GEDEX: Cross-Chain DLR

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***Abstract*— The future is multichain. However, there currently exists no solution for cross-chain trading that enables direct swaps of any asset pair across different chains, in a cost-effective and fully decentralized manner. In this paper, we introduce GEDEX, a Decentralized Liquidity Routing protocol (DLR) that serves both to extend the existing protocols and to create a native cross-chain DEX.**

1. INTRODUCTION

The current trend in the cryptocurrency world points towards a multi-chain future, where interoperability, especially in the realm of decentralized finance (DeFi), is becoming increasingly important. One of the drivers of this trend is the growing number of blockchains, which is currently well over 200[1]. When we consider the ever-growing number of tokens and protocols of all types on each blockchain, it becomes evident that achieving higher levels of interoperability is no longer a mere option, but a necessity.

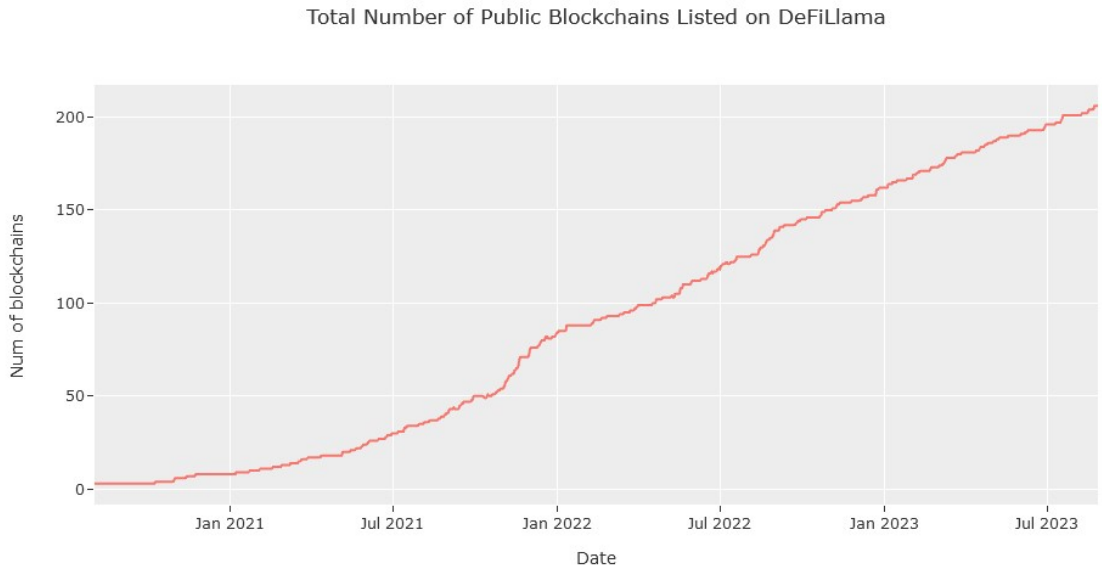

Figure 1. Number of public blockchains currently listed on DefiLlama.

Adding to this landscape, it's notable that almost 60% of all existing blockchains classified as smart contract platforms adopt the Ethereum Virtual Machine (EVM). This speaks to the dominance of Ethereum's technological infrastructure and the widespread

[1] Source data from DefiLlama (https://defillama.com/chains)

adoption of its programming language, Solidity. Standardization has historically been key in the evolution of computing systems, promoting robust and sustainable technical development. Just as HTML and JavaScript were pivotal for web development and Python gained traction in the realm of data science, EVM and Solidity have quickly emerged as the de facto standards for Web3 development.

A central force amplifying the relevance of these standards is the 'network effect', an indispensable principle that underpins the value of these technological ecosystems. In this context, Ethereum boasts a remarkable triple network effect, established across its user base, developer community, and application ecosystem. This cumulative effect reinforces Ethereum's preeminent position within the cryptocurrency landscape, making its ecosystem the best option for the development of new crypto applications, especially in the field of decentralized finance.

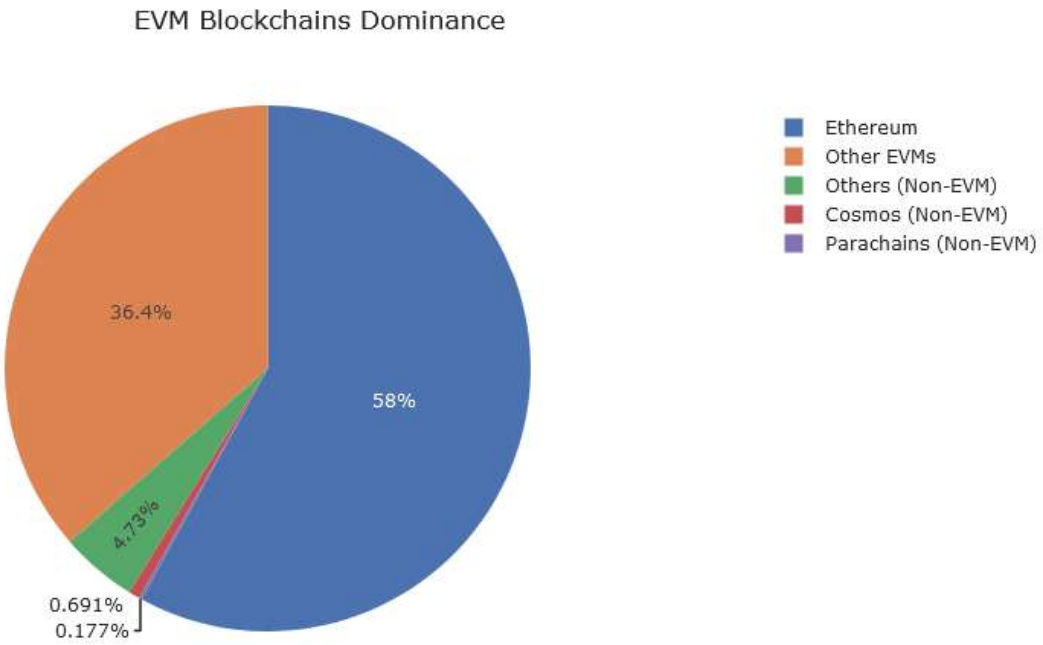

Figure 2. Dominance of EVM blockchains.

Further evidence of this trend toward multi-chain interoperability lies in the rapid proliferation of traditional bridges and the more recent Arbitrary Message Bridges (AMBs) like Axelar (2021), LayerZero (Zarick et al., 2021a) and Chainlink CCIP (2023). These bridges serve as essential connectors between different blockchains, allowing the seamless transfer of not only assets, but also information thanks to the introduction of AMBs. A sample of the momentum of these solutions is that the volume of transactions across bridges has reached an average of $411 million[2] per day in recent months. This is particularly remarkable given that it occurs in the midst of a bear market, with overall

[2] Source data from DefiLlama (https://defillama.com/bridges)

trading volumes on both centralized exchanges (CEX) and decentralized exchanges (DEX) hitting a three-year low. The volume of transactions facilitated by the DEXs has remained at an average of $2.7 billions[3] per day during the same period, which means that traffic through the bridges has now achieved a scale equivalent to 15% of the total DEX trading volume across all chains.

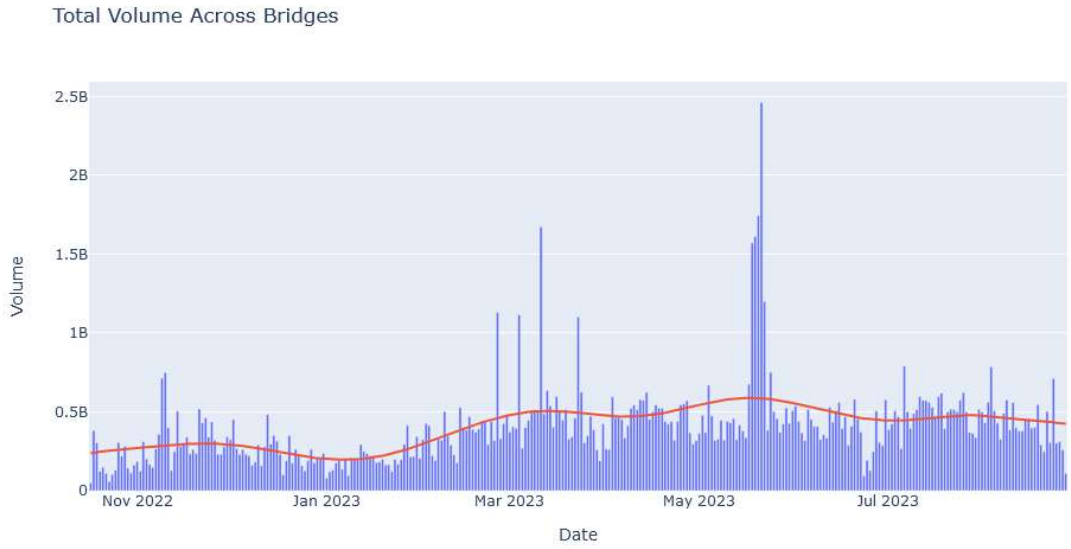

Figure 3. Total volume across bridges (USD).

These volumes, witnessed both on DEXs and bridges, while certainly impressive, pale in comparison to the spot trading volume observed on centralized exchanges, which has maintained an average of around $50 billion[4] per day over the past 12 months. This volume comparison reveals that trading across decentralized exchanges constitutes just approximately 5% of the trading magnitude observed on their centralized counterparts. This indicates that, despite the substantial efforts made in the past five years to develop decentralized solutions, they may not yet be competitive enough against traditional trading options. The question remains: Why?

2. EXISTING SOLUTIONS

While the aspiration for multichain interoperability is clear, the practical realization of seamless cross-chain trading has faced a number of obstacles. Various solutions have emerged to address this challenge, each with its own set of advantages and limitations.

[3] Source data from DefiLlama API (https://api.llama.fi/overview/dexs)
[4] Source data from Coingecko (https://www.coingecko.com/en/exchanges)

Centralized Exchanges

CEXs were among the first solutions to facilitate cryptocurrency trading, offering simplicity, speed, and access to a wide range of trading pairs, making them attractive to both novice and experienced traders. However, CEXs require users to trust the exchange to maintain the integrity of their assets and execute trades fairly, raises concerns about user privacy and anonymity, and conflicts with the decentralized ethos of blockchain.

Decentralized Exchanges and Bridges

Cross-chain swaps, the process of exchanging two tokens on different chains, typically involve a series of steps. This process can be intricate, requiring several transactions and approvals. Depending on the availability of the assets on the bridge, the process might involve up to two swaps on decentralized exchanges (one on the source chain for a bridgeable asset and another on the destination chain for the desired asset), the bridge transaction, and corresponding approvals.

In the worst case, this could mean signing six blockchain transactions across three different applications. This intricate process comes with a high cost in terms of gas, time, and protocol fees, potentially exceeding 1% of the traded amount. Given the cumulative costs involved, it's understandable that the market share of decentralized solutions remains considerably lower compared to the trading volume on centralized exchanges.

Atomic Swaps

Another prominent strategy is the use of atomic swaps, a mechanism that allows direct peer-to-peer exchanges of native assets from different blockchains. Atomic swaps guarantee that both parties to the transaction occur simultaneously or that neither occurs, thus eliminating counterparty risk.

However, atomic swaps face their own challenges. The liquidity requirement on both sides of the trade and the limited number of supported blockchains may limit its usability. In addition, the technical complexity of orchestrating exchanges at the protocol level between different blockchains has hindered the widespread adoption of atomic swaps.

Thorchain

THORChain (2020) is a decentralized liquidity protocol that enables users to swap assets across various blockchain networks. Unlike traditional decentralized exchanges (DEXs) that operate within a single blockchain network, THORChain enables native swaps without the need for wrapped or pegged tokens. It operates as an independent Layer 1 blockchain built on the Cosmos SDK. The protocol's drawback lies in the complexity of adding new blockchains, requiring significant development effort. Additionally, the asset listing process isn't permissionless but rather centralized, which limits the trading

options available natively, the protocol has been exploited on multiple occasions and the blockchain that secures it can be stopped, which raises greater doubts about its security and decentralization. Regarding fees, these vary depending on the size of the trade in relation to the available liquidity, so they can be quite high in some cases, although they usually range between 0.5% and 1%.

Aggregators

A growing trend in the DeFi space is the rise of aggregators, which improve the user experience by leveraging existing DeFi protocols. Unlike the solutions discussed above, aggregators operate at the application level rather than on the blockchain itself, so they are not fully decentralized. They simplify cross-chain trading by automating the search for optimal routes across DEXs and bridges. Aggregators don't tackle the core challenges of high costs and inefficiencies associated with cross-chain trading. Instead, they enhance the overall user experience by reducing the complexities involved in manually conducting these transactions, making the process more accessible and intuitive for users.Examples of these solutions can be found in protocols such as DoDo (2021) and Squid (2023).

Existing multi-chain aggregators use centralized stablecoins as a bridge asset. Recent projects such as Squid or Stargate use this solution. Using stablecoins as bridging assets eliminates impermanent loss and reduces the compensation needed for liquidity providers, resulting in lower fees. However, this solution reduces decentralization and requires dedicated liquidity pools (Stargate, Zarick et al., 2021b) or the use of wrapped versions of stablecoins (Squid) just like traditional bridges, which carries risks of hacking or increased operational costs respectively.

After analysing the range of existing cross-chain solutions, it becomes clear that each approach presents its own blend of advantages and limitations. None of the current solutions allow for the exchange (swap) of assets between different chains in a fully decentralized, permissionless and single-step manner. DEXs allow for decentralized exchanges but only within the same chain and to exchange assets from different chains require the use of a bridge and multiple swaps on the origin and destination chain, with high cost and complexity. Thorchain allows for the decentralized exchange of native assets from different chains, but the number of assets is limited and requires team implementation (it is not permissionless). Aggregators simplify the user experience, but don't deal with the underlying inefficiencies, thus keeping costs high. Finally, there are centralized solutions, which are more economical but are not decentralized or permissionless and require trust in a third party.

3. GEDEX

In response to the shortcomings found in the cross-chain trading solutions that currently exist, we present GEDEX: a decentralized liquidity router that allows DeFi protocols to obtain interoperability in a secure, efficient way while preserving their decentralization.

GEDEX beats existing solutions in all relevant dimensions:

Decentralization

The main problem with all current cross-chain trading solutions is that they sacrifice, to a greater or lesser extent, decentralization to improve the user experience. The absence of alternatives based on the blockchain, together with the urgency to compete in the new multi-chain services market, has caused many DeFi protocols to adopt as a solution aggregators that are fully centralized since they are based on web 2.0 technology (Javascript code and APIs hosted on traditional servers) instead of on the blockchain and do not meet any of the characteristics of Web 3.0: security, permissionless, trustless and censorship resistance. These aggregators also resort to the use of centralized stablecoins as a means of transferring liquidity between chains, further harming the independence and decentralization of web 3.0.

For this reason, GEDEX presents a design that respects the fundamental principles of decentralization, fully blockchain-based, bridge-agnostic, permissionless, trustless, and does not use centralized stablecoins as a bridge asset.

Security

Since the creation of the first cross-chain bridges, news of exploited bridge security bugs that have resulted in the loss of hundreds of millions of dollars of users has been a constant. At GEDEX we are aware of this challenge, and for this reason we have developed our protocol with security as a primary objective.

As a result of this search, our Omnibridge solution was born, which uses all the top-level bridges currently available (Wormhole, Celer, Axelar, LayerZero and Chainlink CCIP) concurrently, guaranteeing that even if a bridge is compromised the funds remain secure and the protocol continues to operate without interruption. As far as we know, there is no other cross-chain protocol with this level of security and service.

Efficiency

GEDEX has been designed to comprehensively minimize existing inefficiencies in the cross-chain trading process, both from the perspective of liquidity providers and users:

- Ultra-concentrated liquidity: Single pool architecture combined with an innovative adaptive AMM (ADAMM) enables low-slippage trading requiring much less TVL than existing major DEXs.
- Impermanent loss: the possibility of depositing liquidity of a single asset instead of a pair together with the characteristics of ADAMM, which transforms the toxic flow of arbitrage orders into a stream of profits for liquidity providers, makes it possible to compensate for the impermanent loss while maintaining low commissions for users.
- Direct exchanges: the main problem that aggregators do not solve is the need to carry out a large number of intermediate operations. A cross-chain exchange using an aggregator like Squid may require (figure 4):
    1. One or more swaps on a DEX to obtain a centralized stablecoin (USDC)
    2. An exchange between the stablecoin and its bridge version (axlUSDC) in a stableswap like Curve.
    3. An exchange between the bridge version of the stablecoin and the stablecoin on the target chain.
    4. One or more exchanges between the stablecoin and the desired asset.

  In total, a cross-chain exchange of assets other than stablecoins requires a minimum of 4 swaps, each with its respective commission, gas cost and slippage, making this process extremely inefficient and expensive. GEDEX performs this same operation in a single step, significantly reducing costs for the user.

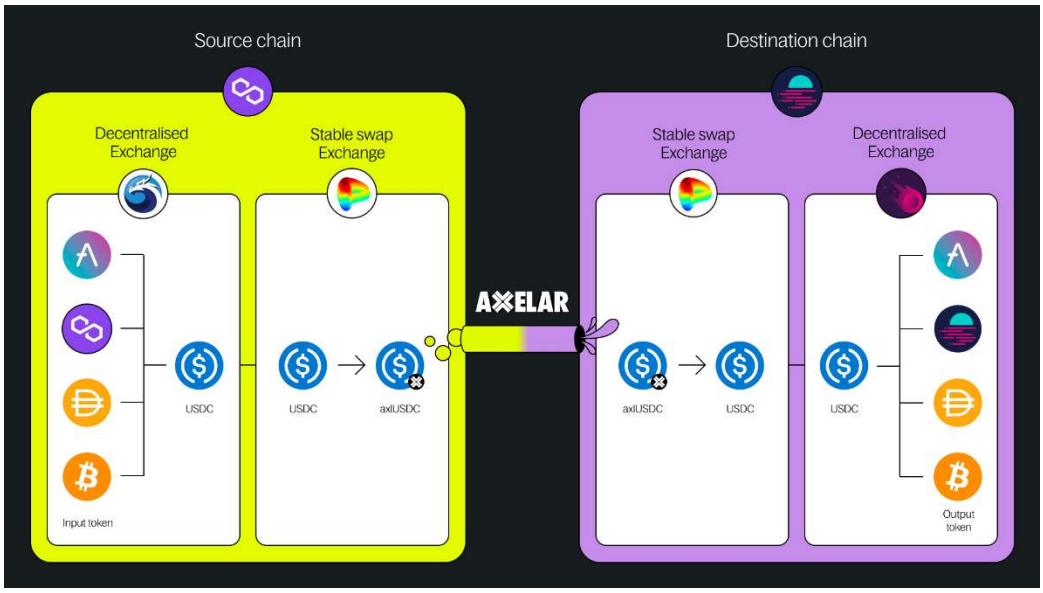

Figure 4. Squid cross-chain exchange process.

The combination of all these features makes GEDEX extremely efficient, optimizing the balance of costs for users and benefits for liquidity providers.

3.1 Automated Market Maker

In addition to functioning as a liquidity router for other DeFi protocols, GEDEX incorporates its own AMM that has the dual function of effectively connecting with other DEXs to transfer liquidity between chains as well as allowing the direct exchange of any pair of assets, both on the same chain as well as between different chains, acting as a native cross-chain DEX.

GEDEX departs from the fragmented liquidity model popularized by Uniswap (Adams, 2018; Adams et al., 2020, 2021), opting instead for the concentrated liquidity model proposed by Bancor (Hertzog et al., 2018; Loesch & Hindman, 2020) and also adopted by ThorChain, since this is much more efficient and suitable for a multi-chain solution. Among its advantages we can mention:

- **Efficiency**: Uniswap's independent liquidity pair model is extremely inefficient, especially when exchanging rare assets for which no pair exists, since it is necessary to carry out several intermediate exchanges, which multiplies the costs of gas and fees. Furthermore, each of these exchanges uses only a fraction of the total liquidity, since it is dispersed among the different pairs, which increases the magnitude of the slippage. The concentrated liquidity model solves all these drawbacks.
- **Decentralization**: Another major drawback of using fragmented liquidity is that to provide exchanges between all assets it is necessary to build an external, centralized application that scans the blockchain to find all liquidity pairs created and calculates the optimal path of exchanges necessary to obtain the desired result, which means that in practice these protocols cannot be fully used in a decentralized way. In the concentrated liquidity and single contract model this problem does not exist, and the protocol can be easily used without the need for a custom front-end application.
- **One-Side Liquidity**: The concentrated liquidity model allows liquidity providers to deposit a single asset, simplifying the process and giving LPs greater freedom to build their portfolio.
- **Impermanent Loss Compensation**: The centralization of exchanges against a single asset allows for various strategies to counteract the impermanent loss of liquidity providers.
- **Lower Fees and Gas Cost**: Direct exchanges result in substantial gas and commission savings for users, especially when trading rare assets.
- **Cross-Chain Swaps**: The use of a common asset to all exchanges whose supply is controlled by the protocol allows value to be transferred between different chains natively and without depending on third parties.

- **Permissionless Pools:** One challenge of liquidity-concentrated DEXs in comparison to fragmented counterparts like Uniswap is the requirement for an approval process to list assets for security reasons. To address this, GEDEX adopts an innovative approach. It employs a hybrid system, allowing any token to be listed without prior approval by manually providing the required amount of GDX tokens to create the liquidity pool, akin to Uniswap-style pools. This solution allows anyone to add their token to the liquidity network without assuming undue risk, while simultaneously generating demand for the GDX token.
- **Reduced Slippage**: GEDEX can also reduce slippage thanks to its design. While a fragmented liquidity DEX would require 2n pools for n traded assets, our system necessitates only n pools. This consolidation provides deeper liquidity and subsequently reduces slippage, notably benefiting traders.
- **Lower Deployment Cost**: Unlike Uniswap, where new liquidity pairs demand the creation of new contracts, GEDEX's integrated architecture significantly diminishes this cost. In Uniswap, each new pair entailed substantial gas costs (often exceeding $1,000 during high network congestion), but the concentrated liquidity model reduces this by requiring only one pool per asset. GEDEX takes this a step further by eliminating deployment costs entirely.
- **Built-in Price Oracle**: GEDEX incorporates an advanced internal oracle system that surpasses existing alternatives in terms of both security and precision. This powerful oracle technology enhances the DEX's reliability and accuracy, contributing to the creation of a more robust and secure DeFi ecosystem.

3.2 GDX token

GDX is the utility token of GEDEX and plays a fundamental role in the operation of the exchange as it is the common asset that allows the exchange of assets both on-chain and cross-chain. Since the supply of GDX summing all blockchains is limited to 100,000,000 tokens, there is a direct relationship between the TVL of the protocol and the value of the token.

GEDEX uses a mixed liquidity provision model, where the liquidity provider only has to provide an asset instead of a pair if that asset belongs to the list of trusted tokens, but permissionless listing of any token is also allowed, providing 50% liquidity in the form of GDX tokens. The only way to purchase these GDX tokens is selling trusted assets to GEDEX. The protocol mints new token supply when GDX is purchased in exchange for trusted assets, and burns it back when it is sold. A small percentage of tokens are also burned each time liquidity is withdrawn from the protocol, as an exit fee.

The second utility of the GDX token is the collection of protocol fees through a staking system. This system is not inflationary, it is sustainable over time and encourages long-term holding through a weight system dependent on the accumulated staking time. It also creates a link between the trading volume of the protocol and the value of the token.

The third utility of the GDX token is the future governance of the protocol. Analogous to the case of protocol fees, a time-weighted staking system will allow token holders to exercise such governance.

Finally, the GDX token is also used to incentivize liquidity providers through yield farming programs. A part of the initial supply of tokens is reserved for this purpose, however the objective is that after the bootstrapping of the protocol a part of the fees generated is allocated to this purpose, generating sustainable and non-inflationary incentives.

4. CONCLUSION

We have introduced GEDEX, a liquidity router that enables DeFi protocols to achieve cross-chain interoperability in a secure and decentralized manner, while also providing direct cross-chain exchanges efficiently.

We have demonstrated that existing solutions for cross-chain exchanges face trade-offs between decentralization, simplicity, and cost. More recent solutions (aggregators) have chosen to address the complexity challenge but at the expense of decentralization, while not addressing the underlying issues of cost or security, which rely solely on a single message bridge. Other solutions, such as Thorchain, streamline the process and come with moderate costs, yet they lack complete decentralization and have limitations on the number of natively supported assets. To the best of our knowledge, there is currently no solution that offers the comprehensive security, efficiency, and decentralization features provided by GEDEX.

In conclusion, it is crucial to emphasize the significant opportunity presented by the absence of suitable cross-chain decentralized trading solutions at a time when the narrative around rollups is gaining momentum and a multitude of new Ethereum Layer 2 solutions are being developed and launched. Add to this that even during a bear market an average daily trading volume of $50 billion is maintained. This outlook underscores the need for innovative platforms like GEDEX, which have the potential to play a pivotal role in shaping the future of decentralized finance by providing seamless and efficient cross-chain trading while addressing existing challenges.

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