Payment systems with a P2P messaging layer and a decentralized settlement layer are unstructured.

The P2P setup of the LN can be better understood by bringing the distributed architecture of traditional payment networks to mind. In current mobile payment applications, individual devices can message directly with one another. This messaging layer represents a P2P network using a mesh topology. In a mesh network, users, devices, or nodes connect directly and non-hierarchically. However, within conventional mobile payment applications, users link bank accounts and card data to the network. Although the topology of traditional mobile payment applications is P2P mesh on the user interface level, the settlement layer

remains centralized on the infrastructure level. Underneath, transactions are processed among financial intermediaries.

Technically, mobile payment applications are hubs with transactions including Person-to-Business (P2B), B2B (Business-to-Business), and Business-to-Person (B2P). Such hubs are structured hierarchically where transactions occur indirectly via the platform. Under the hood, current mobile payment applications use payment service providers (PSPs) and/or act as financial intermediaries, transferring money and holding funds of third-parties. From a regulatory perspective, no P2P transactions occur when the clearing and settlement mechanism is centralized.

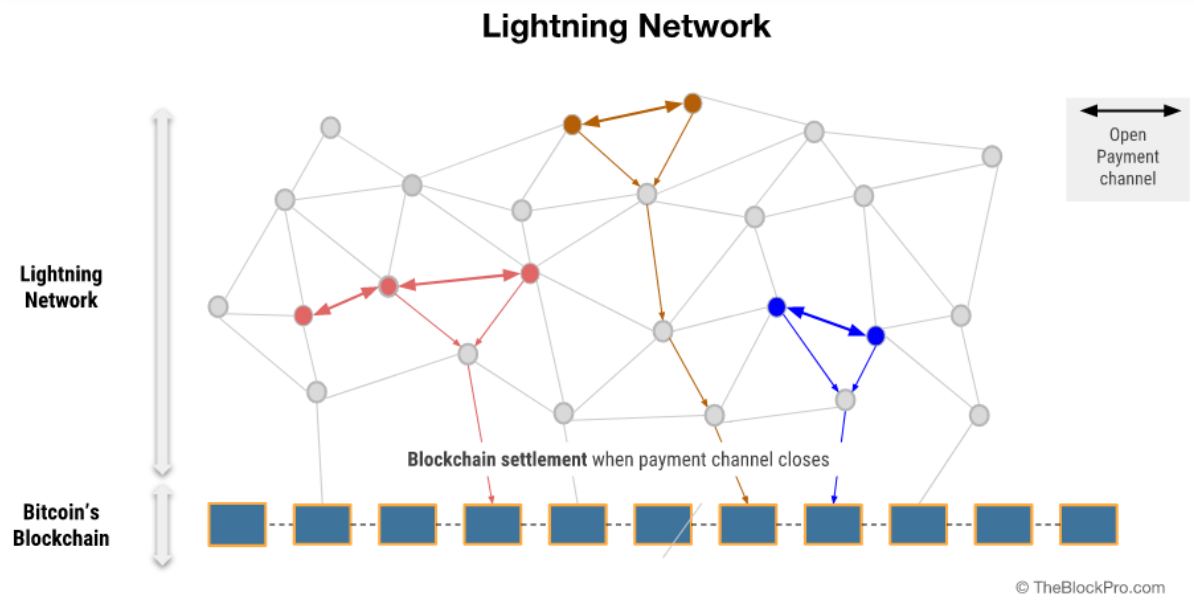
Elements of a payment system — Graph 1



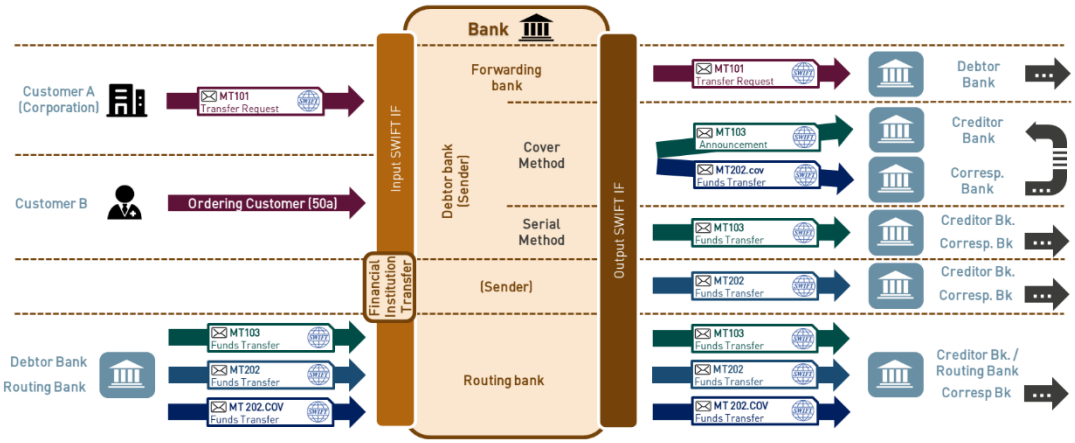
[1] PSP = payment service provider.

Source: CPMI (2018).

In contrast, the Lightning Network is unstructured, whereby the messaging layer and the settlement layer are both decentralized. Other than fiat transactions, funds are controlled by users, not of financial intermediaries. In this regard, the LN constitutes a complete P2P network. Mesh topology is applied fully. Each node functions as a router. This routing layer allows nodes to cooperate with one another to efficiently route transactions through payment communication channels of intermediate nodes that pass data along.



The functioning of the LN can be further clarified by taking a closer look at the characteristics of traditional payment networks. Apart from central clearing houses or card schemes, which act as specialized financial intermediaries for settlements among banks and do not use P2P structures, traditional finance has always been familiar with P2P payments. The transaction flows of the Society for Worldwide Interbank Financial Telecommunication (SWIFT) correspond with the P2P concept. In general, SWIFT uses P2P payments between banks for international transfers, as shown in the transfer message diagram below:



Key money transfer messages:[34]

- MT 101 - Request for Transfer
- MT 103 - Single Customer Credit Transfer
- MT 202 - General Financial Institution Transfer
- MT 202 COV - General Financial Institution Transfer for Cover payments

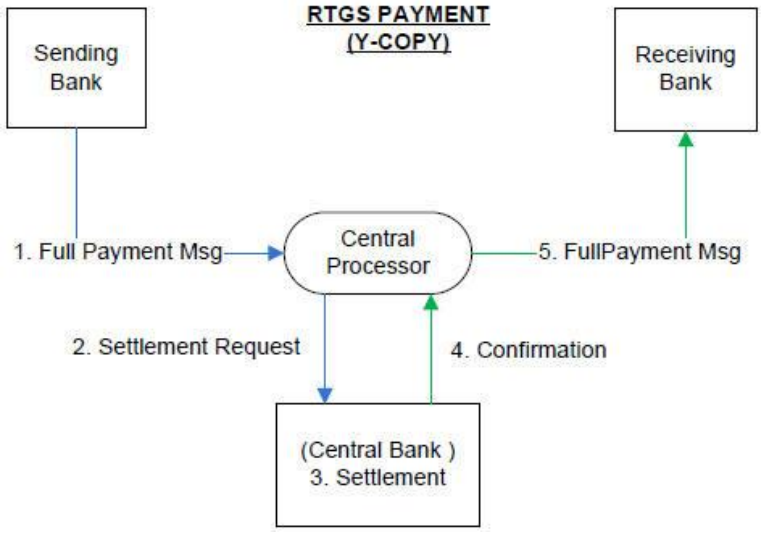
For clarity, SWIFT is a global network connecting banks for communicating messages about financial activities like money transfers. The SWIFT network links members for processing payment instructions and enables the secure

movement of financial messages. As such, SWIFT is not a financial intermediary that provides centralized custody services to hold and move funds but instead is a general ledger with a centralized database that records transaction information privately as compared to a blockchain, which is a specific type of a distributed ledger with a replicated database shared publicly or privately. Via SWIFT, assets are held by banks and balanced based on individual agreements and reciprocal credits among correspondent banks.

Essentially, SWIFT offers payment communication channels for transactional data. In the widest sense, this non-custodial concept is reassembled when connecting Lightning Nodes among each other for communicating transactional data that give access to money. However, there is one major difference: Funds are held in payment channels over the LN and secured by the Bitcoin blockchain powered by multi-signature Bitcoin-based smart contracts to send transactions among peers.

Like SWIFT, the Lightning Network is global. Unlike SWIFT, however, participation is permission-less and only requires a Lightning Node and/or a wallet app on a smartphone. This technical framework means users can transfer their own funds among peers nationally and across borders without the need for a regulated financial intermediary go-between. Consequently, no financial license is required to participate if Lightning Nodes do not provide custodial services to hold and process funds of third parties.

Also, Real-Time Gross Settlement (RTGS) systems run on P2P rails. RTGS are special money transfer systems in which the transfer of money or securities from one bank to any other bank takes place on a gross basis at the national level. RTGS systems are operated by central banks transacting with high value payments, compared to the LN that is focused on micro-payments. The Schematic representation of how an RTGS payment is exchanged and processed in the network is shown below:[35]



It goes without saying that central banks are state institutions. They capitalize on seigniorage through the issuance and control of fiat currencies with a focus on assisting financial intermediaries that offer custodial services. Therefore, they rarely have the intention of supporting private forms of money such as open-source cryptocurrencies running on decentralized networks that bring non-custodial solutions to the masses across borders.[36] Nonetheless, major central banks have rapidly increased their research and development efforts in central bank digital currencies (CBDCs)[37] in recent years, with P2P payments being discussed in-depth. In essence, these network principles apply to both centralized and decentralized systems, regardless of whether fiat or cryptocurrencies are used, regardless of whether permissioned or permission-less distributed ledgers are involved and regardless of whether large-value payments or micro-payments are processed.

4.3.5 Privacy

Privacy is ensured between the participants on a P2P basis. The Plenny Dapp cannot track lightning transactions from participating nodes. Lightning transactions only take place on a P2P basis and can therefore only be tracked by Lightning Nodes in their own payment channels. Using Hashed Timelock Contracts (HTLC), participating nodes cannot track the lightning transactions of others.

Lightning Nodes permit participants to access channel capacity on a non-custodial basis for connectivity and transactional purposes. Access to payments data is granted based on P2P transactions. During this data exchange, Plenny enforces fundamental data protection principals. There is no control of funds by third parties, no accounts for depositing or holding funds, and no financial intermediation taking place.

There are technologies like zero-knowledge proofs to help protect privacy on blockchains. Apart from that, as a general rule, crypto experts recommend having more than one crypto wallet, including at least one that is public-facing and at least one that is private.

4.4 Ethereum Economics

4.4.1 Ethereum L2

The calculations given are based on gas cost in ether (ETH) Layer 1, the native coin of Ethereum, although the Plenny-Dapp is deployed on Arbitrum One, a Layer 2 chain using Optimistic Rollups (ORU).[38] This technology brings economic efficiency and allows decentralized applications to scale at a tiny fraction of L1 fees (i.e. at 50 to 250 times lower cost).

Rollups process transactions almost instantaneously, much faster than L1, with thousands of transactions per second. Still, such L2 transactions are secured over Ethereum L1 by aggregating data and using 2-way pegs and bridges. As ORUs are expected to operate with continuously decreasing fees, Plenny has the potential to maintain its functionalities at an efficient level and provide an attractive value proposition to users.

Ultimately, participating Lightning Nodes rely on paying low transaction fees to use the lightning services of Plenny. It is assumed that the cost efficiency of L2 will create an arbitrage effect in the medium to long term, making it profitable for Lightning Nodes to join Plenny to improve connectivity and increase channel capacity.

4.5 Token Valuation Alpha Release

4.5.1 Method

This section outlines the valuation method[39] used to assess the potential token's exchange rate and examines its application and possible shortcomings (i.e. Alpha release). To reflect the given uncertainty, the modelling of the income and turnover assumptions represents an extremely rough estimate serving as guestimates for educational purposes only.

4.5.2 Quantity Theory of Money

The most widely used valuation methodology for tokens is the quantity theory of money[40] or, more precisely, the equation of exchange.[41] Several models based on those principles have been developed and commonly accepted by the cryptocurrency community.[42]

In a nutshell, the equation MV = PT relates to the price level and the quantity of money. The quantity equation is the basis for the quantity theory of money.

$M \times V = P \times T$ (1)

- M is the quantity of money in circulation within the system (circulating token).
- V is the velocity of circulation: how often does money change hands within a predefined period (i.e. per year). The average velocity of BTC and ETH is used.
- P is the price level of the transactions.
- T is the transactions volume for the predefined period.
- $P \times T$ is the total economic output of the system for the selected period, sometimes referred to as Gross Domestic Product (GDP) of the system meaning the turnover assumptions.

The above formula (1) is not directly applicable to cryptocurrencies (and a commonly encountered misunderstanding) but is applied indirectly for lack of a

better approach. In a cryptographic token economy, the above equation's two sides are denominated in different units.

When considering the GDP of Plenny, the expected income in USD is used to calculate the variables, including the price level. The left-hand side of the equation is denominated in the native token. This formula is solved by introducing an additional parameter representing the exchange rate between the token and USD (or any other fiat currency). The equation then becomes the following:

$$M_T \times E_{T/USD} \times V = P_{USD} \times T \quad (2)$$

This calculation for $E_{T/USD}$ (3) results in the expected token exchange rate (i.e. token value). Adequate estimations are used for the other variables.

From (2), the token value is resolved as follows:

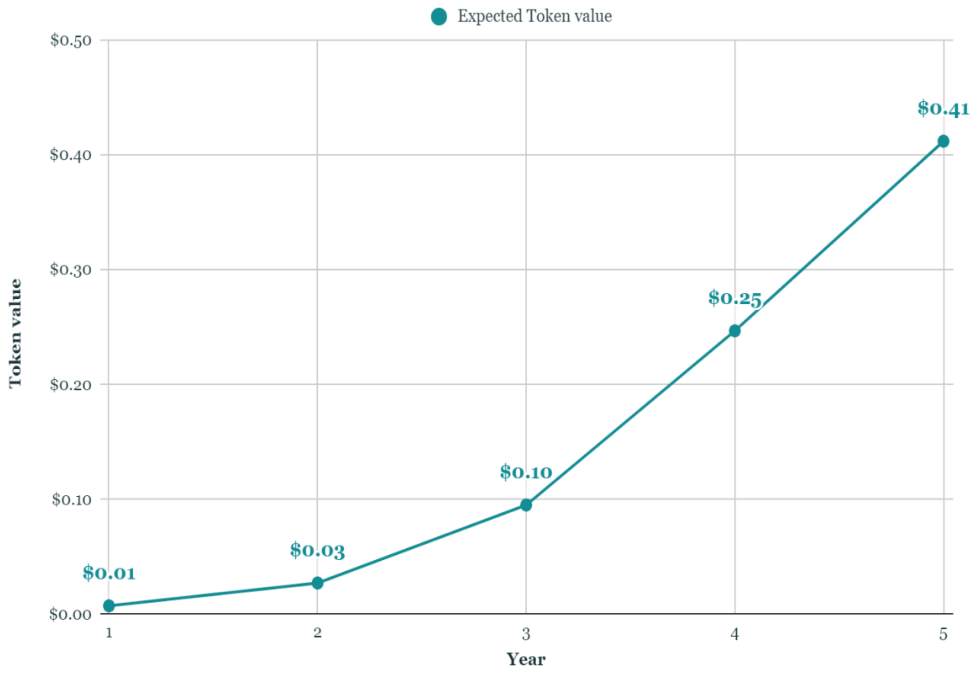
$$E_{T/USD} = \frac{P_{USD} \times T}{M_T \times V} \quad (3)$$

Values related to random data modelling of Year 1:

M: 322.9; V 7; GDP 16.31, P 0.0072

4.5.3 Token Value

Having outlined the valuation approach, the token value (i.e. Alpha release) is solved by using the equation of exchange (3), as seen below:



Estimated token value and return on investment based on random assumptions.

The token value does not refer to market predictions or a forecasted exchange value. The token values mentioned here refer to the rational expectation that the

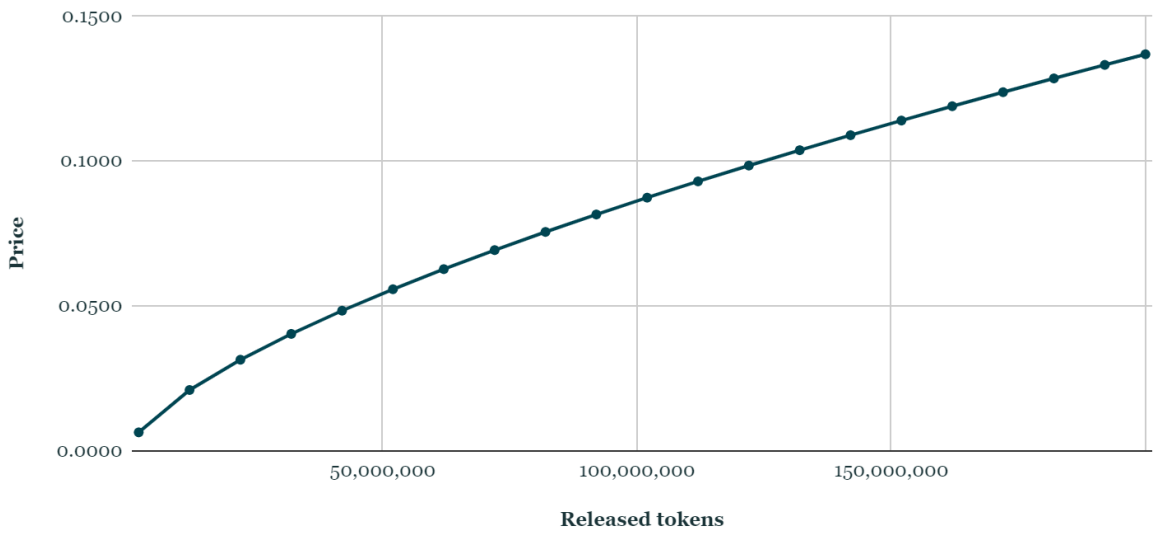
calculated values are consistent with the data modelling of the token economy. Given the current experimental status of Plenny, the exchange value as well as the utility value are virtually impossible to assess at this stage. Due to the hybrid model combining Bitcoin with Ethereum, Plenny has the potential to extend its utility to innovative use cases that have not yet been conceived, which could increase the token's future value in sync with the adoption cycles of the crypto industry.

Speculative exchange rates are subject to market-driven forces, which are not sufficiently factored in here. The actual market value may differ. It is important to realize that speculators evaluate tokens for their future potential following the hype in the markets. Professional traders, on the other hand, research token fundamentals and use technical analysis to value them. Ultimately, one must bear in mind that markets are not rational or predictable. The numbers shown do not qualify as investment advice and serve for educational purposes only.

4.5.4 DEX Bonding Curve

Conceptually, the DEX Bonding Curve refers to the turnover assumptions of PL2 and the token value via decentralized markets. For modelling the different scenarios during the Alpha release phase, a bonding curve was established.

As the token allocations are distributed, the Plenny Community is assumed to continue funding the liquidity contract on the Sushi V2 DEX using Arbitrum Arbitrum One (Ethereum L2) with more WETH/PL2 and stabilizing the token exchange rate, as per the bonding curve below (based on the number of released PL2):



Evidently, community members acting as LPs can independently try to replicate the above bonding curve by funding the smart contract but cannot guarantee the exchange rate when large transactions are made via the suggested liquidity

contract. Therefore, the exchange rate may fluctuate much more in the short term than depicted in the graph above.

For example, suppose the liquidity contract on the DEX starts at 2,000,000 PL2 with USD 12,700.00 (i.e. equivalence in WETH), assuming the currency pair WETH/PL2. USD 12,700.00 and 2M PL2 works out to a token exchange rate of USD 0.00635 per token.

Following the DEX Bonding Curve and allocating funds exclusively to the liquidity contract on Sushi V2 DEX Arbitrum One (Ethereum L2), an equivalent of USD 16.1M could be achieved if community members allocated ETH for at least 200M PL2. This assumption takes into account typical market dynamics and was calculated based on an average of USD 0.0805 per PL2.

The exchange rate of PL2/ETH assumed by the DEX Bonding Curve serves as a provisional reference point for all service fees quoted. Should the PL2 exchange rate be lower than these variables, it suggests cheaper usage of Plenny. Should the rate be higher, community members have the option of reallocating their liquidity positions via decentralized markets.

4.5.5 Scenario Year 1

For experimental purposes, certain behaviors related to the token economy and the resulting token value scenarios were modelled. The test data below served as preliminary indicators in the search for suitable parameters and variables. The conjectures for the first year illustrate the concept and were used as rough estimates to test the Alpha release and draw further conclusions for later versions.

Statistic	Measure	Unit	Alternative	Unit
BASE ASSUMPTIONS ALPHA RELEASE				
Base year	1	Year		
PL2 price	0.1368*	USD		
Average channel capacity	3M sat in 2021 (assumed to increase to 9M sat in 5Y)	sat	0.03 - 0.09	BTC
BTC Rate	60,000	USD		
Plenny in circulation	1,025,000,000	PL2		
Treasury HODL	250,000,000	PL2	25%	
FEES ALPHA RELEASE				
Projections used as the initial parameters are subject to the	N/A	PL2	N/A	USD

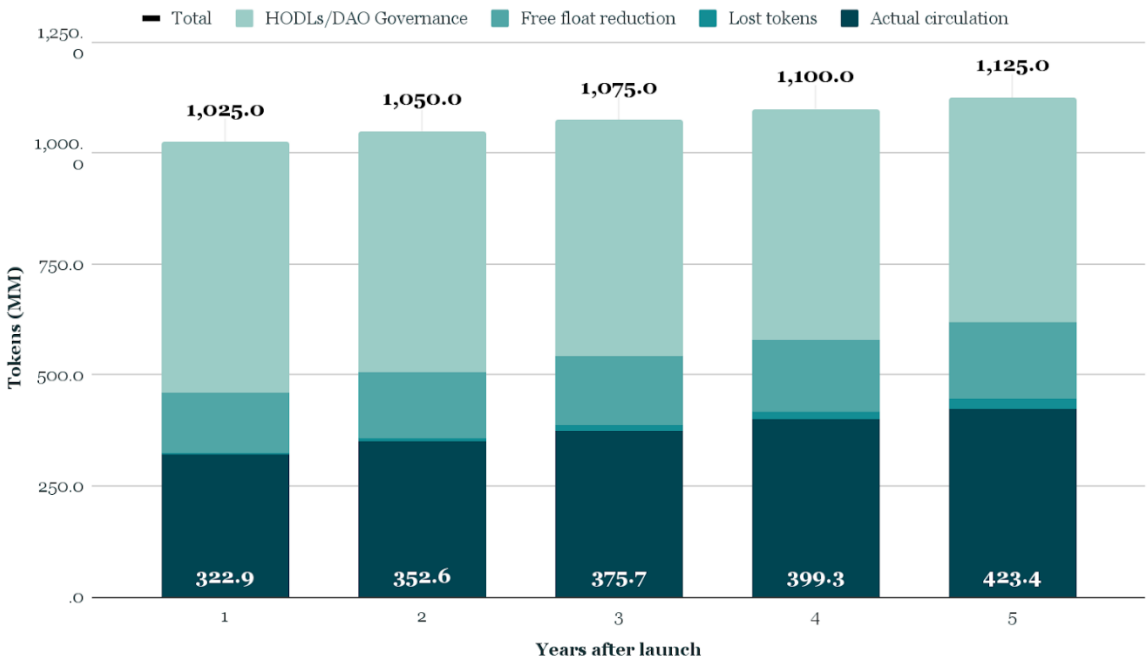
experimental phase and adjustable through governance voting.				
REWARDS ALPHA RELEASE				
Reward for channel opening (LMs)	50	PL2	0.00002%	of TH
Average capacity multiplier	50%			
Channel Rewards for logging outbound capacity:	25	PL2	0.00001%	of TH
Oracle Validator Rewards	200 for prototype (10,000 for MVP and >100k for pilot experiment)	PL2	0.00008%	of TH
Total Channel Rewards for LM	15,035,972	PL2	2,056,892	USD
Total Channel Rewards for Lightning Nodes	30,071,944	PL2	4,113,784	USD
Total Oracle Validator Rewards	120,287,778	PL2	16,455,137	USD
Total rewards	165,395,694	PL2	22,625,813	USD
ECONOMIC EQUILIBRIUM ALPHA RELEASE				
Inflow to outflow	49.15%			
Treasury HODL (Annual Percentage Income Return)	12.29%			
Time to reach economic equilibrium	1	years		
LOC Channel Rewards	25	PL2	10.1	USD
LN Channel Rewards	12.3	PL2	5.1	USD
Oracle Validator Reward	98.3	PL2	40.5	USD

*This is a speculative exchange rate as defined and assumed under "DEX Bonding Curve." However, the token value may change over time, depending on the actual variables applied and actual market conditions.

4.6 Uncertainty Models

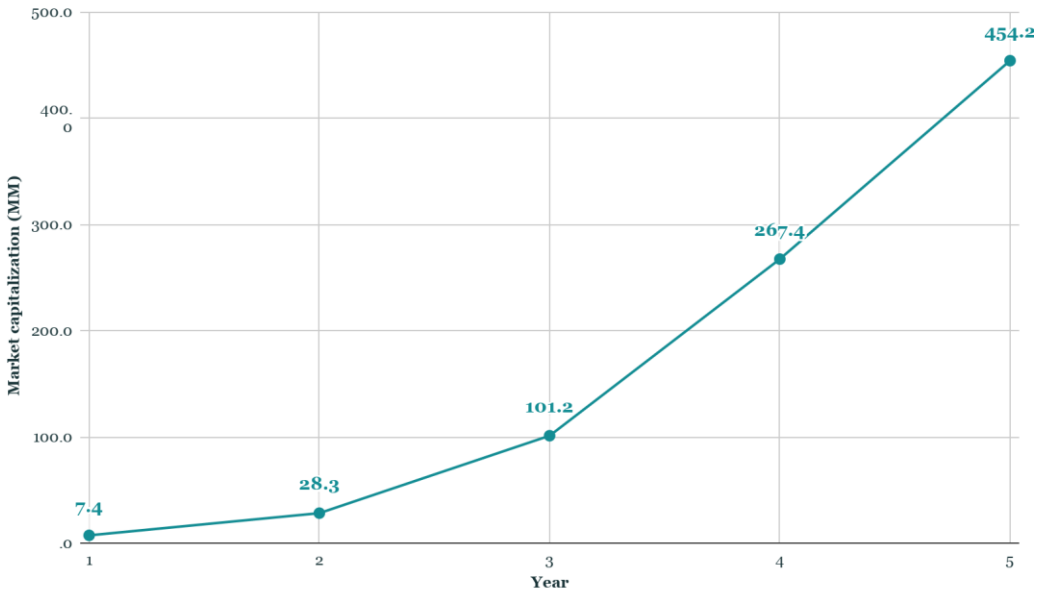
4.6.1 Circulation

Accounting for the common factors that affect the total number of tokens in circulation, the following numbers are assumed for PL2:



4.6.2 Market Capitalization

The market capitalization is randomly projected per M in USD over a period of five years as displayed in the diagram:



Estimated token market capitalization based on the randomly projected token price and total tokens outstanding.

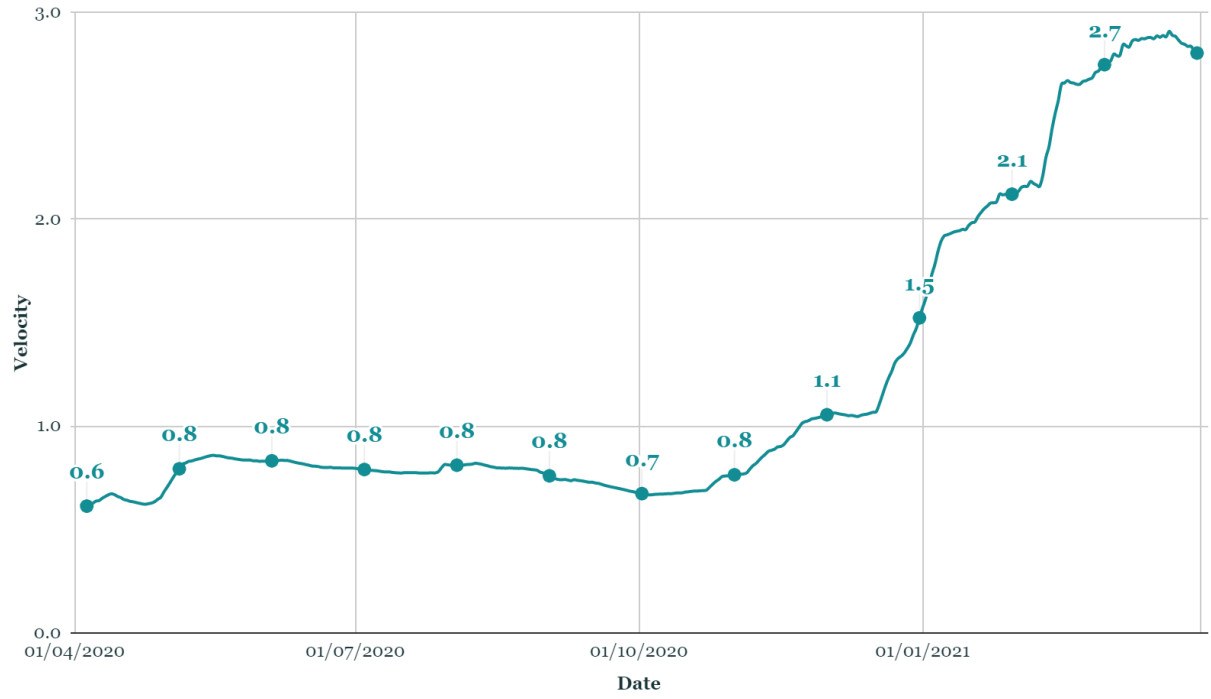
4.6.3 Velocity

This Working Paper refers to on-chain velocity because any actual transfer of value within the Bitcoin and Ethereum blockchain is eventually recorded on-chain.

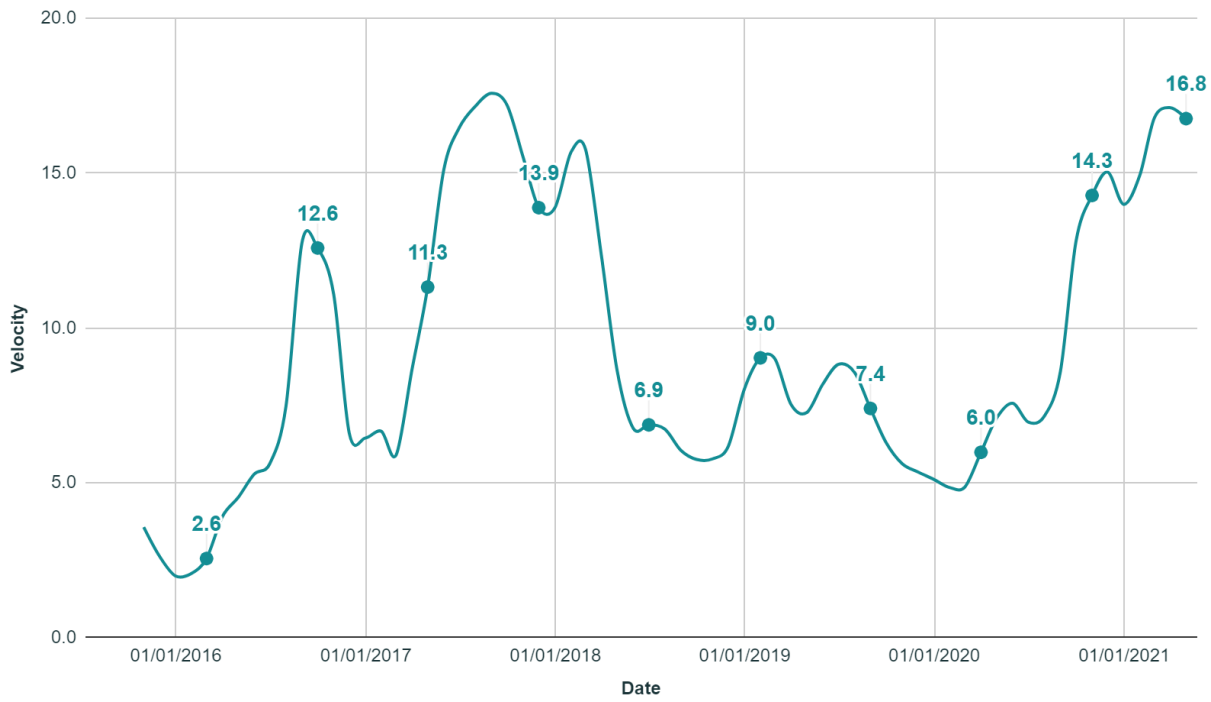
M1 is the money supply of currency in circulation (notes and coins, non-bank traveler's checks, demand deposits, and checkable deposits).

The M2 component includes M1 and adds in saving deposits, certificates of deposit (less than USD 100k), and money market deposits for individuals.

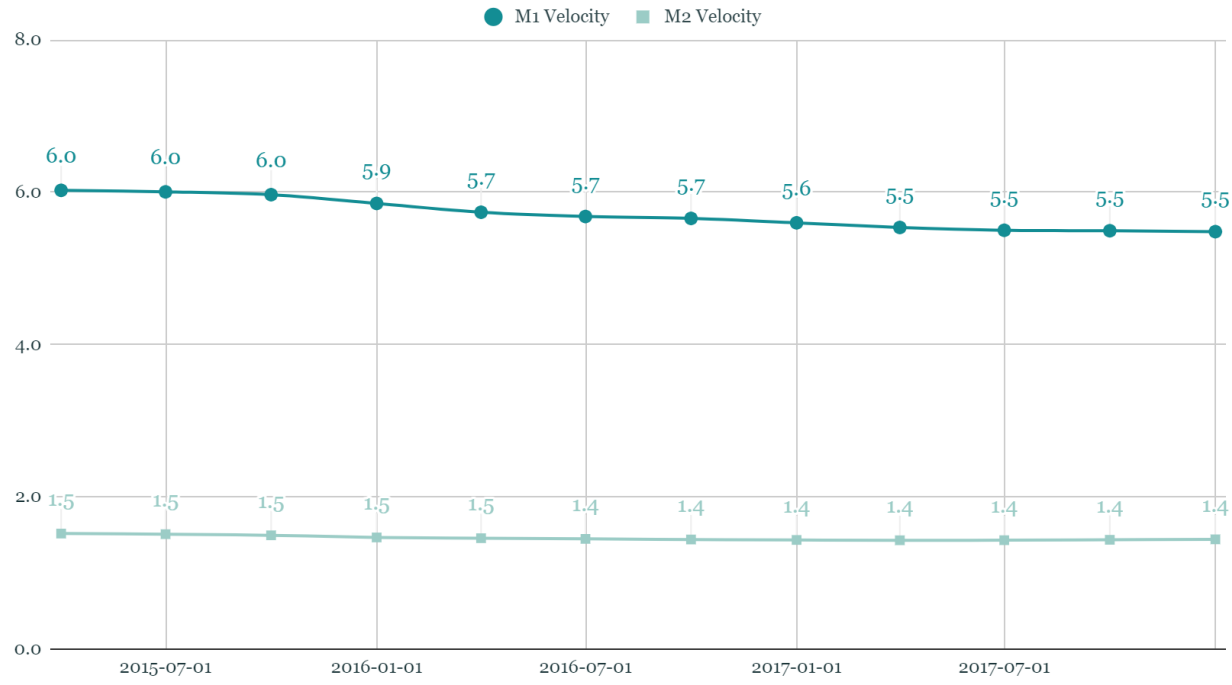
The token velocity is possibly the most complicated and most sensitive assumption to make out of all. Since PL2 does not have a close token sibling, ETH and BTC on-chain velocity[43, 44] are used as benchmarks. In addition, the velocity of M1 and M2 in USD money supply[45] serve as approximate values. All reference points combined lead to an average velocity of 7, which was applied for modelling the transaction scenarios.



Bitcoin velocity of on-chain transactions. The calculation is based on an annualized 90d average transaction volume.



Ether's velocity of on-chain transactions. The calculation is based on an annualized 90d average transaction volume.



The velocity of US Dollar M1 and M2 money supply.

4.6.4 Free Float

Each cryptocurrency has a certain percentage of the supply held by long-term holders and thus not released into circulation. According to CoinMetrics, this

percentage is between 20% and 40% for most of the coins.[46] In this estimate, a midpoint of 30% has been included for this number.

4.6.5 Token Sinks

Inevitably, some tiny percentage of token will be lost each year (e.g. lost private keys). A random estimation of 0.5% of all token per year has been applied. The largest token sinks include the following:

- Tokens kept in the Treasury HODL: Always having ≈25% of the total supply.
- Tokens kept in the Reward HODL: 15% of the original token inventory, reducing over time,
- Token staked for Fish Farming: A random assumption of 10%.
- Tokens staked in the DAO Governance: a random assumption of 5%.

4.7 Theoretical Behavior

4.7.1 LN Turnover Variance

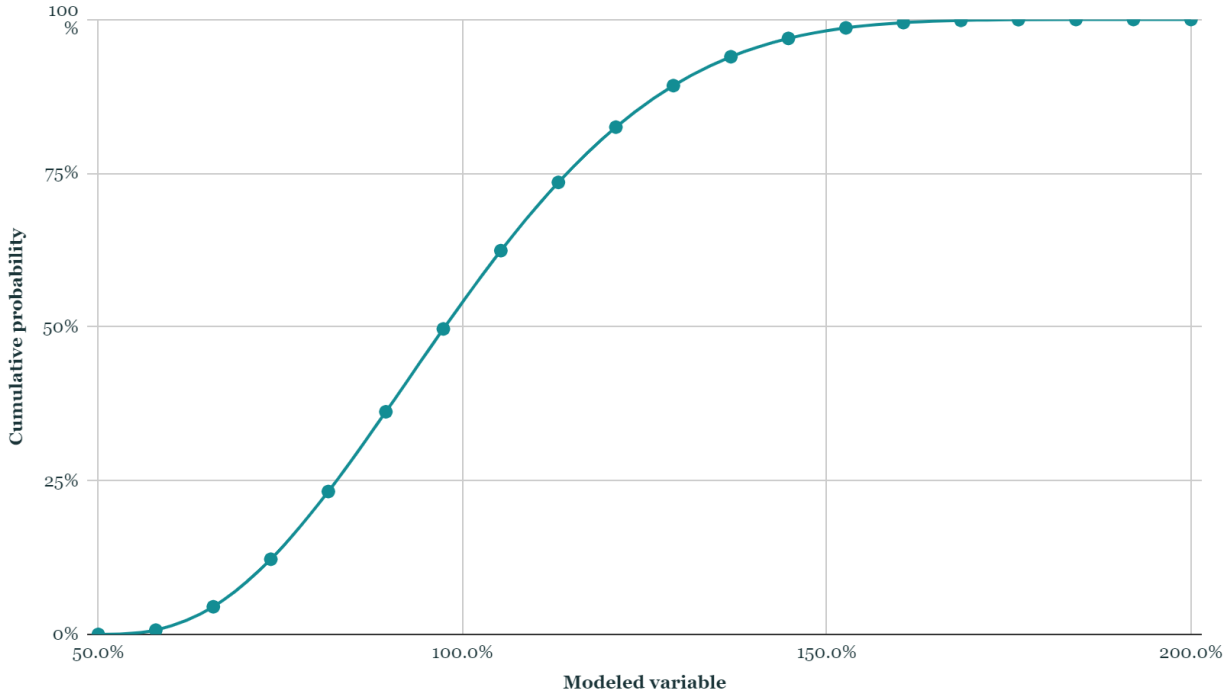
It has been said that "All models are wrong but some are useful." In other words, any model is at best a useful fiction.[47] As there is often no better alternative for innovations than to initially make rough assessments based on vague assumptions, this approach was used to estimate the unknown. The use of average values has resulted in approximate values for the turnover variance that appears to be appropriate.

For experimental purposes, it is assumed that the LN turnover facilitated by Plenny fluctuates randomly. Consequently, this variance is probably affecting the token price. When modeling the randomly expected turnover facilitated in bitcoin by Plenny over the LN, the calculations follow a specific formula. The parameters applied relate to the exchange rate between cryptocurrency (sat and PL2) and fiat currency (e.g. USD).

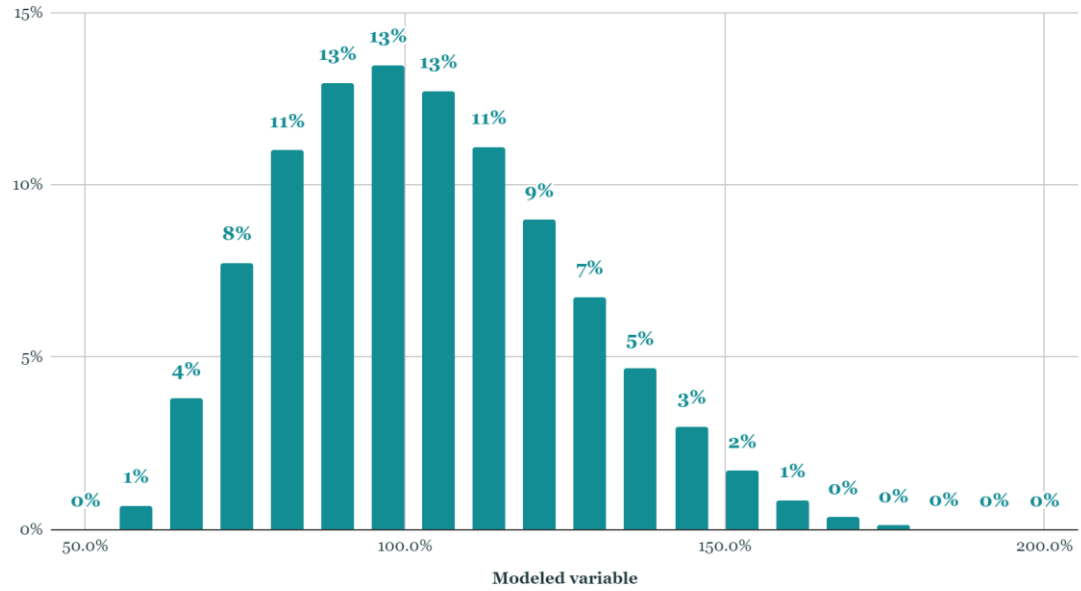
Plenny operates under the assumption it will achieve 200% of its projected turnover in a best-case scenario. In contrast, it will achieve only 50% in a worst-case scenario while still keeping the most likely system at the 100% turnover target achieved. Simulation tools for game design have been used to justify this supposition.[48]

In the statistical literature there is evidence of various distribution models suitable for modelling uncertainty. If turnover is considered as a number of events, the Poisson distribution[49] could be used. In practice, the beta distribution model was used because its application to test data gave a more flexible fit than other models.

Turnover assumptions are random estimates (i.e. "guestimates"). Those numbers are likely to vary widely when real transactions commence. Using a beta distribution (a standard approach for modeling uncertainty)[50] for the expected range of achieved turnover, the predicted range for the token price is modelled very roughly.

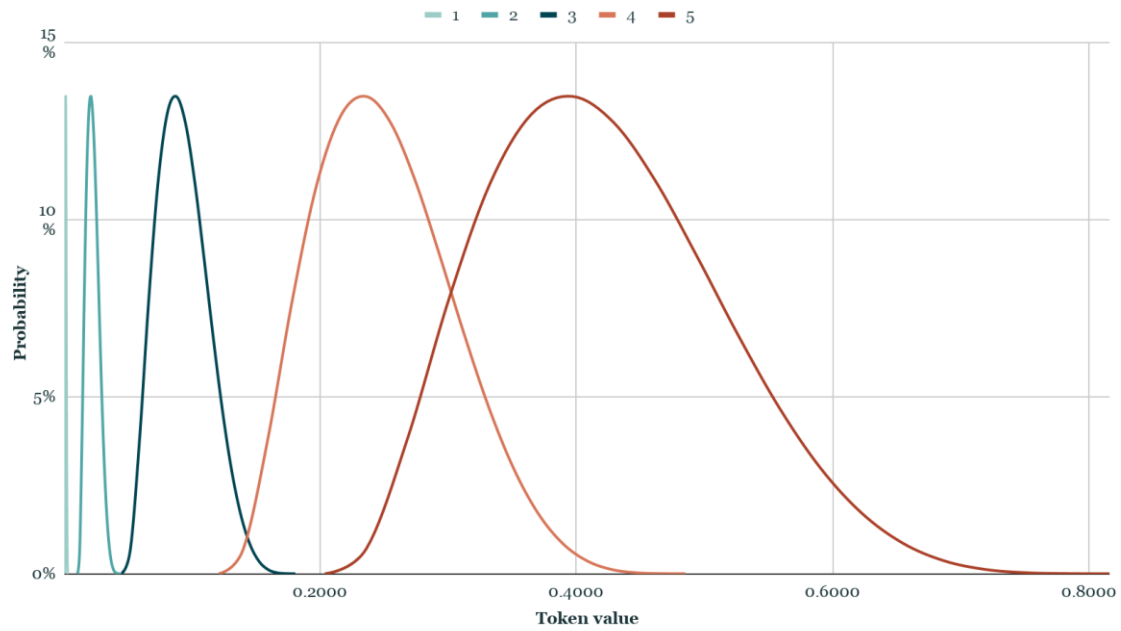


Cumulative probability function, modeling the randomly expected range of variation for the LN turnover facilitated by Plenny's participants.



Discrete probability function, modeling the randomly expected range of variation for the LN turnover facilitated by Plenny's participants.

Using the above discrete probability, the range in which the token price might vary each year is seen below:

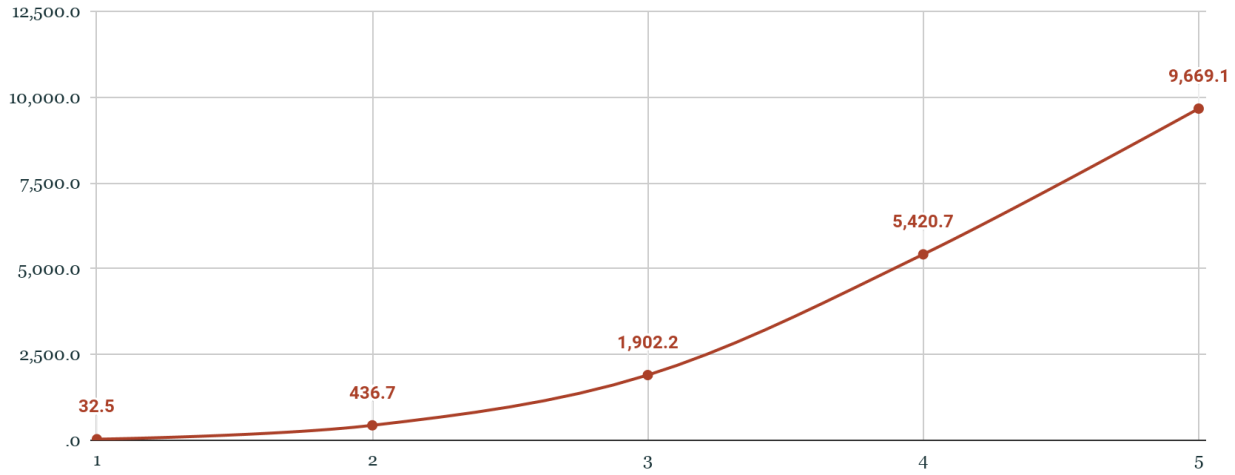


Token price range by year, each year depends upon the year before based on the randomly projected token price (turnover-based) and the related sensitivity estimations (joint probabilities condone inconsistency).

4.7.2 LN Market-share

The behavior of users in terms of their activity on the LN is based on theoretical assumptions. The market share of participants refers to the impact Plenny has on the Bitcoin Lightning Network. It indicates the turnover generated by participating Lightning Nodes across the LN in sat but is displayed as the turnover facilitated by Plenny converted to USD. This figure does not refer to the additional turnover in PL2 of these Lightning Nodes via Plenny within the Ethereum ecosystem.

This hypothesis assumes 10% market penetration via a standard S-shaped adoption curve and extrapolates the potential market size over five years. The assumptions refer to the total market share of participating Lightning Nodes and arrive at the payment channel turnover seen below:



Projected performance and growth of participating Lightning Nodes. The chart shows the performance turnover in M USD broken down by year.

To sum up, this sample calculation randomly assumes that more than 32 million USD in turnover could potentially be generated in Year 1 if BTC/USD is at 60,000.00 and the price neither falls nor rises over the next five years at the given exchange rate.

In general, these turnover assumptions are random and do not constitute reliable predictions or make any kind of citable forecasting nor promise for potential volumes.

5 Community

5.1 Bug Bounty

The security of Plenny is the highest priority. All code and balances are publicly verifiable. White hat hackers are eligible to receive a bug bounty for reporting undiscovered vulnerabilities.

5.2 FAQs

Q: What is Plenny?
A: Plenny connects the Bitcoin Lightning Network with Ethereum through the following simple guiding principles:

- A Satoshi logged is a Plenny earned.
- Plenny connects nodes on the Lightning Network and expands payment channel capacity via the Ethereum ecosystem.
- Following Bitcoin's principle of "Be Your Own Bank" Plenny supports the growth of the Lightning Network by providing decentralized services to Lightning Nodes that empower everyone to run their own payments server more efficiently, conduct instant transactions without middlemen, and as such scale and democratize clearing and settlement mechanisms on a global level.

Q: Is Plenny pegged to bitcoin or ether or USD?
A: No, Plenny is not pegged to the price of bitcoin or ether or USD. Price formation of PL2 is set on free markets.

Q: What is the value of Plenny?
A: Because Plenny is not pegged to an underlying asset like BTC or ETH or USD but is instead linked to providing lightning services, its inherent value relates to the capacity of participating nodes and the number of users in the ecosystem. Fundamentally, the Plenny-Dapp leverages payment channel capacity locked up in Lightning Nodes. Tokens reflecting payment channel activity are backed through implied collateral and indicated as rewards in smart contracts on a non-custodial basis. The practical value of Plenny derives from the utility of the Dapp and the DON as well as the trust users put into decentralized technologies, which are based on both the Bitcoin and Ethereum blockchain.

Q: Is Plenny supposed to replace bitcoin?
A: No, Plenny is a complementary token based on Ethereum to supplement the provision of liquidity for the Bitcoin Lightning Network via the Ethereum ecosystem. There are different cryptocurrencies used by the Dapp and its

integrated Decentralized Oracle Network (DON). Plenny utilizes bitcoin, more specifically sat, ETH, and PL2, known as Plenny, the token of Plenny.

Q: What is the ticker symbol of Plenny?
A: The cryptographic token is called Plenny (plennies), a.k.a. "lightning penny" using the ticker symbol "PL2."

Q: How is money earned with a Lightning Node and Plenny?
A: At the entry level, standard Lightning Nodes receives channel rewards for logging outbound capacity. Among other things, you can use it to license inbound capacity over the capacity market. At the advanced level, Lightning Nodes download a multifunctional open-source software, namely the DLSP module, to act as Liquidity Makers or Lightning Oracles and earn Royalties as well as Channel Rewards.

Q: How can Lightning Nodes earn money without downloading the DLSP module?
A: Simply join Plenny with your Ethereum wallet. First, Lightning Nodes receive the Baseline Reward for verification. Once verified, standard Lightning Nodes start earning LN Channel Rewards for logging their outbound capacity via Plenny.

Q: Where is the Plenny DLSP module available for download?
A: You can download it on GitHub at https://github.com/PlennyPL2.

Q: How does a Lightning Oracle earn money?
A: Lightning Nodes earn money for providing oracle validation services. To start with, users download the Plenny DLSP module, which enables Lightning Nodes to provide decentralized lightning services and receive Oracle Validator Rewards (OVRs). This add-on tool computes transaction data off-chain and works with the Bitcoin Lightning Network and your Ethereum wallet.

Q: How does a Liquidity Maker earn money?
A: Liquidity Makers earn money for licensing transaction data services via payment communication channels. Licensing inbound capacity enables Liquidity Makers to earn Royalties and receive Channel Rewards. In parallel to operating regular payment channels using sat over the Lightning Network, Liquidity Makers utilize the token of Plenny to participate in the capacity market (i.e. Lightning Ocean). The licensing fees are paid by Liquidity Takers. In addition, LOC Channel Rewards and the Baseline Reward are granted by the Dapp. To start with, download the Plenny DLSP module and connect it to your Ethereum wallet.

Q: How do Bitcoin exchanges benefit from Plenny?

A: Bitcoin exchanges benefit from Plenny by using the capacity market. Logging channel capacity in exchange for PL2 generates additional returns on their capital locked up in payment channels. Furthermore, connecting their Lightning Node infrastructure with Plenny facilitates instant payment acceptance for BTC. Customers of exchanges benefit too as they no longer have to wait for blockchain confirmations.

Q: How does Plenny cover its costs?
A: To compensate for its value-adding utility, Lightning Nodes share token rewards with Plenny. Integrated billing functions collect transaction fees. The costs are covered by income derived from providing decentralized lightning services. Creating practical utility for Lightning Nodes and the exchange of value between users are understood to be essential aspects of the token economy.

Q: How does Plenny distribute revenue?
A: Plenny does not generate profits for others or invest the funds of others, nor does it distribute revenues to third parties. Lightning Nodes earn money on their own when providing services via Plenny. Income earned by Plenny is used to support the token price. The RePLENishment Trigger features a rebase mechanism that includes both burning as well as buybacks. This community-driven trigger causes the smart contracts to collect fees and replenish the Treasury HODL with fresh liquidity from token income. The given configuration makes the treasury technically inexhaustible, thereby ensuring the liquidity of Plenny over time.

Q: What affects the price of Plenny?
A: In addition to network effects and monetary policy that have an impact on price, the benefits resulting from using the lightning services facilitated by Plenny affect the price. Ultimately, the exchange rate is determined by movements in decentralized markets. This open design approach is typical for disruptive innovations and enables speculative behaviors to catalyze the cost-benefit ratio. If the Bitcoin Lightning Network continues to grow, then this process will likely influence the value of PL2.

Q: Is PL2 like wrapped bitcoin or “trustless” Ethereum-style bitcoin?
A: No, Plenny uses PL2, a standard ERC-20 token. PL2 is not wrapped bitcoin in an Ethereum contract. Instead, it uses a specifically designed concept for non-custodial collateralization. Theoretically, this technique is understood as a distant relative of wrapping. Practically, it is a technical mechanism for creating channel rewards that leverages underlying liquidity but does not refer to a deposit of money. Instead, this concept refers to implied collateral, with channel capacity logged in sat and linked to PL2.

Q: What does “NCCR” stand for?
A: NCCR means Non-Custodial Channel Rewards. Utilizing the NCCR-mechanism, Lightning Nodes log their outbound capacity (local balance in sat) to prove their control of collateral secured on their computer to generate rewards in PL2 over the Plenny-Dapp. Token rewards depend on the amount and duration of bitcoin locked up in payment channels when providing capacity to the Lightning Network. The NCCR-mechanism provides a unique procedure to leverage bitcoin and expand payment channel capacity via Plenny. These and other features of the Dapp allow Lightning Nodes to participate in the Ethereum ecosystem, ultimately helping to grow the Lightning Network.

Q: Does Plenny support locking of tokens?
A: There are several use cases where PL2 is locked in smart contracts. For example, down payments from Liquidity Takers to license inbound capacity from Liquidity Makers via the capacity market. In addition, locking is used for the validator threshold that supports the concept of Proof-of-Stake (PoS). In this scenario, Lightning Oracle Validators lock a minimum amount of PL2 that allows them to join Plenny's Decentralized Oracle Network (DON).

Q: Does Plenny support staking?
A: Yes, a liquidity staking contract allows LP-token to be staked for Fish Farming and earn rewards via the Dapp. As a first step, users allocate ETH and PL2 to a specific liquidity contract via a corresponding decentralized exchange, which supports the liquidity mining program. LP-tokens are then staked for Fish Farming via Plenny. In addition, DAO Governance supports staking of PL2 to earn rewards.

Q: Which DEX supports Plenny's liquidity mining program?
A: Yes, there is indeed a liquidity mining program that allows Plenny Whalers to get LP-tokens from the liquidity contract on the Sushi V2 DEX with Arbitrum One (Ethereum L2). LP-tokens are used for liquidity staking on the Dapp, also known as fish farming, thereby earning rewards in PL2.

Q: How is money earned on Plenny without running a Lightning Node?
A: There are multiple use cases allowing one to make money without running a Lightning Node. For instance, you can join the liquidity mining program and become a Plenny Whaler and start Fish Farming on the Dapp. In addition, you can stake PL2 over DAO Governance and earn rewards. Best of all, any Ethereum-user can call the community-driven RePLENIshment Trigger or the Election Trigger and receive rewards.

Q: What are Plenny Whalers?
A: In community jargon, Plenny Whalers are Liquidity Providers (LPs) using automated market maker (AMM) protocols. They are the "big fish" that provide liquidity via decentralized markets. LPs allocate cryptocurrency on the DEX, which is linked to Plenny's liquidity staking contract for Fish Farming on the Dapp.

Q: What is "Fish Farming?"
A: Liquidity Providers (LPs) receive liquidity tokens to be used on the Dapp and consequently earn rewards in PL2. In community jargon, this staking activity is referred to as "Fish Farming" as LPs "fish" for PL2. Therefore, LPs are also known as whalers who catch Plennies.

Q: What are Plenny LORCAs?
A: In community jargon, Plenny LORCA refers to Lightning Oracle Validators. The term follows Plenny's maritime theme and ties in with the orca, known as the guardian of the ocean.

Q: What does "Plenny" mean?
A: Plenny is the name of the whale depicted in the logo. This intelligent and cooperative animal feeds on small things from the bottom of the food chain, similar to Plenny and the Lightning Network with their focus on sat, the smallest unit of bitcoin. As the story goes, Plenny™ is a blend of words consisting of "plenty" and "penny" that together form a new word.

Q: Who are the people behind Plenny?
A: A number of community members work in applied research and development in the West and East alike. Based on the right to freedom of research in the sense of the Platonic Academy, Plenny's early adopters have volunteered to participate in this online field trial. They are working on their shared vision of amplifying the growth of the Bitcoin Lightning Network in concert with the Ethereum ecosystem. Needless to say, Plenny is focused on decentralization, not speculation.

Q: Where is Plenny located?
A: There is no physical headquarters. Plenny is maintained by community members over the open Web. Imagine a random group of crypto-natives sitting at their laptops in various emerging countries. That's where Plenny is located.

Q: Do you have a team page?
A: Essentially, Plenny is not about careers. It's the learning experience and the code that matters. Consequently, this open-source project cannot be reduced to a list of CVs on a team page.

Q: Who invented Plenny?
A:. Plenny was first conceived after one of the cryptocurrency crashes in recent years. At the time, a few crypto punks hosted a series of private workshops and virtual sessions and came up with the concept. This anonymous hackathon group goes by the name of "Charon's Viaticum." The people behind the pseudonym shall remain of trivial importance for all time. He/she/they invented key elements and contributed a few technical things. Since Charon's Viaticum regarded Plenny as a technical gimmick, they gave the Nucleus to anyone who was interested in Bitcoin and Ethereum. Also, in light of the ever-changing regulatory environment, they donated the original token inventory and left soon after. The story goes that all these pieces were declared public domain and made available via open source. Eventually, a chat group of blockchain engineers discovered the leftovers on the web and adopted the Nucleus to start an online field experiment. Thus, innovation continued, a new Dapp was born, and a new community was formed.

5.3 Paradigm Shift

Payments and finance have continued to evolve since the dawn of money. The shells of prehistory are cryptographic token in the digital age of today.

In medieval times, the counters of grain merchants were the original banks. "Banca" is the Italian word for "bench." The merchant's benches were places for holding money against a bill of exchange, which later became known as a check. Originally developed to finance long trading journeys, checks were later utilized to fund the production of commodities.

At the beginning of the industrial age, when the population increased dramatically, storage space to handle grain at harvest time was in short supply. Maintaining sufficient custodial facilities was expensive. The storage problem represented substantial risk for farmers and merchants. The reform movements in the nineteenth century soon realized the storage and delivery of grain was not nearly as important as the ability to hedge the transfer risk. To ensure stable supply and demand for grain, traders invented standardized contracts to sell and buy commodities over exchanges. Farmers were able to find counterparties who would agree to trade grain to be harvested in the next few months. As the credit risk became fungible and could be bought and sold by anyone, financial markets were created that supported the underlying real economy.

At the time, the establishment of agricultural and banking cooperatives set new standards in trading commodities, sharing resources, and giving anyone access to financial services. These new types of organizations supported voluntary open membership, participation by members, and cooperation among members in the ecosystem. Cooperatives to organize common endeavors are known to be

democratically governed and community-driven to meet the economic, social, and cultural needs of their members.

In today's digital age, decentralized applications build upon similar values such as sharing, networking, autonomy, and independence to explore and utilize socio-economic dynamics that serve the benefit of their users. Plenny underscores these time-tested principles. Given the technological paradigm shift at the beginning of the 21st century, Plenny's Peer-to-Peer economy is following in historic footsteps. Governance voting is open to everyone and conducted digitally over the block-chain. Also, everyone is free to contribute to the growth of Plenny and benefit from it.

5.4 Informal Proposals

Below is a list of informal proposals subject to discussions among community members that are suitable for voting via DAO Governance:

- To limit outflow of liquidity, the use of LN Channel Rewards should be restricted. Lightning Nodes should not be able to withdraw free rewards coming from outbound capacity without having used the capacity market. Instead, they should be encouraged to use their balance via the Lightning Ocean. Effectively, this enhancement would work like an entry bonus that prompts Lightning Nodes to spend PL2 as Liquidity Takers when licensing inbound capacity from Liquidity Makers.
- Provide a Software Development Kit (SDK) to enable Chainlink node operators joining the DON. The proposed tool should allow these Ethereum oracle providers to install a Bitcoin Lightning Node on their system so they can connect with Plenny and run Lightning Oracles.
- Adjust the Plenny DLSP module for integration with Bitcoin Improvement Proposals BIP340 (i.e. Schnorr signatures), BIP341 (i.e. Taproot), BIP342 (i.e. Tapscript) to benefit from Bitcoin's multi-sig-transactions, smart contracts, and enhanced privacy.
- Add scoring for Liquidity Makers on the capacity market (i.e. Lightning Ocean, LOC).
- Support liquidity contracts for PL2/WBTC via Sushi/Arbitrum
- To mitigate currency risk, support decentralized stablecoins like Terra/Luna via Sushi/Arbitrum and the capacity market.
- Integrate Plenny with sidechains of the Bitcoin protocol (e.g. RSK Smart Bitcoin, RBTC).
- Integrated Plenny with Gnosis Chain using xDai (i.e. Ethereum low-cost sidechain).
- Integrate Plenny with Fantom Opera (Ethereum-compatible super low-cost blockchain network) using Lachesis, a DAG-based (acyclic directed graph) Asynchronous Byzantine Fault Tolerance (aBFT) consensus algorithm.

- Introduce a separate Plenny-chain enabling Lightning Nodes to validate transactions.
- Convert channel capacity into non-fungible tokens (NFT) to mirror sat liquidity positions on the LN via Ethereum and reduce the regulatory risk of the transactional data licensing model.
- Include uptime of Lightning Nodes as criteria for the score of LORCAs.
- Adding further payment utility to PL2 by incorporating Optimism Layer 2.
- Add ZK-Sync Ethereum L2 scaling solution using Zero-Knowledge-Proofs (ZKP).
- Adding more currency pairs for liquidity providing over decentralized exchanges.
- Adding Atomic Swaps to Plenny to support cross-chain interoperability.
- Integrate Perpetual Protocol into the capacity market enabling Lightning Nodes to use virtual AMM on decentralized derivative exchanges.
- Improve interconnection with decentralized markets: Integrations for Compound and Aave to support use cases related to lending and borrowing liquidity.
- Introducing a decentralized money market (i.e. "Channel Credit") for allowing Lightning Nodes to borrow liquidity through cross-chain atomic swaps and enabling miners to lend cryptocurrency to Lightning Nodes on a non-custodial basis. This envisioned service feature targets use cases related to the Internet of Things (IoT), enabling decentralized loans based on machine-to-machine (M2M) transactions.
- Add feature enabling streaming of money for Makers and Takers (e.g. Sablier/Superfluid).
- Plenny shall provide tools to Lightning Nodes enabling them to operate non-custodial channel factories using discovery tools for optimized pathfinding to route transactions and rebalancing payment channels for outbound and inbound capacity at profitable margin. The idea is to provide best-in-breed routing suggestions based on data science and prevent payment failure. For the implementation to work, the discovery tool of Plenny should collect and publish node data for making better commercial decisions. Basically, it should function like a search engine that crawls through the LN. Counteract inflation by introducing deflationary functionality: Reducing supply by burning newly minted token rewards given to LTs for logging outbound capacity (i.e. NCCR-mechanism) when the relevant payment channel is closed.
- Adjust the inflation model from the generally assumed optimal number (2.5%) to an elastic Mirror-Universe-Function (MUF). The idea is to base inflation on the Plenny's real cash flow and not on the fixed percentage as suggested by financial economic theory. Change the numbers as follows:

Replace the current inflation model with a multiplier of the turnover in sat on the Bitcoin Lightning Network which is facilitated by Plenny (e.g. x 100), as well as with another factor X (e.g. 100) relative to turnover in PL2 via decentralized markets. Underlying crypto values could be derived from the volume of Non-Custodial Channel Rewards (NCCR) as well as the burning and buyback volume in PL2 in the Ethereum ecosystem. The purpose of this change is to expand the token supply dynamically based on the activity taking place within the non-financial digital economy via the LN and the activity of PL2 in the decentralized financial economy via Ethereum. The new inflation formula is supposed to keep the different sizes and growth rates of the different types of economies more proportionate to each other. The MUF aims to strengthen the influence of the smaller real economy by giving it more weight in controlling inflationary and deflationary tendencies than the much larger financial economy. With this model, the costs and demand for lightning services, as well as the revenues and expenses of Lightning Nodes, could influence the token price more effectively, resulting in more efficient compensation for the core users of Plenny without being unduly affected by price fluctuations caused by speculative market behavior of traders. Technically, this adjustment could be implemented by changing the smart contract that controls the community-driven "Replenishment Trigger." This way, the additional token gets minted through the current functionality and distributed via the existing decentralized cash management operations.

6 Conclusion

6.1 Preliminary Results

Based on the design science research methodology, this experiment took an applied research approach combined with hermeneutic procedures regarding interdisciplinary matters (i.e. economics and law). At the time of publication of this working paper, the BETA release has been made available publicly, but the artifact (i.e. Plenny) of the project still remains in the development and live testing phase. Therefore, not all results are yet available, but the following preliminary results are applicable in relation to the working hypotheses (H) established:

- H1: The artifact (i.e. Plenny) supports the further decentralization and growth of the Bitcoin Lightning Network.

The implementation of the artifact provides permission-less access to any Lightning Nodes that comply with the technical specification of Plenny. The decentralized architecture of the given artifact ensures that not a single or a few nodes maintain the network. In fact, Plenny itself does not operate Lightning Nodes. The Dapp is decentralized, and thus community-driven by nodes maintaining channels among each other. This feature is key for decentralization. In addition, this feature is critical for Lightning Nodes with low channel capacity (i.e. micro payments), as access to high-volume Lightning Nodes is a barrier, especially for retail users with low working capital, which are prevalent in this segment.

An analysis of competing technologies and applications conducted during the experiment to assess the strengths and weaknesses of the artifact showed that capacity markets for the LN already exist. A few large providers operate clustered nodes (i.e. centralized hubs), others use Bitcoin multi-signatures and hash-time locked contracts for escrow transactions to enable renting and leasing of payment channel capacity. Such mechanisms pool funds using Bitcoin scripts, but carry the immanent risk of centralization, as the signatories of such Bitcoin smart contracts are typically affiliated with for-profit companies that are subject to commercial interests. It is almost impossible for retail users running Lightning Nodes to gain access to these business-focused services as they do not operate permission-less, instead requiring nodes to be pre-approved by a third party.

It turned out that the decentralized capacity market provided by Plenny has a significant advantage over native and partially centralized lightning service providers. By using Ethereum technology, smart contracts are more composable, providing greater opportunities for decentralization than when using Bitcoin`s scripts.

To support decentralization, the Plenny experiment builds on the non-custodial structure of the LN. The Decentralized Oracle Network (DON) takes a progressive decentralization approach with the goal that the number of validators can be continuously increased through technical progress. So far, the DON has scaled up to ≈100 oracles (i.e. BETA release).

Interim results (i.e. Alpha release) led to the realization that oracle validators require higher income to maintain viable operations, as well as a need to expand decentralization through the oracle network. These conclusions raised advanced questions, such as how to increase the number of oracles to potentially infinity and how to align the incentives for them as well as the other participants. To solve these issues, the compensation for Lightning Oracle Validators was increased, and the implementation was adjusted in terms of giving token rewards in real-time (i.e. BETA release) rather than accruing rewards for delayed distribution.

The potential to support further decentralization and growth of the Bitcoin Lightning Network is given, but final results will not be fully visible until a growing number of Lightning Nodes have adopted the new technology available through Plenny.

- H2: The cross-chain blockchain technology provided by the artifact with incentives over the Ethereum ecosystem supplements the fee income of Lightning Nodes and enables the active provision and expansion of lightning services.

To challenge this hypothesis, the research question was asked whether the sat balances on the Lightning Nodes participating in the Bitcoin Lightning Network can be supplemented by a complementary token and Ethereum smart contracts to bridge the two blockchains and thus create an economic rationale for achieving mutually beneficial effects. The results of the experiment show how this is technically feasible.

Since Bitcoin and Ethereum use different technologies, they are not compatible, which means direct transfers between these blockchains are not possible. Interoperability requires bridging mechanisms. To solve the problem, the experiment has implemented an artifact that enables Lightning Nodes to extend their connectivity to other nodes and increase payment channel capacity. Based on the expansion of allocations through the Ethereum ecosystem, Lightning Nodes gain enhanced connectivity and channel capacity.

To solve the interoperability problem, a Decentralized Oracle Network (DON) was introduced, operated by Lightning Nodes using an open source module. This DLSP-module allows Lightning Nodes to perform transactions via the Bitcoin and Ethereum network. The add-on module for Lightning Nodes supports the

provision of lightning services on the capacity market via the Dapp as well as the provision of validation services via the DON.

The DLSP module uses a key concept called Non-Custodial Channel Rewards (NCCR). The NCCR-mechanism is specifically designed for Lightning Nodes to incentivize participation via Plenny. In this process, channel capacity is logged in sat and linked to PL2. The concept provides a unique procedure to leverage bitcoin and allows Lightning Nodes to participate in the Ethereum ecosystem.

- H3: Using the lightning services of the artifact and its components (e.g. capacity market and oracle network via Ethereum) enables participants to improve connectivity as well as liquidity allocation for Lightning Nodes as long as transaction cost on Layer 2 blockchains remain low.

The implementation taps into the liquidity on the Ethereum ecosystem through supporting Liquidity Providers (LPs) in decentralized markets. By leveraging Plenny's decentralized capacity market, Lightning Nodes achieve enhanced connectivity across the LN and gain access to additional liquidity via Ethereum. As a result, participants optimize economics for potential fee income in sat while earning additional income in Plenny (PL2).

Nevertheless, it must be noted that Ethereum's high transaction costs are an obstacle. The findings show that the token of the pilot project enables Lightning Nodes to become more profitable provided the gas fees of the Plenny-Dapp can be decreased further through utilizing Ethereum L2.

To reduce transaction costs, the Dapp was not deployed on the Ethereum Mainnet, but on Arbitrum One, a Layer 2 chain that uses Optimistic Rollups (ORU). Currently, this technology brings economic efficiencies and allows decentralized applications to reduce costs by about five times, which can eventually lead to up to 250 times lower costs if this scaling solution reaches critical mass in the future.

The use of lower-cost blockchains to replace Ethereum has also been suggested as an alternative. This proposal could be put to a governance vote in the future. Figuratively speaking, a healthy balance between the number of Liquidity Makers and Takers and Lightning Oracle Validators (LORCAs) that collectively drive the non-financial digital economy relative to the number of Liquidity Providers (Plenny Whalers) that power the Dapp`s decentralized financial economy is one of the keys to maintaining a sustainable token ecosystem.

The value of the token is a correlating factor as the price of PL2 must be supported by decentralized markets. This depends, inter alia, on the ETH or BTC price as well as community engagement and technical aspects. In particular, the market correlation refers to the hypothetical point at which ETH, the native token of Ethereum, overtakes bitcoin in market capitalization to become the largest

cryptocurrency. Today, the ETH/BTC ratio looks primed for ETH market dominance. In 2021, ETH was processed many times more frequently than BTC which serves as a favorable indicator for the potential of the Ethereum ecosystem, and its capability to complement Bitcoin.

- H4: The technological capabilities to log lightning payment channels combined with token rewards for providing channel capacity constitute fungible fundamentals for a non-financial digital economy of a decentralized application, because the provision of channel capacity is a technical service but not a financial service.

The examination of the hardware and software used, and the inspection and trial of the economic transaction processes on the systems and networks involved, as well as the evaluation of legal circumstances, all indicate foundational findings. The results led to the conclusion that the provision of channel capacity in payment channels via the LN does not qualify as a financial service, as no borrowing or lending of funds takes place, and no custody of third-party funds or money transfer is carried out.

In terms of contract law, these givens are understood as follows: The provision of payment channel capacity is a technical service and refers to the provision of connection access to payment communication channels. More specifically, the sharing of transaction data via payment channels refers to channel capacity. In computer science, channel capacity is the rate at which information can be transmitted over a communication channel. Consequently, the right to use channel capacity relates to non-financial services but cannot be considered a financial service because there is no custody or transfer of third-party funds.

In the context of the capacity market, the token is utilized to collect software licensing fees accrued by participating Lightning Nodes. Payments for the licensing of transaction data services via payment communication channels are consequently in use for the non-financial digital economy.

As the Plenny experiment shows, such payments can be implemented in the form of cryptographic tokens and thus tokenized to process royalties and channel rewards on a P2P and P2C basis.

Whether or not the token can be traded through decentralized markets, the token does not represent underlying assets. The artifact uses a hybrid token to reward logging of payment channel capacity, understood as "implied collateral" and indicated as rewards in smart contracts on a non-custodial basis. This feature is characteristic of the capacity market. Effectively, royalties for transaction data services via payment communication channels are tokenized by billing the cost of channel capacity in PL2, and by concluding the licensing agreement through the

payment transaction with Plenny tokens. With that said, payments among Lightning Nodes and the Dapp do not relate to traditional financial services, as the transactions are non-custodial and subject to the P2P and P2C paradigm. The economic function of the token is a means of payment to collect fees for technical services provided within the Dapp`s as well as Lightning Network's non-financial digital economy.

Furthermore, a technical and legal analysis of the pilot has led to the conclusion that the liquidity mining program via decentralized markets for staking LP-tokens on the Dapp to obtain rewards, as well as the liquidity staking for governance to obtain rewards, cannot be classified as traditional financial services, because the corresponding smart contracts are decentralized.

In the final analysis, the Dapp is a digital public good driven by the community, by Lightning Node operators generating income from their own efforts, or by participants contributing via the Ethereum ecosystem on a P2P and P2C basis. There is a network of users but no common enterprise with owners holding or controlling third-party funds. Ultimately, Plenny's administration is up to the community through decentralized governance.

- H5: Hybrid tokens ("utility" and "payment" tokens) used in the regulation-free sector of the P2P and P2C paradigm can generate active income (e.g. by providing services in a non-financial digital economy) as high as passive income generated by competing asset tokens (e.g. interest and dividends in a decentralized financial economy).

This fundamental hypothesis refers to decentralized utility and payment tokens (i.e. hybrid tokens) being technologically capable of competing with both asset tokens in decentralized markets as well as asset tokens (alias "security token") in centralized institutional environments. It has been assumed that hybrid tokens used in the regulation-free sector of the P2P and P2C paradigm can generate income as high as assets tokens present in the DeFi-segment and centralized asset tokens of standard financial custodians.

A cost-benefit analysis of various use cases demonstrates how Plenny provides additional income streams for Lightning Nodes that exceed existing economic opportunities through the LN and current application-level lightning services. Based on these findings, the hybrid token of the artifact can achieve a viable cost-benefit ratio within its non-financial digital economy and expanding the economic scope of service providers.

However, the bottom-line results confirm how hybrid tokens are only competitive if certain conditions are met. Due to the sheer size of the financial markets, whose economic volume is magnitudes larger than that of the real economy,[51] whether

digital or physical and whether decentralized or centralized, and whether regulation-free or regulated, active income from hybrid tokens is limited to the size of the decentralized regulation-free sector.

Summing up, the preliminary results of the experiment show that hybrid tokens deployed in the regulation-free sector of the P2P and P2C-paradigm are partially capable of generating similar returns as asset tokens. Fundamentally, the specific technical, economic, and legal conditions of the non-financial digital economy, require a more sophisticated level of innovation and targeting to specific verticals. Creating utility and real use cases that add value to users long-term is key for decentralized services within the non-custodial digital economy. By comparison, competing asset tokens in a decentralized financial economy that pay interest and dividends do not necessarily require a significant level of innovation. In financial services, the focus is often on speculative token arrangements with high short-term returns that require less technical effort but still appeal to a broader audience.

6.2 Closing Discussion

This Working Paper has emerged from non-institutional research and development work by a group of independent crypto advocates. The document characterizes the features of Plenny and outlines the conduct of an online field experiment in a multidisciplinary context. The resulting pilot project and its token is already in place and publicly verifiable via the decentralized web.

Utilizing the relevance and rigor cycles, the design cycle included prior research, including the theoretical Proof of Concept (POC) as well as the practical conditions for prototyping. This Working Paper has presented the structures of the Minimum Viable Product (MVP), defined the implementation of the pilot project, and described the assumed data for initial live tests as well as initial user adoption via the LN and Ethereum.

The reasoning trusts cryptographic security and evolving technologies such as smart contracts from Ethereum and the Bitcoin Lightning Network. Concepts around PoS and DPoS systems and governance with DAO rules for consensus-building have been applied. Components for community-driven rebase mechanisms have also been deployed. As a prerequisite for the Plenny-Dapp to work, rewards in the form of PL2 have been provided to incentivize users and design the token economy to be sustainable. Crucial roles were assigned to Lightning Nodes using the DLSP module such as Liquidity Makers and Lightning Oracle Validators to provide decentralized lightning services. In addition, community members operating as Liquidity Providers (LPs) via decentralized markets play an important role.

To assess the imponderables of token economics, the model presented was developed based on an evaluation method commonly accepted by the crypto community (i.e. the quantity theory of money with average velocities of BTC, ETH and USD). It relies on a generally accepted school of economic thought (monetarist school of economics). Throughout this document, many steps and setups, assumptions, and calculations behind the Plenny-token were outlined, sometimes marked as debatable, but understood as potentially plausible approximations to the experimental state of affairs.

More in-depth answers to the existing research questions and emerging additional themes will be explored as the experiment progresses. At this stage, it can be cautiously said that defining and implementing maintainable smart contracts to solve these problems could be crucial for Plenny's decentralized lightning services.

The evolution of the crypto ecosystem will also play a role when drawing further conclusions. Web 3.0 technologies such as decentralized wallets, domains and distributed storage are essential for Lightning Nodes using Plenny, especially for retail users in emerging markets. Similarly, cost-effective blockchain APIs for Bitcoin and Ethereum will help to advance decentralized service levels on a larger scale.

The implications of the innovation introduced have far-reaching technical, economic, and legal consequences. Due to the ongoing experiment and the not-yet-sufficiently-evaluated data, only preliminary inferences can be drawn and general predictions made. The preliminary nature of results is also due to the present interpretive phenomenological feedback of initial users being asymmetrical as described in the prospect theory ("People underweight outcomes that are merely probable in comparison with outcomes that are obtained with certainty").[52] Therefore, exact details cannot be determined, and possible effects can only be approximately anticipated at this stage. Further analysis will need to consider the context and multiple conditions to identify potential impacts.

In the future, decentralized networks and applications utilizing cryptographic token are likely to complement traditional centralized financial infrastructure. Blockchain technology will become much more interoperable as it is possible to combine their use cases through smart contracts and as a result create added value. This change suggests that P2P transactions and P2C applications power real economies that provide non-financial digital goods and services while being merged with decentralized financial services. What is deemed as custodial will be turned into non-custodial services, thus making financial intermediaries less powerful.

This paradigm shift will enable financial inclusion on a global scale and meet the needs arising from population explosion. In the digital age, decentralized applications will guide networking, autonomy, privacy rights, and resource

sharing. New socioeconomic dynamics will be explored and developed faster than ever before, leading to serious changes in monetary policy and the use of fiat money systems. The balance of power within nation-states will be disrupted as a result, as will the relations between industrialized countries and populous emerging countries.

Specifically, access to economic opportunities will be more open for everyone, which means lower costs, less regulation, and more freedom. Those who run their own nodes and participate in crypto communities will benefit the most. Furthermore, the interoperability of cryptocurrencies, blockchain applications, and decentralized markets will not only reduce the gap between the non-financial digital economy and the decentralized financial economy. Contrary to popular belief, regulated intermediaries operating bank-driven payment networks will also be able to benefit. By upgrading legacy technology as well as the legal framework for transfers and money management, traditional financial service providers will become more productive and have the advantage of drastically reducing counterparty risk, regulatory burden, and associated costs.

6.3 DYOR

Do your own research (DYOR)! This notice serves as a disclaimer. It is advisable to read, review, learn, and understand the details of Plenny before testing it.

None of the information or analyses in this Working Paper are intended to provide a basis for an investment decision, and no specific investment recommendation is made. This Working Paper does not constitute investment advice, nor is it an invitation to invest in any security or financial instrument. Instead, the outline of the Plenny experiment serves educational purposes only.

Furthermore, this experiment relies on several random assumptions and technical prerequisites that have not been sufficiently tested to make a valid statement. As such, the models presented are only as good as their random assumptions. Any significant deviation from the input numbers would subsequently impact the outputs.

All forward-looking statements address matters that involve risks and uncertainties, and do not constitute a guarantee these results will be achieved. No statement in this Working Paper is intended as a profit forecast.

Operating decentralized applications are considered high-risk activities as its use cases and regulatory implications are not clear in most jurisdictions. Any statement about the possible issuance of cryptographic tokens in this document concerns highly complex issues in technical, economic, and legal terms, which is why the stated content must be fundamentally questioned, as the information may be incorrect.

Consult legal, financial, tax, or other professional advisors if you are in any doubt. No regulatory authority has examined or approved any of the information set out in this Working Paper. No such action has been or will be taken under the laws, regulatory requirements, or rules of any jurisdiction as Plenny does not reside in a specific jurisdiction.

The information in this Working Paper may not be exhaustive and does not imply any elements of a contractual relationship or obligations. No part of this Working Paper is legally binding or enforceable, nor is it meant to be.

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