Product Paper for Archimedes Protocol for Leveraged Tokens V1.0

1 What is Archimedes Finance?

Archimedes Finance is a decentralized finance protocol with a focus on derivatives. It is a marketplace for various decentralized derivatives, including leveraged tokens and more.

2 What is the Archimedes Protocol for Leveraged Tokens (APLT)?

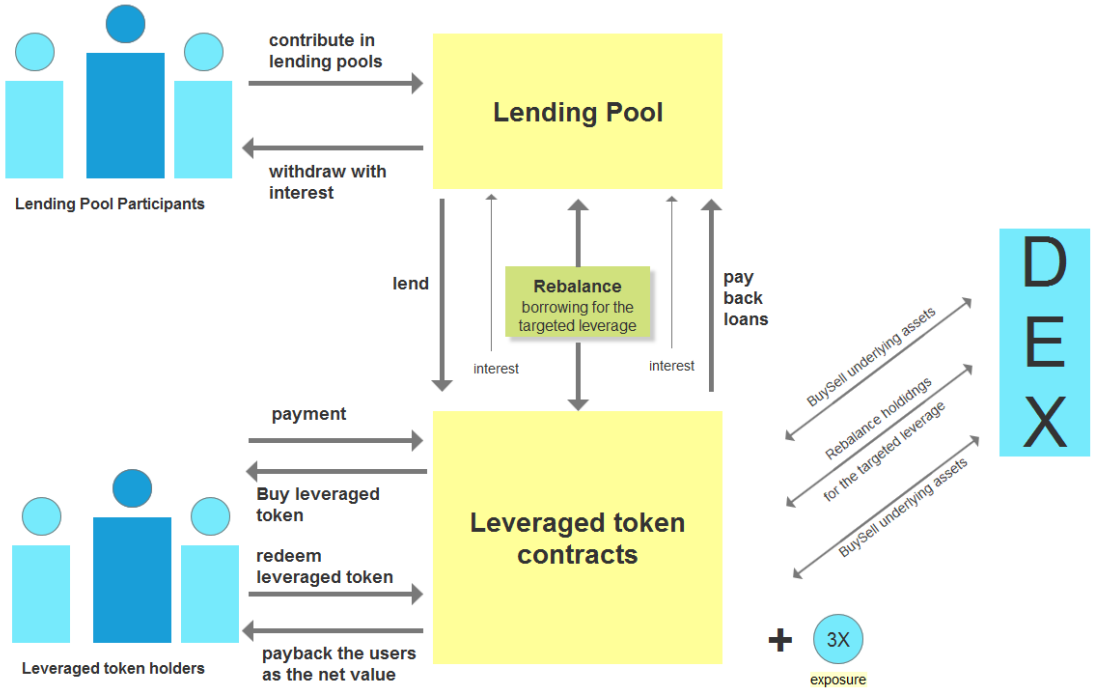
APLT stands for Archimedes Protocol for Leveraged Tokens. It is one of the main products of Archimedes Finance. The APLT serves to create and trade decentralized leveraged tokens on crypto assets, like BTC, EOS, etc., on EOSIO. Leveraged tokens are powered by no-loss lending pools, where participants can earn interest. All the core functions of token minting, redeeming, taking leverages, rebalancing, borrowing and lending occur on-chain and are managed by smart contracts. It is a permissionless, censorship-resistant, and non-custodial protocol. APLT's goal is to make it simple to trade leveraged tokens in an easy, secure, transparent and decentralized way. It also provides a friendly venue for lenders to earn interest for powering the leveraged positions for the leveraged tokens.

3 APLT v1.0

Introduction

The Archimedes Protocol for Leveraged Tokens (APLT) v1.0 is a decentralized and non-custodial protocol for creating and trading decentralized leveraged tokens, which are powered by lending pools. Archimedes's Leveraged Tokens give holders leveraged exposure to cryptocurrency markets, without having to worry about actively managing a leveraged position. The rebalancing mechanism maintains the holders' leverage exposure at a fixed level, no matter how the underlier's price moves. Therefore, token holders will never get liquidated - a key difference compared to trading on margin or using perpetuals. Archimedes leveraged tokens are asset-backed tokens, NOT synthetic assets. They always have 100% collateralization, in collaboration with other decentralized exchanges. Real cryptoasset borrowing and transactions are conducted through smart contracts to back the value of the tokens. Thanks to the on-chain rebalancing mechanism, a leverage range close to 3x is maintained for the holders. Anyone can monitor and verify the collateral and leveraged positions embedded in the tokens at any time in a transparent way. Lending pools power the tokens' leverage. When leveraged tokens are created, they automatically borrow an equivalent amount of cryptoassets from the pools, and trade to get leveraged exposure. Pool participants will earn passive interest returns.

Basic Modelling Structure



4 Leveraged Tokens in DeFi

Leveraged Token Basics

What Are Leveraged Tokens?

Leveraged tokens are derivatives giving holders leveraged exposure to cryptocurrency markets, without having to worry about actively managing a leveraged position. They were initially introduced by derivatives exchange and have since been listed on other centralized exchanges. For example, the EOSBULL/USD — also known as 3X Long EOS Token — is a token with a return that corresponds to three times the daily return of EOS. For every 1% EOS that goes up in a day, EOSBULL rises by 3%. Leveraged tokens usually offer fixed leverages or leverage ranges through rebalancing mechanisms.

Differences between Leveraged Tokens and other derivatives

	BORROWING	MARGIN TRADING	PERPETUALS	LEVERAGED TOKENS	OPTIONS
Model type	Real Assests Trading	Real Assests Trading	Derivatives/Synthetic asserts	Real Assests Trading & Synthetic asserts	Derivatives/Synthetic asserts
Leverage Level	Less than 2x	2x-5x	5x-100x	2x-100x	0-20x
Leverage Maintenance	Variable	Variable	Variable	Constant	Variable
Leverage Adjustement	Manual	Manual	Manual	Passsive and Automatic	Passive
Liquidation Risks	Yes	Yes	Yes	No	No
Costs	Borrowing Interest	Borrowing Interest	Funding Rate	Borrowing Interest	Option Premiums
Expiry	No	No	No	No	Yes
Current on-chain volume	High	Low	Medium	Low	Low
Volume on Centralized Venues	High	High	High	High	Medium and Growing Fast
DeFi Platforms	Compound,AAVE,Venus	dYdX	DYdX,MCDEX,Injective Perpetual Protocol	Phoenix,Tokensets,Charm	Phoenix,Hegic,OPYN

The biggest difference between leveraged tokens and margin trading/perpetuals is that leveraged tokens will rebalance themselves both periodically and upon reaching a certain threshold in order to maintain a certain leverage. This is obviously different from both margin trading and perpetuals - products whose real leverage constantly changes according to price fluctuations, even though traders have designated a specific leverage level upon taking a position

Rebalancing

Rebalancing is a one of the most important elements in the design of leveraged tokens, for it is the mechanism that keeps the leverage at the targeted level. Let us take a closer look at how rebalancing works, with an example. You are holding $100 USDT and purchase an EOSBULL (3x) leveraged token. The protocol will automatically borrow $200 in USDT, and trade the total $300 USDT for $300 EOS. Therefore, the $100 EOSBULL (3x) leveraged token is backed by $300 EOS holding and $200 USDT borrowing. Suppose the price of EOS increases by 20% and the EOSBULL (3x) token price rises to $300*(1+20%)-$200=$160 before rebalancing. Now, your real leverage becomes 2.25 ($360/$160), lower than the target leverage. As part of the rebalancing process, the protocol will borrow more USDT and purchase extra EOS tokens to shift the leverage back to 3x. In our example, it will borrow another $120 and exchange it for EOS. The total leverage thus becomes ($360+$120)/$160=3x again. Suppose the price of EOS decreases by 20%, and the EOSBULL (3x) token price decreases to $300*(1-20%)-$200=$40 before rebalancing. Now, your real leverage would become 6 ($240/$40), higher than the targeted leverage. In this case, the mechanism will sell EOS tokens and repay the outstanding debt to deleverage. In this example, it will sell $120 EOS for USD and payback to the pool. The debt would become $80 and the total leverage would once again be ($240-$120)/$40=3X.
In other words, the leveraged token will automatically re-leverage in profit and deleverage in loss to restore its target leverage level. If the mechanism works smoothly, the leveraged token will compound profits in the favorable market moves. While in unfavorable market trends, leveraged token holders will never be liquidated, as the deleveraging mechanism will constantly lower the effective leverage level

Why does DeFi Need Leveraged Tokens?

Traditional leveraged tokens are traded on centralized exchanges, like Binance, FTX, Huobi, etc. These innovative derivative products have attracted great volume since their creation. Few pieces of research have covered the possibility of decentralization before, yet the Archimedes team believes these products are a winning innovation in the DeFi space.

- With Archimedes Finance, on-chain leveraged tokens are borderless and permissionless. Anyone can get access to this instrument freely without KYC requirements.
- Leveraged tokens have a rebalancing mechanism adjusting their leverages

according to their current exposure. Archimedes codes are open-source, and all the mechanisms and transactions are public and on-chain. Therefore, better transparency is guaranteed compared with centralized exchanges.
● All leveraged tokens are collateralized with underlying crypto assets. There will be no counterparty risks when redeeming.
● All leveraged tokens are EOSIO tokens, making it simple to store them in wallets or transfer them between addresses

5 How does the APLT work?

Tokenization of Leveraged Positions

Archimedes tokenizes decentralized leveraged products into EOSIO tokens. These tokens are fungible and can easily be transferred. Tokenization makes it extremely easy for holders to take fixed leveraged exposures. By simply buying tokens and holding them, traders automatically and passively take leverages. For example, EOSBULL 3x means that the token is longing EOS and taking a 3x leverage with EOS exposures. If EOS goes up by 1%, the token will go up by 3%. An EOSBEAR 3x token shorts EOS with a 3x leverage. If EOS goes up by 1%, the token will go down by 3%

Net Value and the ‘Anchor’

Archimedes’ leveraged tokens are fully backed with cryptoassets and their net value can be calculated through live price feeds. The net value of leveraged tokens is an important indicator when evaluating their financial performance. The net value of a leveraged token is calculated as the value of total assets subtracting total debts. When drafting a balance sheet for the token, the net value will be equivalent to the ‘net assets’ in equities.
To make the tokens easier to comprehend and trade, Archimedes protocols designate the initial value/price for leveraged tokens as $100. This initial ‘price’ is regarded as the ‘Anchor’. If the price of a leveraged token becomes too low and the market is unfavorable, the protocol will restore the price to its initial anchor and adjust the quantity of the token accordingly. The mechanism shares similarities with rebasing, as the quantity of the token holding is subjected to changes according to the asset’s price. To maintain the continuity and smoothness of the price curve, in the first version of the protocol (APLT v1.0), the rebasing price is set to be $10. For example, assume Bob purchases 10 units of EOSBULL (3x) tokens. If the value of the token decreases to $10, due to the drop of the EOS price, the value of Bob’s holdings becomes $100. The $10 price triggers the rebasing process, and the value of the EOSBULL (3x) token will be rebased to $100, while units of Bob’s EOSBULL (3x) tokens will be adjusted to 1. Bob’s holdings are worth $100, the same as they were before rebasing

Collateralization Requirements

When creating decentralized leveraged tokens, the APLT makes sure that these tokens are 100% collateralized. In other words, Archimedes leveraged tokens are NOT synthetic assets, but asset backed tokens. Real transactions on decentralized exchanges guarantee that the tokens' value is fully backed by cryptoasset holding and borrowing. Suppose there are no gas or other transaction costs. When one buys an EOSBULL (3x) token with a net value of $100, he/she will pay $100 for the token, and the smart contract will simultaneously borrow $200 from the stablecoin lending pool. The $300 will immediately be transacted for $300 worth of EOS from decentralized exchanges, assuming there is no slippage. This will generate a 3x EOS price exposure. If we are making a balance sheet for the token, the total asset is $300 and the total liability is $200, which makes the net value of the token $100. The leveraged token is therefore fully collateralized.

If the EOS price rises by 50%, due to the 3x leverage, the leveraged token price will be $100 × (1+50%×3) = $250. According to the 'balance sheet', the total asset in EOS will be worth $300×(1+50%)=$450, while the total liability is still $200, as it is borrowing stablecoins. Therefore, the net asset/equity of the token will be $250 ($450-$200). Again, the leveraged token is fully collateralized. These considerations remain true when the EOS price drops. Full collateralization is a fundamental tenet of Archimedes' leveraged tokens.

Creation and Minting

When users buy Archimedes leveraged tokens, the same number of tokens is minted by smart contracts. A series of transactions take place upon the receipt of the consideration, priced in stablecoins or the underlying assets.

For example, imagine a user buying 1 unit of EOSBULL (3x) token with USDT, supposing its net value is $120. Let us assume there is no transaction cost or price slippage, and the token has not rebalanced yet.

After receiving $120 USDT, the contract will invoke the function needed to borrow $200 USDT from the pool, which is two times the "anchor" net value of the token. Then, the $320 USDT will be exchanged for EOS from decentralized exchanges. 1 unit of EOSBULL (3x) token will be minted accordingly, with a claim to the net value of the collateral. Note that in this example, the actual leverage upon purchasing is 2.67 ($320/$120).

For the creation of an EOSBEAR (3x) token, the process would be slightly different. For every EOSBEAR (3x) token, $200 EOS will be borrowed from the pool and sold through decentralized exchanges for stablecoins.

Redemption

In the APLT v1.0, when the Archimedes leveraged tokens are "sold" on the market, they are actually redeemed, which also triggers a series of transactions. The same number of leveraged tokens is burnt, and the purchasing transactions are reversed, with the remaining balance paid back to the holders. For example, if the value of EOSBULL (3x) token is $110, the 'balance sheet' of the token comprises $310 EOS

in total assets and $200 borrowing in total liabilities. When 1 unit of the token is sold/redeemed, the mechanism sells the EOS for $310 and repays the $200 debt, leaving $110 as the remaining balance to be transferred to the seller. To redeem an EOSBEAR (3x) token, EOS will be bought back from the market to repay the EOS debt. The remaining balance will be transferred to the seller.

Lending pools

Concepts and Utilities

Lending pools power and rebalance the leverage for the "Bull" and "Bear" tokens. For Bull tokens, a stablecoin pool is created. The single pool can lend assets to bull token contracts with different underlying assets. For example, the BTCBULL (3x) token and EOSBULL (3x) token share the same stablecoin pool. When new bull tokens are minted or rebalanced, borrowing and lending transactions take place within the protocols. For Bear tokens, separate pools with underlying assets are created to power different tokens. For example, the PBTCBEAR (3x) tokens will borrow PBTC and sell to take short positions on the market, therefore, a PBTC pool provides the necessary leverages when minting or rebalancing.
In the APLT v1.0, the standard interest rate is fixed, provided that the lending pools are not fully utilized. Interest is collected periodically from the leveraged tokens, distributed to and shared by all pool participants automatically

Pool Shares

Similar to most pooled models in DeFi, the shares of the APLT lending pools are tokenized as PPT, standing for “Archimedes Pool Token”. APLT lending pools are created when individual liquidity providers contribute liquidity by staking their crypto assets in the pool. The liquidity providers receive a pool token - the PPT - which represents their share of ownership in the pool. In the APLT v1.0’s lending pools, Interest is not distributed; instead, users earn interest simply by holding PPT. Over time, each PPT becomes convertible into an increasing amount of the asset, even while the number of PPTs in a wallet stays the same

Pool Net Value and PPT Value

What Is Pool Net Value?

The Pool Net Value measures the monetary value of all assets and the outstanding lending amount currently in the lending pool. The Pool Net Value is also regarded as the Total Value Locked (TVL) in the lending pools.

What Affects Pool Net Value?

Let us take the EOS pool for example. The total Pool Net Value (PNV) in USD is affected by the following factors: 1) EOS deposits increase the PNV; 2) EOS withdrawals decrease the PNV; 3) Receiving interest from lending assets to leveraged tokens increases the PNV; 4) Changes in the USD value of EOS increase or decrease

the PNV.

PPT Value

After a user deposits crypto assets into the pool, assets are collateralized, and the holders are entitled to the benefits of having a fraction of the lending pool. PPT is minted and delivered to the users, representing a pro-rata share of the pools. The net value of PPT is calculated using the Pool Net Value (as defined above) and dividing it by the total number of PPT tokens.

$$Net\ Value\ of\ PPT = Pool\ Net\ Value / No.of\ PPT$$

Due to the no-loss characteristics of the lending pools, the PPT value will be ever-increasing, if measured in pooled assets. Specifically, the PPT value of the USDT pool is ever-increasing measured in USDT, and the PPT value of the EOS pool is ever-increasing when measured in EOS.

Basic Interest

Participants in the lending pools can earn interest from lending, which powers the tokens' leveraged position. Interest is collected and distributed in the pool automatically through smart contracts, which leads to an increase in the PPT value over time, measured in terms of pooled assets. Unlike most DeFi borrowing and lending protocols, the basic interest rate for borrowing and lending activities is a fixed amount in APLT v1.0. For the borrowers, the borrowing rate is fixed and not subjected to changes, provided that the pool is not fully occupied. For lenders, the higher the utilization rate of the pool, which means the larger proportion of the pooled assets is involved in lending, the higher APY the pool will have.

Interest Adjustment Mechanism

When the lending pools are fully occupied, it is possible the targeted leverage level cannot be achieved when rebalancing, due to a lack of funds to borrow from the pools. In this case, the rebalancing could temporarily fail. To address this issue, in order to incentivize more contributors to join the specific lending pool that is fully utilized, the interest rate for borrowing and lending will be temporarily increased, which in turn will attract lenders. If the pool is still not big enough to cover the amount needed for the tokens' rebalancing, the interest will be further increased, until the targeted leverage level is reached. Once the targeted leverage is reached, the rate will move back to the basic interest level.

Rebalancing Mechanism

Rebalancing is the key mechanism that keeps the leverage at the targeted level. There are two instances when leveraged tokens will rebalance themselves.

Scheduled Rebalancing

Archimedes leveraged tokens "rebalance" themselves periodically, so they can keep the target leverage. At every rebalancing occasions, each leveraged token reinvests profits if making any, and if losing money, sells off part of its position to lower the

leverage to avoid liquidation. In the APLT v1.0, the targeted leverage range is set and periodically, the protocol will check if the real leverage is within the targeted range level. If the real leverage is lower than the minimum threshold or higher than upper threshold, the rebalancing will be triggered. For example, let us imagine that a user holds 1 unit of EOSBULL (3x) token with an initial cost of $100. The price of EOS increases by 15% and the token price rises to $145 before rebalancing. Now, the holder's leverage becomes 2.38 ($345/$145), lower than 2.5, e.g., the targeted leverage.

During the scheduled rebalancing, the protocol will borrow more USD from the stablecoin pool and purchase extra EOS tokens to shift the leverage back to 3x. In our example, the protocol would borrow another $90 and exchange it for EOS. The total leverage would thus become 3 ($435/$145) again.

Following the example above, what would happen if the EOS price decreased by 15% and the token price dropped to $55 before rebalancing? The holder's leverage would become 4.64 ($255/$55), higher than the targeted leverage, e.g., 3.5. During the rebalancing process, the protocol would then sell EOS tokens and repay the outstanding debt to deleverage. In our example, the protocol would sell $90 EOS for USD and payback to the pool. The total leverage would once again be 3X ($165/$55). For Bear leveraged tokens, the rebalancing process is similar to the examples mentioned above.

Temporary Rebalancing

One interesting aspect of leveraged tokens is that their holders never have to worry about liquidation, as the product automatically deleverages itself. However, it is important to be aware that a temporary rebalancing may be needed when an unfavorable price movement occurs, especially if this happens in a short period of time.

For example, for EOSBULL (3x) tokens, if the EOS price were to drop by over 33%, the token value would go 'negative" — something akin to getting liquidated. In such cases, the rebalancing mechanism needs to be triggered to deleverage the tokens, even if the time for a scheduled rebalancing has not yet arrived.

In the APLT v1.0, for the 3x leveraged tokens, the threshold to trigger a temporary rebalancing is set to be a 20% unfavorable movement against the past underliers' rebalancing price. Bull and Bear leveraged tokens with different underlying assets will have independent triggers to activate a temporary rebalancing.

The temporary rebalancing process itself, however, will be the same as the scheduled rebalancing.

Termination

If the temporary rebalancing is unsuccessful, no matter the reason, the protocol will initiate a termination process once the price gets to a 30% unfavorable movement. Termination is similar to a liquidation process, with all the terminated leveraged tokens being redeemed and burnt. After triggering a series of transactions on Dexes, the debts will be paid back, outstanding interest and fees will be deducted, and the

remaining balance will be claimable for the leveraged token holders

6 Risks

Price slippage and transaction fees in purchasing and rebalancing

When Archimedes leveraged tokens are minted, as they are backed by assets, a series of transactions need to take place with decentralized exchanges. Similarly, during rebalancing, transactions need to be triggered in order to maintain the targeted leverage level. Traders may face price slippage and transaction fees when making these transactions, with the degree of slippage and transaction costs depending on the depth of the market liquidity in the trading pairs and the volume of the transaction. Larger orders when purchasing or redeeming, and a greater volume of transactions when rebalancing may lead to a higher price slippage and transaction costs, thus having a negative influence on the tokens' financial performance.

Risks associated with maintaining leverages

The fact that leveraged tokens maintain their leverage exposure to a fixed level or range may lead to unexpected outcomes, especially compared with margin trading. (From this perspective, please remember that leveraged tokens are commonly regarded as an instrument to trade rather than hold.)

This is because when bull leveraged tokens have gains, they will borrow and reinvest to increase their long positions. And if bear leveraged tokens have gains, they will borrow and sell more to increase their short positions.

A practical example will help clarify how the behavior of leveraged tokens differs from standard leveraged trading. Let us compare EOSBULL (3x) with trading a 3x EOS position on margin. If EOS goes up one day and then up again the next, EOSBULL will do better than a standard margin position, because it will have reinvested the profits from the first day back into EOS. However, if EOS goes up and then falls back down, EOSBULL will do worse, because the reinvestment during rebalancing increased the exposure, compared with margin trading.

Therefore, it is possible that even if the underlier's price increases, the leveraged token's net value drops. As shown in the table below, even though over two days the price of EOS rises from $2000 to $2024, the value of leveraged tokens decreases, due to the re-leveraging on day 1.

Time	EOS Price($)	EOS Price Change	Leveraged Token($)	Margin Trading($)
Day0	2000		2000	2000
Day1	2200	10%	2600	2600
Day2	2024	-8%	1976	2072

Risks associated with transaction failure

Dexes run on public chains and there may be unexpected scenarios leading to

transactions failure, like network conjunctions, volatile price movement or platform misfunction. Collaboration of protocols may lead to the composability of risks. This may in turn cause a rebalancing failure, making the protocol unable to maintain the targeted leverage. In extreme cases, if the market makes a dramatic unfavorable movement, the lending pool may suffer a value loss due to the negative value in leveraged tokens.

Smart contract risks

The whole DeFi ecosystem is still in an early experimenting stage. Please always be alert to possible smart contract risks and only invest what you can afford to lose.

Oracle risks

Archimedes has partnered with Chainlink, the leading decentralized blockchain data provider, to bring off-chain data to smart contracts on EOSIO and other blockchains. The APLT v1.0 applies decentralized price feeds covering cryptoasset pairs provided by Chainlink.
Chainlink is a decentralized oracle network that enables smart contracts to securely access offchain data feeds, web APIs, and traditional bank payments. It is well known for providing highly secure and reliable oracles.
Nevertheless, oracles and external price data aggregation can be considered as a potential risk to the stability of the APLT if any unforeseen issue arises.

7 Conclusion

Leveraged tokens have already proved to be valuable instruments in crypto trading, yet they are still rarely seen in DeFi.
The APLT v1.0 is a brand-new product, introducing leveraged tokens to the world of DeFi. Archimedes's goal is to greatly enhance liquidity in the decentralized derivatives market and become a leading force in providing DeFi options products in a user-friendly and professional way.