Narwhal Finance Litepaper

Narwhal Finance Team

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Abstract: Narwhal Finance is a decentralized perpetual exchange built on the Binance Smart Chain that allows leveraged trading of cryptocurrencies, forex, and stocks. Synthetic assets will be used to facilitate the trading of the unique multi-asset pool, and leverage will be made possible through liquidity providers on Narwhal, who earn yields from trading fees and traders' performance. Narwhal aims to be the most extensive perpetual exchange that allows users to perform all their transactions on one platform.

1. Background

After being introduced to crypto in 2016, perpetual trading has become the most prominent crypto derivatives market. The entire crypto derivatives market represented 70% of the total trading volume in crypto (CryptoCompare, 2023). Although much of the volume is still concentrated in centralized exchanges, recent events have increased on-chain trading activity and the need for decentralization, self-custody, and transparency in the industry.

The nascent decentralized perpetuals industry gained increased popularity started gaining noticable traction with the real yield narrative, rewarding liquidity providers with more substantial sources of protocol revenue rather than inflationary token emissions. This was made possible by rewarding users with protocol revenues such as platform fees and losses from leveraged trades on perpetual exchanges.

However, decentralized exchanges need more features that centralized platforms have that allow users to have an intuitive trading experience, making the larger retail market unwilling to migrate their trading activity. Thus, an opportunity remains for decentralized exchanges to provide the most comprehensive trading experience for users.

2. Current gaps in perpetual exchanges design

To lay the groundwork for Narwhal's protocol design, we review relevant existing solutions to illustrate gaps that fail to meet user expectations, and the discussion will help explain the rationale behind certain design principles Narwhal adopts. Narwhal's protocol design takes inspiration from existing centralized and decentralized solutions and aims to combine the best of both solutions.

2.1. *Centralized Exchanges (CEX)*

Centralized exchanges offer the best user experience and execution engine for the average user looking to trade crypto. They predominantly use an off-chain central limit order book (CLOB) model, which facilitates better price discovery in that each buy order at a specific price is matched with a corresponding seller willing to sell at that same price. While these features of a CLOB are powerful, they are difficult to implement within an on-chain environment. This primarily stems from the high throughput and low execution cost requirements of an order book.

Nonetheless, centralized exchanges come with their shortcomings. They require a centralized intermediary for order management, execution, and, most importantly, custody of funds. Perhaps the most prolific documentation of these shortcomings is the collapse of FTX, formerly a top 3 exchange by trading volume. Its collapse unveiled malicious practices possible of centralized entities, namely rehypothecation of customer funds, special treatment of margin to specific accounts, and internal frontrunning.

Additionally, centralized exchanges are permissioned, which means the operator restricts user access. This can be in the form of know-your-customer (KYC) requirements or geographic restrictions.

2.2. *Decentralized exchanges*

Origins of on-chain derivative products date back to the early days of Ethereum in 2017, with products such as Synthetix and Solo (now dYdX) pioneering permissionless access to a suite of financial products that were traditionally only available via centralized exchanges. Due to the aforementioned limitations of running a fully-fledged CLOB on-chain, derivatives in DeFi have yet to reach mass adoption. Nevertheless, over time there have been innovations by projects in an attempt to look for alternative means to introduce these primitives to DeFi native users.

GMX is a decentralized spot and leveraged trading platform built on Arbitrum and

Avalanche. GMX facilitates trading and swaps via a multi-asset counterparty pool, GLP, and Chainlink oracles to support pricing to achieve zero price impact trading. Users who provide liquidity to the GLP pool are compensated by earning a portion of protocol fees, native GMX token rewards, and aggregate profits or losses of counterparty traders. Considered the original innovator of the "peer-to-pool" leverage trading model and "real yield" narrative, where the protocol distributes fees generated back to ecosystem token holders, GMX has gained significant traction over the past year, totaling over $75B in trading volume and has distributed over $100M in fees back to token holders. However, the GMX protocol has drawbacks:

Asset listing scalability- underlying assets that GMX supports are limited by GLP pool composition, which currently only consists of 4 blue chip assets. While this has been a minor problem for the protocol during its growth phase since a large share of overall crypto trading volume is dominated by BTC and ETH, this limits the platform to scale further and limits its addressable market. This issue is currently being addressed by the core team, as listing synthetic assets is the next item in their roadmap. However, their implementation of synthetics is done in an isolated manner separate from GLP, meaning there would be a need to bootstrap counterparty liquidity for each newly listed asset.

Risk management parameters - GMX's core features are a lack of slippage, price impact, and funding fees. Slippage and price impact in CLOBs represent the cost of liquidity, and the absence of the two could open the platform for exploits in edge cases. This risk is limited because assets in the GLP pool are generally blue-chip tokens with higher liquidity, but this doesn't eliminate it. This was illustrated in September 2022, when a trader could manipulate AVAX prices on centralized exchanges during periods of low liquidity and subsequently profit on GMX by opening large positions with zero slippage. The same strategy executed on a CLOB using market depth data at the time would have incurred a 13% slippage making it unprofitable. Furthermore, the absence of funding fees means that there are no built-in parameters to incentivize the balance of open interest skew. This is especially important in edge cases with extreme market sentiment to protect GLP holders.

Gains Network is a decentralized leverage trading platform on Polygon and Arbitrum. gTrade, its trading platform, allows for leveraged trading of crypto, forex, and stocks. All trades are synthetic, priced via a real-time custom Chainlink decentralized

oracle network, and settled against the DAI vault, a single stablecoin vault acting as the counterparty to all traders. A single DAI vault and synthetic leverage allow the platform to support a wider range of diverse assets as long as valid oracles support pricing. However, some attributes of the protocol present tail risks that may hinder its growth:

Native token as a backstop mechanism - A key differentiator of gTrade's DAI Vault is that individual DAI stakers do not act as a direct counterparty to traders on the platform. Rather, the vault stores excess PnL as a buffer, and in cases of under-collateralization, GNS, the platform's native token, is minted and sold OTC to cover the deficit. Conversely, when the vault is overcollateralized beyond a target rate, excess DAI will be used to buy back and burn GNS tokens as means of value accrual. In scenarios of extreme single-sided sentiment and platform traders being net positive, a vault under collateralization could lead to a death spiral and hyperinflation of GNS token supply. This was seen once in May 2022 when short traders were profitable during the LUNA crash, and GNS had to be minted to cover the DAI vault, causing the token to fall over 70% in a week. Extremely one-sided price action is not uncommon in crypto markets. While GNS has introduced new risk management parameters since then, such as funding rates, rollover rates, and an inflation cap, the protocol is still exposed. GNS token holders are betting against traders on the platform, which is a fundamental misalignment of stakeholder interest.

dYdX is a decentralized perpetual trading exchange on Ethereum. It utilizes an off-chain order book powered by Starkware L2 with on-chain settlement to provide a CEX-like user experience. As one of the earliest pioneers of decentralized leverage trading, dYdX has gone through multiple iterations and has amassed the highest volume share in the decentralized perpetuals space. However, the protocol itself faces technical limitations of running a CLOB on-chain and has announced a migration to its own application chain built on the Cosmos SDK. It will remain to be determined if a standalone app-chain will be able to meet the technical demands of running a high throughput CLOB on chain, though in the meantime, the protocol faces its own share of economic growing pains:

Tokenomics - order book exchanges face a liquidity cold start problem of incentivizing both makers and takers. Like many early DeFi tokens, dYdX adopts a heavily inflationary token model, distributing its native token to incentivize liquidity from both

sides. Distributions have since been altered a few times, depleting the native token staking pool and the liquidity module, citing inefficient allocations of tokens. Fees generated, on the other hand, accrue to dYdX trading Inc., the parent company behind the protocol operations. This causes misalignment between the protocol growth, users, and token holders. While it is understandable that the protocol is prioritizing growth over value accrual, seen in many early DeFi protocols, this has consequently allowed newer competitors to close the gap in both adoption and market cap.

3. Narwhal Finance

Narwhal Finance is a decentralized perpetual trading platform on BNB Chain. It allows users to trade many assets without KYC, geographic restrictions, or high centralized exchange fees. The protocol ecosystem revolves around USDT, a stablecoin that can be used as collateral when opening trades; NLP, the liquidity token used as a counterparty to traders; and NAR, the protocol's governance and utility token.

3.1. *Trading Engine*

Narwhal's trading engine features synthetic assets and leverage, priced via a hybrid of Chainlink's price feed, Pyth network's price feed, and a custom decentralized oracle network. Traders place orders by placing USDT as collateral, and a synthetic position is opened for them, with the size being based on their selected leverage multiplier. This results in a more capital-efficient means of providing leverage as no real borrowing of funds occur, and trades are directly settled against the counterparty pool.
Narwhal's price feed was designed to maintain accuracy, filter price outliers, and simulate spot prices of the most liquid exchange venues. The price feed requests 8 on-demand Chainlink nodes for crypto assets, with each node providing the median price of 7 centralized exchanges' APIs. Lastly, these prices are sent to an aggregate contract to filter for outliers. The last step is extremely important as the smallest of price deviations may reflect a significantly larger change in position value after considering leverage.

3.2. *Single Stablecoin Counterparty Pool*

NLP is an ERC-4626 vault minted with USDT. Users that mint USDT act as a counterparty to leveraged traders on the Narwhal trading engine; as such, they are awarded traders' collateral if they close a loss trade and pay out a balance if traders close their

trade in profit. Statistically, the average trader will lose money over time, which should make liquidity provisions to NLP have a positive expected value over the long run. In addition, NLP holders are compensated for this risk by receiving a pro-rata share of protocol fees paid by traders.

NLP Share price is calculated as:

$$\frac{USDT\ Deposits \pm traderscumulativepnl + fees\ accrued]}{Outstanding\ NLP\ shares}$$

3.3. *Risk Management*

As explained in section 3.2, synthetic leveraged trading platforms bring indigenous and exogenous risks in cases where various parts of the trading engine can be exploited, causing the protocol, traders, or liquidity providers to suffer unintended losses. Narwhal's risk management principles stem from lessons learned from previous exploits and can be categorized as follows:

3.3.1. *Oracle*

As a synthetic exchange with no order book or pricing algorithm to facilitate price discovery, pricing accuracy becomes paramount. As mentioned in section 4.1, Narwhal's pricing uses the median price of 7 liquid centralized exchanges, then filters for outliers. This eliminates price deviations between exchanges for less liquid tokens, especially applicable in cases of differing depths, such as when there is an immense single-sided buy or sell pressure for a specific token, known as "scam wicks."

The oracle architecture is not susceptible to any single point of failure. Seven exchange APIs are used, and a minimum of three is required to work, making it difficult to game the system by exploiting prices on a single exchange. Additionally, prices received from each Chainlink node are compared to the Chainlink Price Feed to filter for outliers, making it impossible for a single person to manipulate the price.

3.3.2. *Market Skew*

Whenever the market is imbalanced in the sense that there is more open interest on one side, NLP holders take on market risk in the opposite direction of open interest skew. This has shown to be detrimental to counterparty pools, such as the LUNA crash in May and FTT crash in November. As such, the following parameters are introduced to incentivize balance and minimize risk.

Funding Rate To book perpetual exchanges, a funding rate is introduced to incen-

tivize perpetual prices to trade at par to spot prices through a funding rate mechanism, where longs pay short if contracts are traded at a premium to spot, and vice versa. Narwhal takes an alternative approach to calculate funding based on the current long/short open interest skew, incentivizing a balance and minimizing directional risk for NLP holders.

Open interest cap Open interest caps are set to prevent edge cases where market sentiment leans on one extreme side to set a cap to maximum exposure for each asset class NLP holders take on. Open interest caps are independent per asset and determined by the asset's market cap, liquidity, and volatility.

3.3.3. *Market manipulation*

Zero slippage, oracle-based trading platforms are susceptible to price manipulations in situations where prices can be moved in a direction when order books are thin and subsequently profit by opening leveraged positions with zero slippage. Narwhal's first defense is to filter out price outliers from the oracle architecture described in section 4.3.1. In addition, price impact is added to a trade's execution cost to simulate the cost of liquidity based on reference exchanges' order book depth. This better accurately represents costs of liquidity, especially applicable when opening large positions for assets with shallow order book depth. Price impact (%) is defined as follows:

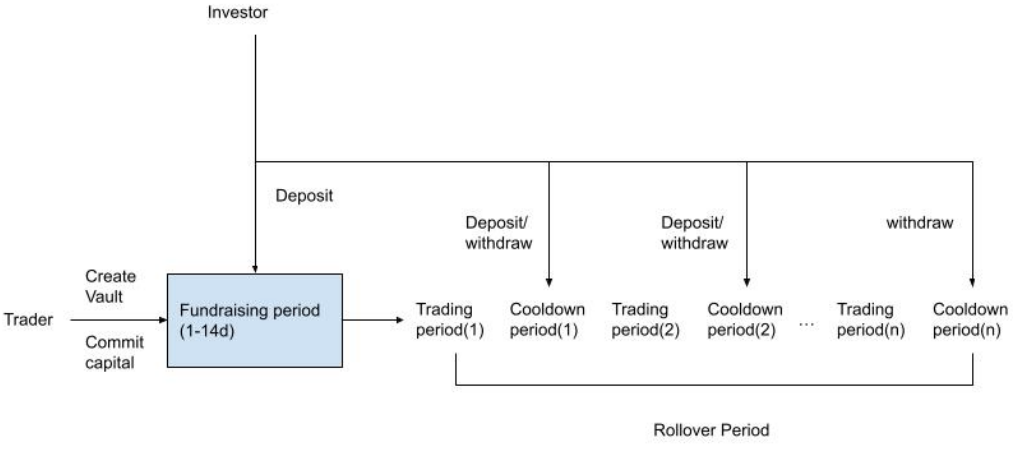
$$\frac{Open\ interest\ long/short + \frac{new\ trade\ position\ size}{2}}{1\%\ depth\ above/below}$$

3.4. *Copy Trading*

Copy trading is a fast-growing market in both traditional finance and crypto, which has proven to be mutually beneficial for advanced and beginner traders. Narwhal introduces a unique design built on top of its perpetual trading engine, enabling trustless copy trading completely on-chain.

Narwhal adopts a vault system, analogous to a decentralized asset management structure, to allow investment managers and traders to create vaults, commit their capital, and allow investors to subscribe to their vaults. The vault owner trades on behalf of all subscribers, meaning there will be no difference in slippage, leverage, execution price, or PnL from the trader. This is a first-of-its-kind feature that allows permissionless fundraising and the ability for professional traders, influencers, and institutions to execute a variety of strategies across multiple asset classes.

For investors, Narwhal Copy Trading will enable discovery of vaults, non-custodial subscriptions, and redemptions. The trustless and transparent nature of a blockchain will enable easy tracking and verification of transactions and PnL computations utilizing a simple-to-use front-end interface.



$$Rollover\ period = \Sigma_{i=1}^{n} T_i + C_i$$

Narwhal's copy trading platform allows for permissionless creation of vaults for traders with an appetite for managing external capital. To create a vault, a trader must commit a certain amount of the vault maximum to prevent moral hazard, and the remaining amount in the vault will be open for followers to subscribe to. When a vault is created, there will be an initial fundraising period of up to 14 days, where traders can market their fund. Upon completion of the fundraising period, trading will commence, and committed funds will be locked. Traders are able to select a vault period based on their trading strategy and time horizon; their corresponding vault parameters would be fixed as follows:

Vault Period	1 Day	7 Day	30 Day
Trading Period	23h	6d 23h	29d 23h
Deposit Period	1-14 Days	1-14 Days	1-14 Days
Cooldown Period	1h	1h	1h
Rollover Period	1m: 30d	1m: 28d	1m: 30d
	3m: 30d	3m: 56d	3m: 60d
	6m: 180d	6m: 175d	6m: 180d
	12m: 365d	12m: 364d	12m: 365d

After the end of each trading period, there will be a one-hour cooldown period where trading stops and users can choose to deposit or redeem their capital. In light of the short one-hour cooldown period, users will be able to queue transactions for deposits and withdrawals in advance, which will be batched and executed upon the commencement of the next cooldown period, provided that the vault has enough capacity. Upon the end of a trading period, all positions will be closed and the net asset value (NAV) of each trading vault will be computed based on the trader's PnL and serve as a price for depositors' claim of the vault:

$$NAV = Total\ vault\ deposits \pm cumulative\ PnL - performance\ fees(if\ in\ profit)$$

$$NAV\ per\ share = \frac{NAV}{shares\ outstanding}$$

At the end of the rollover period, based on the final NAV of the vault, the trader and all investors will be given back their share of the vault.

4. Conclusion

In conclusion, Narwhal Finance aims to combine the best elements from both centralized and decentralized solutions to create an efficient, user-friendly perpetual exchange.

5. References

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