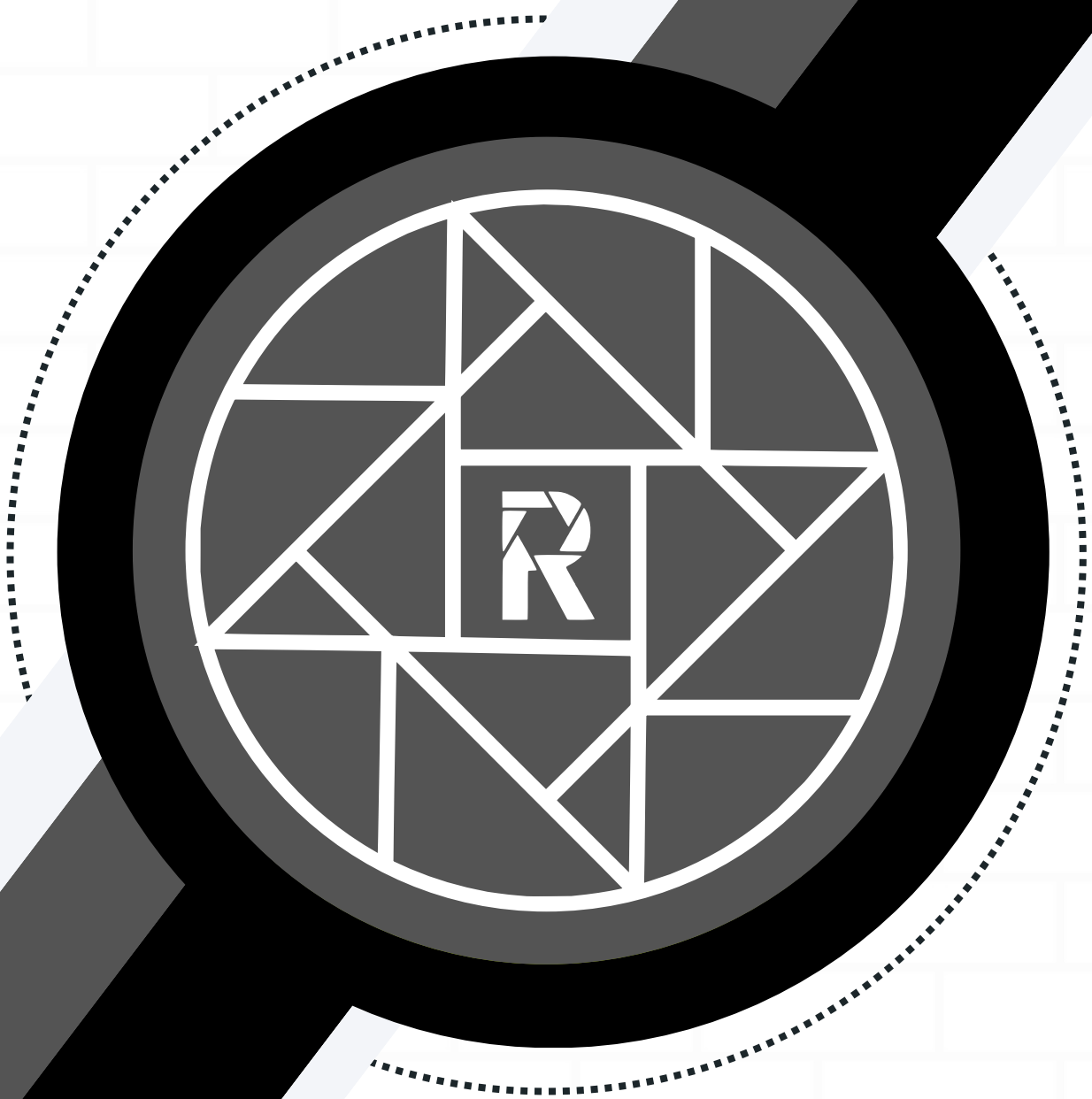
Resonate
Whitepaper



Abstract

Asset management is a complex field where investors must navigate between the two fundamental goals of maximizing returns while negating downside.

This balancing act takes on a unique dimension for fund managers who have a primary mandate to safeguard their clients' funds. These investors, some of whom adopt a conservative approach such as money markets, insurance funds, and pension funds, face the challenge of managing portfolios that seek to minimize risk while still aiming to maximize returns.

Digital assets, with their potential for substantial returns, present an alluring opportunity. However, they remain largely inaccessible to these stable-value funds due to several issues. In particular, the custody of digital assets is a significant concern, and there is a lack of well-defined regulatory frameworks to guide these investments. Furthermore, traditional strategies that rely heavily on low-risk fixed-income assets do not easily align with the high-risk, high-reward nature of digital assets.

A significant opportunity exists to help traditional asset managers achieve higher yields securely. These conservative fund managers oversee trillions of dollars and can be broadly categorized into the following groups: L1 and L2 treasuries, stable-coin reserves, crypto-facing insurance companies, traditional stable-value funds, and crypto-native hedge funds. Each group encounters distinct challenges and regulatory constraints.

Resonate enables low-to-no risk asset managers to maintain their current safe and secure gains from US Treasuries while tapping into additional high-potential yields without jeopardizing their deposits. It empowers conservative asset managers to leverage their existing fixed-income portfolios, unlock hidden value within these assets, and access digital assets in a compliant, principal-protected manner. By separating interest from the underlying asset, Resonate mitigates risks and ensures that the worst-case scenario is limited to a failure to achieve expected interest payments rather than a loss of principal.

The Challenge of Accessing Digital Assets

Accessing digital assets while adhering to a zero-loss framework poses a complex challenge. Resonate not only facilitates access to these assets but does so without adding any additional risk. Stable-Value Funds, including pension funds, insurance companies, and money market funds, exhibit varying risk tolerances and investment mandates. While their interest in digital assets is growing, their primary objective remains the preservation of principal. This scenario introduces several challenges for the different subgroups of fund managers.

L1/L2 Treasuries, Stablecoin Reserves, and Crypto-Facing Insurance Companies:
These entities actively engage with blockchain protocols but have been constrained by regulatory and risk-averse mandates. They typically hold the majority of their assets in short-duration, fixed-income instruments and are more akin to traditional institutions. However, they are also more comfortable with digital assets.

Traditional Stable-Value Funds, Including Insurance and Pension Funds:
These traditional fund managers hold the largest amount of capital ($88.5T) but are less familiar with digital assets. They face the strongest mandate to avoid losses of investor capital, preferring low returns over principal loss. Many express interest in holding digital assets in their portfolios, but regulatory and custody challenges deter them.

> *In a survey conducted by Nomura, 86% of insurance fund managers expressed interest in holding digital assets in their portfolio, with 50% expecting to allocate between 2% to 5% of their portfolio to digital assets within the next three years. Nevertheless, 60% cited legal or regulatory custody restrictions as potential obstacles. When combined with the well-known volatility of digital assets, these roadblocks can appear insurmountable for traditional fund managers. The effort to reconcile traditional asset management strategies with the dynamic digital asset space is an ambitious and challenging one, especially in the context of evolving SEC regulations.*

Crypto-Native Hedge Funds:
These funds, particularly market-neutral ones, are actively involved in the digital asset space. They are seeking safe avenues to gain exposure to digital asset price action, as their core strategies often prevent them from taking significant delta exposure. Many of them hold their reserves in short-duration fixed-income assets, typically cash equivalents. This subgroup is the highest risk by nature, prioritizing returns above all else.

Securing No-Risk Added Yield for Stable-Value Funds Using Digital Assets

Resonate presents an innovative solution to tackle this challenge by allowing conservative fund managers to leverage their fixed-income portfolios into compliant, principal-protected positions in digital assets. The adopted risk is confined to the interest component, ensuring that the worst-case scenario for any digital asset investment made through Resonate is the failure to earn a return on secured collateral rather than any loss of principal. Furthermore, they can use the underlying fixed-income asset to collateralize other positions.

This groundbreaking solution is enabled by the unique valuation of short-duration fixed-income assets. Short-term, fixed-duration assets typically lack strips, meaning they are purchased at a value lower than their face value and realize that face value upon maturity.

Resonate facilitates the realization of this value at any point during the maturity process by lending against the unrealized value. This decouples interest from the underlying asset, allowing borrowers to deploy the borrowed capital into DeFi and digital asset strategies.

Guaranteed Returns

Lock assets; earn instant yield.

Long Yields

Purchase discounted yield futures.

Protocol Sustainability

Protocols can utilize otherwise idle treasury-assets to sustain high staking rewards without runaway inflation.

Resonate: Case Study

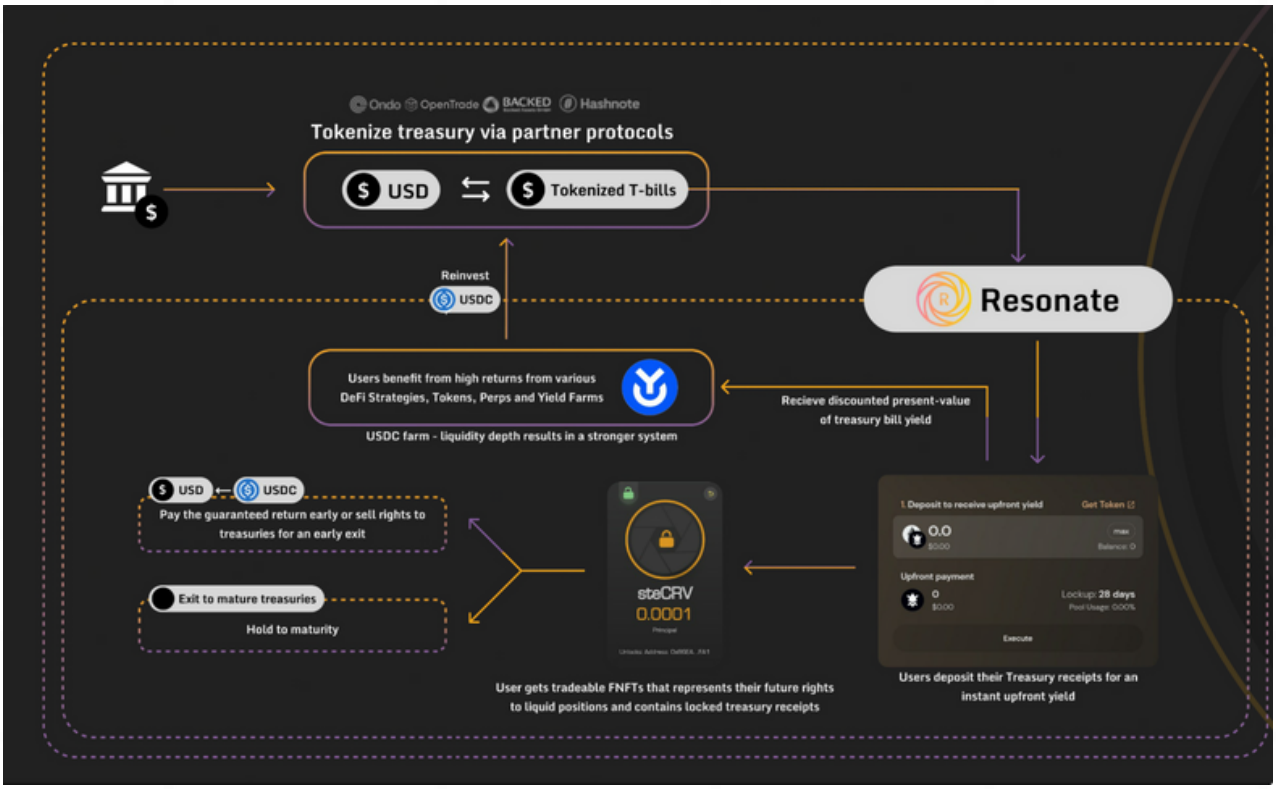
Consider an insurance fund holding most of its assets in three-month treasuries, which it always holds to maturity. A $10 million position in that insurance fund will be collateralized with $10 million worth of one-month T-Bills, which, at 4% interest, will be worth $10.1 million in three months (4%/4 = 1%). The collateral needed is $10 million. At the beginning of the term of holding these assets, the collateral on hand is $10 million in T-Bills. However, by the end of the 3-month term, the position is overcollateralized. The fund can utilize Resonate to borrow $95,000 against its $100,000 future returns and invest that $95,000 into digital asset strategies while maintaining the $10 million of collateral needed on hand.

This innovative strategy allows fund managers to avoid rehypothecation and deploy existing fixed-income portfolios across various investment strategies. In practice, Resonate operates through a three-party system where borrowers and lenders face each other. Resonate's smart contract system serves as an escrow and issues a collateral representation of the underlying principal, which is not involved in the trade. As the underlying assets increase in value over time, the loan is automatically repaid upon maturity, with the accrued interest embedded in the payout.

Resonate leverages third-party tokenization engines to bring fixed-income assets onto the blockchain. These tokenization protocols are already prevalent within the DeFi space. Instead of dealing with various legal considerations, Resonate partners with a range of RWA tokenizers, ensuring broad jurisdictional coverage and decoupling the protocol from legal intricacies. It benefits from the KYC'd nature of many of these protocols, enhancing security and protecting against theft of capital.

Additionally, Resonate benefits from the custodial compliance of these tokenization protocols. For institutions working with these compliant tokenizers, Resonate offers custodially compliant access to DeFi. As the backing asset is held off-chain, and the investor's principal is never at risk, Resonate represents a compliant method for bringing institutional capital on-chain and acquiring on-chain liquidity without exposing it to the inherent risks of on-chain investment vehicles.

Trade Architecture & Legal Framework



One of Resonate's primary providers of Real World Assets (RWAs) is OpenTrade, which enables institutions access to a suite of on-chain credit products for tokenized real-world assets. We'll utilize their framework as a case study:

Legal Framework and Onboarding Process:

OpenTrade's Treasury Management Product operates within a robust legal framework. It involves secured lending to a bankruptcy remote Cayman Segregated Portfolio Company (SPC), overseen by an independent board of directors and an FCA-regulated investment firm. The onboarding process includes rigorous KYC/AML/CFT screening, execution of the Master Lending Agreement (MLA), and white-listing the desired wallet(s).

Master Lending Agreement (MLA):

The MLA serves as the umbrella agreement defining lending mechanics, rights, obligations, roles, responsibilities, and more. Each transaction under the MLA is meticulously documented through a legally binding Loan Confirmation, issued in accordance with the Master Lending Agreement. This Confirmation outlines the specific terms governing each transaction.

Collateralization and Security:

All transactions facilitated by the OpenTrade Treasury Management Product are fully collateralized with eligible loan collateral, including US Treasury Bills, USD, and USDC. A Security Trustee holds a security interest on behalf of lenders in all collateral, managing accounts pursuant to a Security Trust Deed.

Analysis of Resonate

Value Proposition for Borrowers and Lenders:

Resonate's innovative financial ecosystem benefits both borrowers and lenders within the digital asset landscape. Institutional investors, such as insurance funds or pension funds, stand to gain significantly. They can deploy their existing fixed-income assets into digital assets without exposing their principal capital to undue risk. This is particularly appealing for risk-averse investors who may have been deterred by the volatility of digital assets in the past. Resonate provides a risk-mitigated path to gain exposure to high-return asset classes.

On the lending side, lenders can earn attractive returns ranging between 10% to 20%, backed by collateralized fixed-income assets. These returns offer considerably higher yields than traditional fixed-income investments, attracting lenders, including hedge funds and DeFi participants. The potential for attractive interest rates has the capacity to attract a broad pool of lenders, ultimately increasing liquidity and enabling more borrowers to access digital assets.

Diversification Opportunities:

Resonate's solution opens up new opportunities for institutional investors to diversify their portfolios. Traditionally restricted to low-risk, fixed-income assets, these investors can now explore a broader range of investment options, potentially increasing returns without adding potential risk.

Empowering KYC'd Institutions:

KYC'd institutions gain access to a revolutionary financial ecosystem. They can securely deposit tokenized fixed-income RWAs, starting with tokenized treasury bills, and receive upfront returns in cryptocurrencies. This novel system ensures that institutions can diversify their portfolios and harness the power of blockchain technology with confidence.

Risk Management and Principal Protection:

One of Resonate's unique strengths is its decoupling of interest from the underlying assets, providing a safety net for investors. The worst-case scenario for any digital asset investment made through Resonate is failing to earn a return on the interest, rather than suffering a total loss of principal. This risk management approach is vital for conservative investors who prioritize the preservation of their principal capital. This assurance holds as long as users refrain from utilizing their (FNFTs) as collateral for loans, reinforcing the security of this financial landscape.

Analysis of Resonate

Regulatory Alignment and Legal Protections with Custodians:

Resonate strategically partners with various Real-World Asset (RWA) tokenization protocols to navigate jurisdictional and legal compliance intricacies. This approach allows Resonate to serve a broad range of jurisdictions while maintaining custodial compliance—a crucial aspect for institutional investors facing stringent regulatory requirements. The RWA tokenization engines employed by Resonate incorporate Know Your Customer (KYC) verification, enhancing security and reducing the risk of theft or fraud. By leveraging these well-established protocols, Resonate provides a compliant method for institutions to transition their capital onto the blockchain, enjoying on-chain liquidity benefits without exposing their assets to the inherent risks of many on-chain investment vehicles. All accounts with qualified custodians are regarded as bankruptcy-remote, providing essential legal protections.

The Three-Party System:

Resonate's three-party system, utilizing smart contracts as escrow, ensures the security and transparency of the lending process. In this system, smart contracts oversee the entire lending process, safeguarding the interests of both borrowers and lenders. Interest payments are secure and automatic, instilling trust among lenders that they will receive their interest payments as agreed upon. Simultaneously, borrowers can rely on the smart contract to ensure that their collateral is accurately valued and their principal is protected.

Facilitating Blockchain Adoption:

By serving as a bridge between traditional finance and the blockchain world, Resonate plays a pivotal role in advancing blockchain adoption in the institutional investment space. As more institutional capital flows into digital assets, it contributes to the growth and maturation of the digital asset ecosystem. The implications of Resonate's approach are far-reaching, offering a paradigm shift in how asset management institutions approach digital assets and blockchain technology. It empowers them with innovative financial tools, risk mitigation, and compliance, ultimately reshaping the way they engage with the digital asset landscape.

Analysis of Resonate

Reduced Scrutiny for Forward Returns:

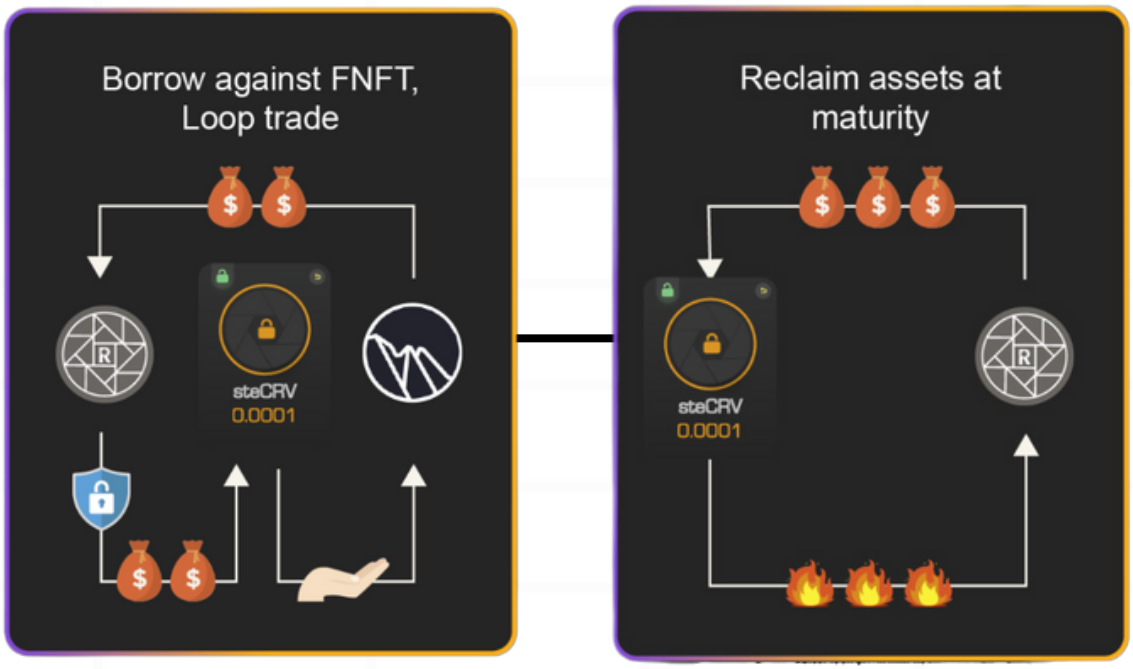
Within the Resonate ecosystem, forward returns are distinctively not considered cash-equivalent. This unique characteristic minimizes scrutiny regarding their deployment within the DeFi landscape, granting institutions greater flexibility to actively engage within the ecosystem.

Potential for Cash Settlement:

This innovative model introduces the potential for a cash-settled alternative, providing an additional layer of flexibility for participants.

FNFT as Secure Collateral:

Of particular interest is the principal FNFT, which opens doors for institutions to extend the leverage of their assets. This FNFT can serve as valuable collateral for DeFi loans and stablecoin minting. Refer to the visual representations available in the graphics provided below.



Asset Management: Broader Impacts

Resonate's groundbreaking financial ecosystem is poised to revolutionize asset management across diverse sectors, presenting distinct implications and opportunities for various groups to optimize operations and enhance returns.

Delta-Neutral Hedge Funds:
The impact on delta-neutral hedge funds is substantial, granting them the ability to take on more significant price exposure to digital assets. This newfound flexibility empowers these funds to leverage higher and explore additional avenues for generating alpha. Resonate's ecosystem creates opportunities for adaptation to evolving market conditions, providing a competitive edge for delta-neutral hedge funds.

Stablecoin Treasuries, L1 Treasuries, and Insurance Companies:
Organizations with risk-volatility mandates, including stablecoin treasuries, Layer 1 (L1) treasuries, and insurance companies, stand to benefit from more efficient capital management. Streamlined capital allocation processes enable these entities to better fulfill their primary objectives and meet the needs of their user base. This enhanced efficiency contributes to improved risk management, leading to more effective financial operations.

Money Market Funds:
Even the most conservative asset management funds, such as money market funds, can leverage Resonate's ecosystem to enhance returns on cash equivalents. This means achieving higher yields while maintaining necessary liquidity levels. Resonate's system empowers money market funds to navigate a fine balance between risk and liquidity, delivering improved returns to stakeholders.

Insurance Funds and Portfolio Management Arms:
Institutions in the insurance sector will undergo a transformation in capital allocation. With Resonate's ecosystem, insurance funds and their portfolio management arms can more effectively allocate capital reserves, optimizing financial performance and reducing reliance on extensive reserve stores. This, in turn, frees up capital for allocation to more productive and growth-oriented activities.

Asset Management: Broader Impacts

Path into Web3:

Resonate's ecosystem not only optimizes traditional asset management but also paves the way for greater involvement in Web3, the decentralized and blockchain-based web. It offers secure and principled digital asset management opportunities. Stable-Value Funds can explore new avenues for investment and participation in the emerging blockchain and cryptocurrency space, aligning themselves with the cutting-edge technologies of the future.

Resonate: Security Audits

Our paramount commitment is to fortify your capital's security. Here's how:

- Audits completed by Zellic.
- Audits completed by BlockSec.
- Segregated Liquidity Pool Contracts.
- Long-standing Bug Bounty Program.
- FNFT Self-Custody Technology.
- Extensive Fuzz Testing.

Conclusion

Resonate's pioneering approach to risk mitigation, principal protection, and innovation in asset-backed lending represents a paradigm shift in the financial industry. By opening doors for institutional investors to confidently venture into the digital asset space, Resonate enables access to high-return asset classes without exposing principal capital to undue risk. The platform caters to both borrowers and lenders, creating a harmonious ecosystem where risk-averse institutional investors find an appealing path to diversification, while lenders benefit from attractive returns backed by collateralized fixed-income assets.

This pioneering initiative offers a safer, more efficient, and more inclusive route for institutional investors to access the ever-evolving world of digital assets. In conclusion, Resonate's innovative approach is more than a financial platform; it's a bridge to a future where traditional and digital finance coexist seamlessly, providing new opportunities and security for institutions and the broader digital asset community.

Appendix: Navigating Resonate

1. Examples

Example 1

An Issuer deposits $100 in a pool offering an upfront yield of 5%. The Issuer would receive $5 immediately upon being matched with an Underwriter. An Underwriter would have to deploy $5 to completely match the Issuer.1 If the Underlying Yield Farm has a Yield of 6%, then the Underwiter would earn a Boosted Yield of:

$$\frac{6\%}{5\%} - 1 \quad = \quad 20\%$$

over the Term for which the Principal is locked.

1 Partial matching may occur proportionally if the Underwriter deposits less.
2. Assuming that the average Yield on the Underlying Yield Farm is equal to the current Yield on the same Underlying Yield Farm over the Term.

Example 2

An Underwriter deploys $100 to a pool offering Issuers 1% upfront. If the Underlying Yield Farm has a Yield of 2%, then the Underwriter would earn a Boosted Yield of:

$$\frac{2\%}{1\%} - 1 \quad = \quad 100\%$$

over the Term for which the Principal is locked. An issuer would have to deposit:

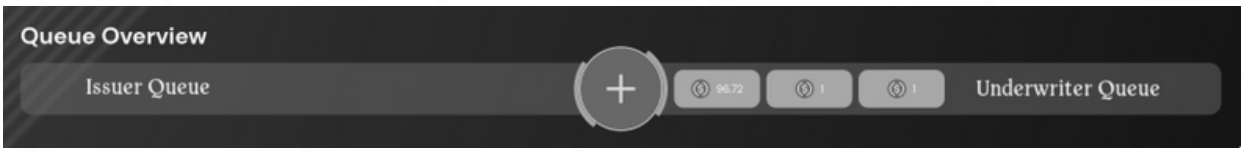
$$\frac{\$100}{1\%} \quad = \quad \$10000$$

to completely match the Underwriter.

2. Mechanism:

2.1 The Temporal Orderbook

Resonate uses an orderbook-like system to match Issuers and Underwriters. For any pool, there will be two sides: one for the Issuers and one for the Underwriters. Issuers and Underwriters will enter a queue on their side and wait to be matched with their counter-parts. If one of these queues has capital still unmatched, the queue on the other side will necessarily be empty. This mechanism is much like traditional orderbooks, however, instead, it facilitates orders on a first-come-first-serve basis.



Appendix: Navigating Resonate

2.2 Scaling:

A traditional constant-product AMM architecture, in spite of any optimizations, will suffer from price impacts for large enough trades. A basic constant product AMM will be such that:

$$x \cdot y = k$$

where x and y are the number of tokens for the respective tokens in the relevant pair in the liquidity pool, and where k is the invariant. If trading *i* of token *x* for *o* of token *y*, the price impact, π, can be calculated thusly:

$$\begin{aligned}
& (x+i)\cdot(y-o) &=& \ k \\
\Rightarrow\ & (x+i)\cdot(y-o) &=& \ x\cdot y \\
\Rightarrow\ & x\cdot y + i\cdot y - o\cdot x - i\cdot o &=& \ x\cdot y \\
\Rightarrow\ & i\cdot y &=& \ o\cdot(x+i) \\
\Rightarrow\ & o &=& \ \frac{i\cdot y}{x+i}
\end{aligned}$$

And, since constant-price would imply: $o = \frac{i\cdot y}{x}$:

$$\begin{aligned}
\Rightarrow \pi &= 1 - \frac{\frac{i\cdot y}{x+i}}{\frac{i\cdot y}{x}} \\
\Rightarrow \pi &= 1 - \frac{x}{x+i}
\end{aligned}$$

If *p* is the maximum desired price impact:

$$\begin{aligned}
1 - \frac{x}{x+i} &< p \\
1 - p &< \frac{x}{x+i} \\
(1-p)\cdot x + (1-p)\cdot i &< x \\
(1-p)\cdot i &< x - (1-p)\cdot x \\
(1-p)\cdot i &< x\cdot(1-1+p) \\
(1-p)\cdot i &< p\cdot x \\
\frac{1-p}{p}\cdot i &< x
\end{aligned}$$

2.2 Scaling *(continued)*:

Assume, without loss of generality, that one $1M with:

```
   less than 5% price impact: then     $38M in liquidity is required
 less than 2.5% price impact: then     $78M in liquidity is required
   less than 1% price impact: then    $198M in liquidity is required
 less than 0.1% price impact: then   $1998M in liquidity is required
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Evidently, such a model would require unattainable levels of liquidity for the low price impacts desired. Furthermore, since the nature of the pools here are for trading yield, as opposed to tokens, (i.e. this is an exotic market), and since these pools will often need to be rotated with underlying yield rates changing and maturities coming to term, the problem of attracting sufficient liquidity for all supported assets becomes orders of magnitude more difficult.

Using our Temporal Orderbook mechanism, however, there is zero slippage (i.e. no price impacts). A user only need enough liquidity by the counterparty to match their order, and even if there isn't sufficient liquidity to fulfill the entire order, portions of the order may still be fulfilled. Finally, if liquidity lacks completely for a certain order, then there's no market interest in fulfilling that order. Since there's no price impact, regardless of the size of the order, this mechanism lends itself to infinite scalability.

2.3 Rolling Maturities:

ERC-20 Constant-Product AMM models will need a new pool for each term and maturity, thereby requiring more liquidity for each pool, making it completely unviable to have arbitrary maturities, especially where terms partially overlap. Using ERC-1155 and our Temporal Orderbook mechanism, there need only be enough liquidity from a counterparty to match a user's order. And since terms start upon order-execution, terms may have arbitrary start and end dates, allowing for rolling maturities impossible with the AMM model.

3. Pricing the Upfront Payout:

Typically, the upfront payout ought to be priced such that if the Issuer deposits his upfront payout into the underlying yield farm, he will not earn more than if he had deposited his principal into the underlying yield farm directly. Let *u* be the upfront payout, *U* be the maximum possible upfront payout.

$$u \leq U$$

Let r be the yield rate of the underlying farm.

$$\begin{aligned} U \cdot (1+r) &= r \\ U &= \frac{r}{1+r} \end{aligned}$$

This is the equation for the Present-Value of Money over one period.

3.1 Example:

If the yield rate of the underlying farm is 10%, the maximum upfront payout rate is:

$$\begin{aligned} U &= \frac{0.1}{1+0.1} \\ U &= 0.\overline{0909} \end{aligned}$$

4. Value Proposition:

Underwriters are able to earn boosted yield on the amount of principle they deploy. This can result in very large APRs. Let *b* be the boosted yield. The boosted yield over a term is calculated as follows:

$$b = \frac{r}{u} - 1$$

If *t* is the length of the term in years, then the APR for the underwriter is calculated as follows:

$$\begin{aligned} \texttt{APR} &= \frac{b}{t} \\ \texttt{APR} &= \frac{\frac{r}{u} - 1}{t} \\ \texttt{APR} &= \frac{r-u}{u \cdot t} \end{aligned}$$

4.1.1 Example

The APR of the underlying yield farm is 8% and the term length will be one week. The yield rate of the underlying yield farm over one week is:

$$\begin{aligned} r &= \frac{0.08}{52} \\ r &= 0.00\overline{153846} \\ r &\approx 0.15\% \end{aligned}$$

The present-value is:

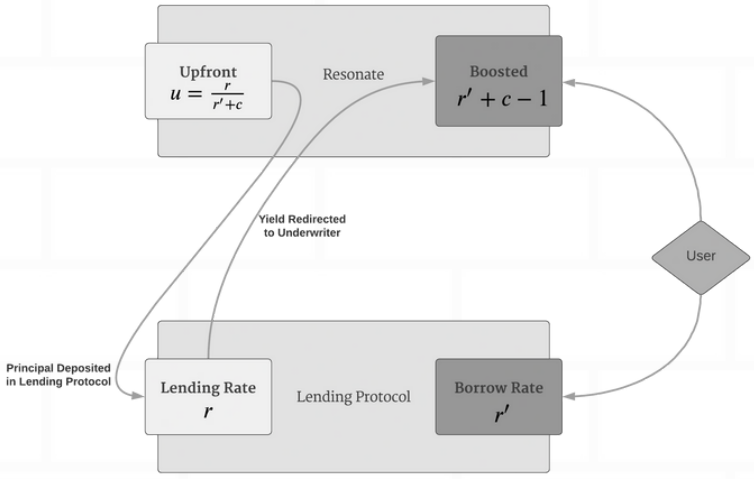
$$\begin{aligned} U &\approx \frac{0.0015}{1 + 0.0015} \\ U &\approx 0.149775\% \end{aligned}$$

We will set the upfront payout to 0.125%. The underwriter APR will be:

$$\begin{aligned} \texttt{APR} &= \frac{r - u}{u \cdot t} \\ \texttt{APR} &= \frac{\frac{0.08}{52} - 0.00125}{\frac{0.00125}{52}} \\ \texttt{APR} &= \frac{0.08 - 0.065}{0.00125} \\ \texttt{APR} &= \frac{0.015}{0.00125} \\ \texttt{APR} &= 12 \\ \texttt{APR} &= 1200\% \end{aligned}$$

4.1.2 Fixing Borrow Rates on AAVE:

The underwriter may enter a Resonate pool that is strongly correlated with the borrow rate, earning a boosted yield which, in effect, negates (or nearly-negates with little variance) the variable portion of the borrow rate. This may serve to achieve a fixed borrow rate. If r is the lending rate, r' is the borrow rate, $\rho(r,r')$ is close to 1, c is a constant:



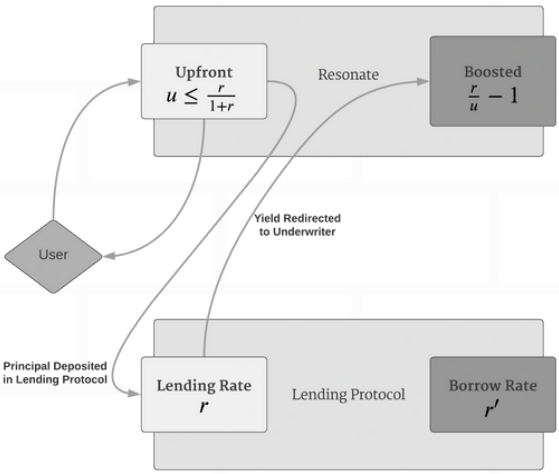
If ρ = 1, then the user pays a borrow rate of 1 − c, where $c \geq r - r' + 1$.
If ρ is close to 1, then the user will pay a borrow rate of $1 - c$, with the variable factor of the rate greatly reduced.

4.2. Issuers:

Issuers, by taking a portion of the yield upfront as a lump-sum payment, are able to put this yield to work in other ways, with various risk profiles, while their principal stays protected. Here we'll briefly describe a few strategies Issuers might make use of:

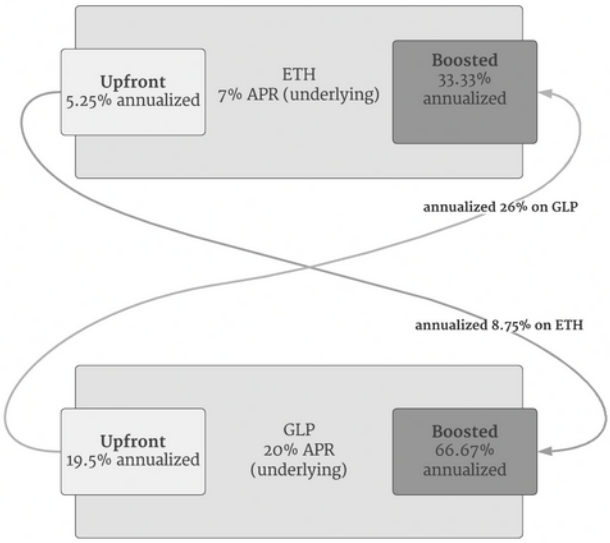
4.2.1 Fixing Lending Rates

Fixed lending rates can be very advantageous to prospective lenders. Issuers can deposit capital into Resonate which will then be deposited into a lending pool. In return, they will earn a fixed rate paid upfront.



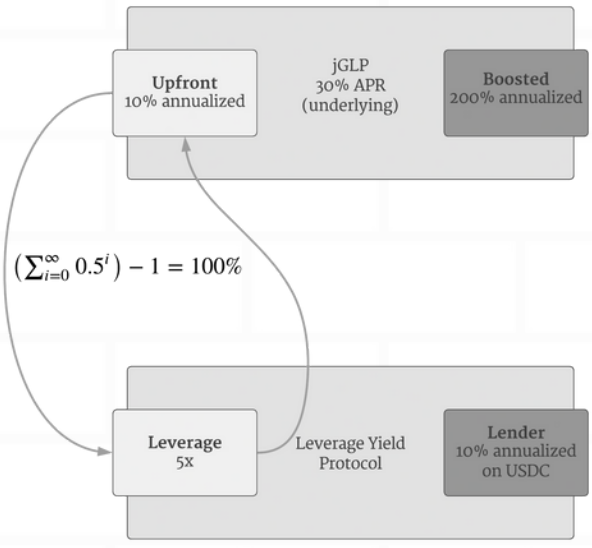
4.2.2 Reverse Rehypothecation:

Reverse Rehypothecation refers to the practice of taking out a loan to, then, use the borrowed assets to loan out to someone else. With respect to Resonate, this means depositing principal to take an upfront payout (underwrit by someone else), then using the upfront payout to underwrite the upfront yield on another pool to gain a boosted yield. This is useful when the user locks less volatile assets for an upfront payout, then rehypothecates by underwriting the yield on more volatile assets.



4.2.3 Leveraged Yield Rate Arbitrage:

Yield rate arbitrage is when a user borrows at one rate and farms those borrowed assets for a higher rate, keeping the difference for himself. Adding leverage to the equation allows the user to take greater advantage of arbitrages, however this also adds liquidation risk. If a Leveraged Yield Rate Arbitrage is performed with upfront payouts instead of principal, the principal stays protected and the user may be able to safely generate outsized returns on his principal; he only risks losing his yield. The user may even take upfront yield on the leveraged assets.



Appendix: Navigating Resonate

Terms:

Order: Refers to capital deposited on either the Issuer Side or Underwriter Side.
Issuer: Users who submit orders to receive upfront yield on their principal.
Underwriter: Users who submit orders to receive boosted yield by underwriting Issuers.
Consumer: Synonymous with Underwriter; the Consumer Queue refers to the queue of orders on the Underwriter Side of the Pool.
Producer: Synonymous with Issuer; the Producer Queue refers to the queue of orders on the Issuer Side of the Pool.
Pool: Synonymous with orderbook and refers to the combination of the Consumer Queue and Producer Queue, along with the rate at which Issuers will receive their Upfront Yield.
Available Capital: Refers to any queued unmatched capital that can be matched in the future.
Upfront Yield: Refers to the percentage of the Principal paid out immediately for locking the Principal for the Term.
Boosted Yield: Refers to the percentage earned by the Underwriter on their capital deployed by earning Yield on the Principal over the course of the Term.
Packet on the Issuer Side: Refers to the minimum amount of capital required to create an order on the Issuer Side. Analogously, a packet on the Underwriter Side refers to the minimum amount of capital required for an Underwriter to match 1 packet on the Issuer Side at the pool rate.
Packet Count: Refers to the number of packets within an order.
Packet Size: Refers to the minimum number of tokens required on the Issuer Side for an order. This is represented as 'S.'
Issuer Token: Refers to the token supported on the Issuer Side. The price of an Issuer Token is represented as 'pi.'
Underwriter Token: Refers to the token supported on the Underwriter Side. The price of an Underwriter Token is represented as 'pu.'
Pool Rate: Is the upfront percentage an Underwriter will pay an Issuer to purchase the Issuer's future yield. This is represented as 'r.'

Appendix: Navigating Resonate Key Functions

Resonate employs a Temporal Orderbook to match capital deposited by Issuers and Underwriters. The two primary functions responsible for matching and activating capital within these queues, as well as for enqueuing unmatched orders, are ‘submitConsumer’ and ‘submitProducer’. These functions can be found in ‘Resonate.sol’. Before diving into these functions in detail, refer to the key terms provided.

‘submitProducer’ Function

This function is responsible for submitting an Issuer's order and matching capital as required. When a user submits an order to receive upfront yield (referred to as 'I' hereafter), the **‘submitProducer’** function is called. The minimum required amount for an order on this side is 'S' Issuer Tokens. An Issuer must deposit 'n' times 'S' Issuer Tokens for any order.

1. Check for available capital on the Underwriter Side of the pool. If none is available, proceed to step 10.
2. Obtain the vault asset and adapter for the pool.
3. Examine the first order in the Consumer Queue (referred to as 'U').
4. Verify that 'U' is still active; if not, dequeue it and proceed to step 9.
5. Determine whether 'I' or 'U' has a smaller packet count.
6. Based on the previous step, calculate the amount of capital that needs to be activated (i.e., the smaller packet count). If 'U' = r·n·S·pi/pu, to fully match 'U', an order of 'n·S = (U/r)·(pu/pi)' Issuer Tokens are required.
7. Match 'I' with 'U' for the determined amount of capital.
8. If 'I' fully activates 'U' (i.e., 'I' has at least as many packets as 'U'), dequeue 'U'. Otherwise, update the remaining amount of capital in 'U'.
9. If 'I' is completely fulfilled (i.e., 'I' has at most as many packets as 'U') or if the Consumer Queue is entirely empty, move on to the next step. Otherwise, update the remaining amount of capital in 'I' and repeat steps 3 to 9.
10. Finally, if 'I' is not entirely fulfilled (i.e., there's no more capital in the Consumer Queue to match with it), enqueue the remaining amount into the Producer Queue.

Appendix: Navigating Resonate Key Functions

‘submitConsumer’ Function

This function is responsible for submitting an Underwriter's order and matching capital as required. When a user submits an order to purchase future yield (referred to as 'U'), the ‘**submitConsumer**’ function is called. This function operates very similarly to ‘**submitProducer**’ with minor differences. The minimum required amount for an order on this side is 'r·S·pi/pu' Underwriter Tokens. An Underwriter must deposit 'r·n·S·pi/pu' Underwriter Tokens for any order.

1. Check for available capital on the Issuer Side of the pool. If none is available, proceed to step 10.
2. Obtain the address of the smart pool wallet for this pool, where the assets deposited into the queue will be matched.
3. Examine the first order in the Producer Queue (referred to as 'I').
4. Verify that 'I' is still active; if not, dequeue it and proceed to step 9.
5. Determine whether 'I' or 'U' has a smaller packet count.
6. Based on the previous step, calculate the amount of capital that needs to be activated (i.e., the smaller packet count). If 'I' = 'n·S', to fully match 'I', an order of 'r·n·S·pi/pu' Underwriter Tokens is required.
7. Match 'I' with 'U' for the determined amount of capital.
8. If 'U' fully activates 'I' (i.e., 'U' has at least as many packets as 'I'), dequeue 'I'. Otherwise, update the remaining amount of capital in 'I'.
9. If 'U' is completely fulfilled (i.e., 'U' has at most as many packets as 'I') or if the Producer Queue is entirely empty, move on to the next step. Otherwise, update the remaining amount of capital in 'U' and repeat steps 3 to 9.
10. Finally, if 'U' is not entirely fulfilled (i.e., there's no more capital in the Producer Queue to match with it), enqueue the remaining amount into the Consumer Queue.

Appendix: Navigating Resonate Functions

Security Considerations

The capital deposited in both the Consumer Queue and the Producer Queue is stored in our in-house Counterfactual SmartWallet solution. This relies on the '**CREATE2**' opcode to deploy a contract where the capital is stored for interacting with (matching orders), and the '**SELFDESTRUCT**' opcode to destroy the contract afterward (**NB:** Thanks to an appeal to EVM core-devs, EIP-4758 (Deprecate SELFDESTRUCT) has been appended with EIP-6780 (SELFDESTRUCT only in same transaction) to prevent the "bricking" of Resonate's value storage solution). Consequently, there is no contract where the capital is stored, making it significantly more difficult to exploit. In effect, we've extended the SmartWallet system created for Revest to SmartPools for Resonate. Additionally, we've implemented reentrancy guards to ensure the safety of all capital.

Furthermore, we burn the first 1000 packets when a pool is created, creating "dead shares" to prevent MEV attacks. This exponentially increases the amount of capital needed by an attacker to successfully dilute the value of another user's deposit. This strategy was popularized by Uniswap V2.

Conclusion

For both types of orders (Issuer-side and Underwriter-side), Resonate will loop until all packets in that order are matched with capital on the other side or until there's no remaining capital on the other side. Consequently, there will never be capital on both sides of a pool at the same time, as expected. If there are already queued orders on the side an order is submitted, Resonate will not perform the loop and will simply enqueue the order behind the existing orders. Because there are orders already queued on the side the order is submitted, we can be sure that there are no orders queued on the other side. Resonate also employs first-in-class security measures to ensure that capital remains safe throughout.

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