

YIELDFUSION: A PROPOSED DN-404 STRUCTURED PRODUCT ARCHITECTURE

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Abstract. The DeFi space cannot properly mature until yield and risk opportunities are combined and simplified. To address this problem, Rome Blockchain Labs introduces a pioneering DeFi protocol, **YieldFusion**, that leverages the novel DN-404 standard, bridging the gap between the versatility of non-fungible tokens (NFTs) and the liquidity of fungible tokens (ERC-20), to create a suite of dynamic structured yield products. This whitepaper presents the architectural foundation for *yield fusing*, the combination of diverse yield-generating assets into ERC-721 and ERC-20 positions.

At its core, YieldFusion facilitates the creation of sophisticated yield strategies that cater to diverse trader needs, from risk-averse individuals seeking stable yields to speculative traders exploring high-yield opportunities. The DN-404 standard, a cornerstone of the **YieldFusion** protocol, enables the issuance of unique digital assets that represent ownership in distinct yield-generating strategies, each with its own risk profile and composition. In this whitepaper, we elucidate how YieldFusion is architected to create wholly novel and bespoke DeFi products.

1. Preface

Meaningful exploration and analysis of 404-series tokens in the Decentralized Finance (DeFi) space have been limited thus far. This whitepaper is a technical summary of one of the possible applications of DN-404 tokens: tranching, on-chain structured products. Given the nascent stage of 404-series tokens, this whitepaper will not review all details of 404s, such as complex architectures, dissimilarities between other 404-series architectures, etc., having assumed that the reader is moderately familiar with the overall concept. Instead, this paper will provide a foundational description for creating composable structured products, project name YieldFusion.

2. Introduction

The derivatives sector within DeFi presents a significant opportunity for value capture across a diverse set of primitives and emergent protocol types. The recent expansion of real-world assets (RWAs), liquid staking (LST) and restaking (LRT), and on-chain perpetual protocols is also evidence of the tidal wave of yield-driven market acceleration. A core problem of both markets is the complexity inherent in managing numerous positions across a diverse product set. Portfolio risks, such as liquidations, de-pegging, and undercollateralization, exist for all DeFi users and are difficult to effectively hedge against without simultaneously utilizing complex combinations of equities, contracts, and robust monitoring services.

Structured products solve this dilemma by combining a diverse set of financial assets (or a single type of asset) into a singular product and normalizing the payout along standard terms. Most structured products also cover downside risk with derivatives (E.g., options contracts) thereby providing a more refined and stable access to inherently volatile DeFi markets. Examples of structured products include equity-linked notes, accumulators, principal-protected notes, and bespoke synthetics.

YieldFusion is a novel structured products platform that facilitates the creation and dissemination of any type of structured product. YieldFusion accomplishes this by minting unique

404-series tokens per product, creating a primary market for these types of financial vehicles. A secondary market for any structured product can exist since the ERC-20 side of 404-series tokens can be used in V2 & V3 AMMs, CLOBs, or OTC markets. YieldFusion structured products can be issued as single-tranche vehicles where all buyers share similar risk and return profiles or multi-tranche products where one class of buyers (senior tranche) holds a lower risk, lower return position, and the other class of buyers (junior tranche) hold a higher risk, higher return position. We term this novel process of structured product creation, minting, and tranching “yield fusing” due to the multifaceted opportunities present with the countless yield-bearing instruments operating in the DeFi ecosystem today. To understand the *yield fusing* concept, let’s first look at one example of how a traditional structured product functions.

The Principal-Protected Note

A PPN that is tracking the S&P 500 may offer 100% principal protection at 3-year maturity in exchange for a participation rate of 80% and a cap of 50%. In other words, if the value of the index rises by 30% after 3 years, the buyer receives 24% and their initial deposit. If the index falls by 20% after 3 years, the buyer is returned their full deposit because the note is “principal-protected.” If the S&P 500 increases by 70% after 3 years, the buyer receives a maximum of 50% of the return due to the cap. The risks of this asset include the capacity to liquidate on the open market and downside protection during the product’s lifecycle. These are often offset through the purchase of bonds that are expected to mature to the principal protected price by the end of the products term, the utilization of call options to increase upside potential, and various hedging strategies.

This form of structured product is only one example of the numerous types that are possible.

The ERC-404 token structure, as developed by Pandora Labs as an experimental fusion of ERC-20 tokens and ERC-721 tokens, can be utilized to create *token-based, tranching structured products*.¹ This dual token architecture allows for capital to be allocated to a structured product via a sale of the corresponding ERC-20 or ERC-721 tokens, beneficial rights of a specific product to be assigned (via the ERC-721), and yield to be distributed accordingly based on the % or quantity of tokens held by a wallet or protocol. Fractionalized ownership of structured products solves numerous challenges plaguing the financial space, such as high barriers to entry for traditional financial products, limited transparency, and supports the creation of a near-limitless quantity of DeFi-specific assets merging RWAs, LSTs, derivatives, LP tokens, cTokens, vaulting system, yield tokens and more. The capacity for tranching via the ERC-721 tokens means that singular structured products can be pieced out according to risk level or expected yield. It also means they can gain beneficial rights and protections to adapt more closely to the buyers’ risk tolerance within a product. Before we explore the proposed YieldFusion platform’s basics, we shall provide a brief, high-level overview of the 404 token structure.

¹ <https://pandoralabs.mintlify.app/introduction>

3. The 404 Standard: A Brief Introduction

As distinct assets, ERC-721s and ERC-20s both face unique challenges. For the former, the non-fungible nature of the tokens necessarily results in low liquidity markets as purchases must be of whole, individual assets. ERC-20s face challenges such as limitations around uniqueness, out-of-the-box utility, and more. Together, they can offer complementary value and reciprocally address their shortcomings. Enter ERC-404.²

ERC-404 allows a minter to create an NFT with fractionalization capabilities such that a certain number of ERC-20s are associated with that individual or collection of NFTs. Ownership, redemption rights, and several other factors can be assigned in conjunction with the proper smart contract framework to create a highly customizable token offering.

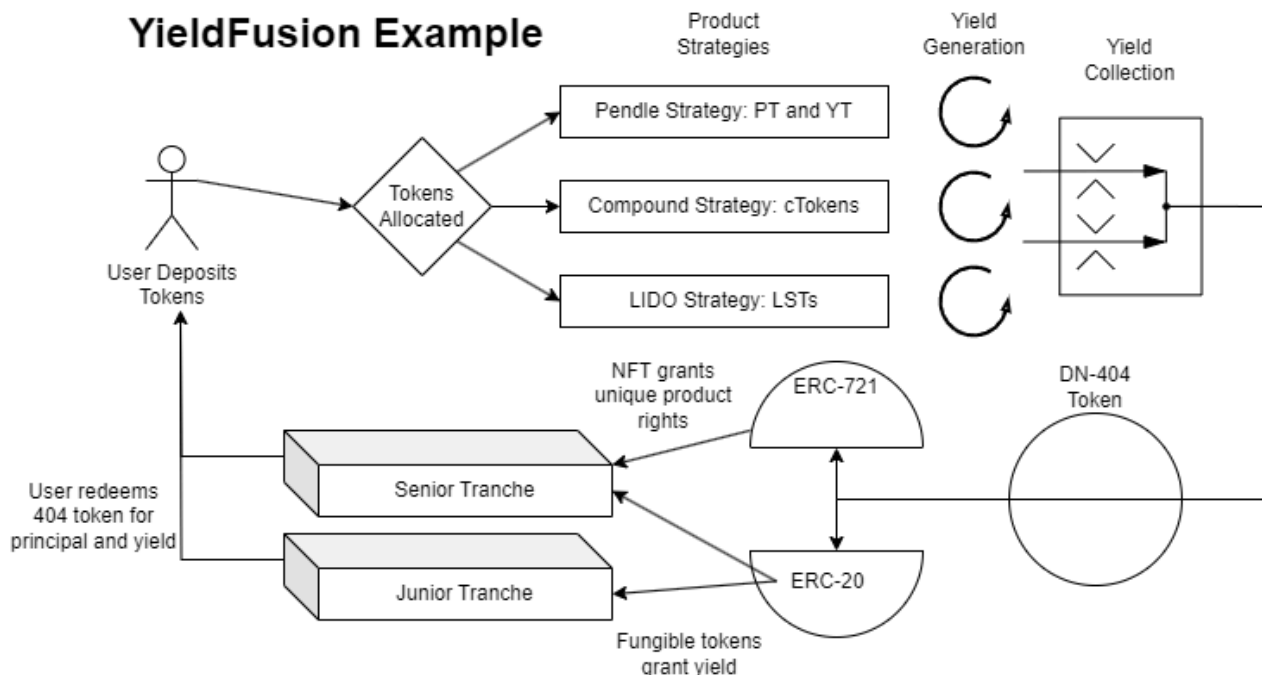
Within the DeFi ecosystem, the innovation behind 404 tokens lies in its ability to bridge the gap between unique ownership and identification associated with NFTs and the highly fluid ERC-20 markets. YieldFusion leverages DN-404s, an iteration of ERC-404s, to democratize access to structured products such that a limited number of NFTs can be minted to represent preferential ownership in a specific product. This preferential ownership may grant access to higher quality tranches within the product, early access to future structured product launches, or any number of incentives, such as access to exclusive communities. For traders not interested in high-dollar, preferential positions, they may instead purchase a limited number of ERC-20 tokens minted for that same structured product. These tranches take on the risk that the senior tranches avoid and are compensated with the potential for higher returns. Due to the fractional nature of the 404 token, tranches can be even a few dollars, removing the barrier to entry for this type of financial vehicle. Both NFT and ERC-20 holders participate in the same product, but the dual nature of DN-404s allows for a novel hybrid structure that can be adapted and adjusted over time. Some structured products may be mostly NFTs with little ERC-20 tokens associated with them, while others might be primarily ERC-20s with a handful of NFTs created. The ratio and distribution are only limited to market interest and digit limitations of the contract itself.

4. Overview of YieldFusion Protocol

YieldFusion (YF) is a yield-based structured product system leveraging the DN-404 token architecture. Numerous types of structured products can exist, with the following example being only one of a set of products that can be created using DN-404s. Please review section 2, paragraph 1 of this whitepaper for a longer list.

An example proposed product on YF is classified as a PolyYield Multi-Strategy Fusion, or simply PolyFusion. Let's look at the below diagram to understand the concept better. In this example, Bob is interested in securing a stable, low-risk return for his ETH. Rather than manage multiple positions simultaneously or rely on just one protocol, he purchases part of a PolyFusion, which begins automatically managing his assets across several DeFi systems. The PolyFusion will be a "token-protected note" such that Bob will receive, at minimum, the same number of tokens he

² <https://github.com/Pandora-Labs-Org/erc404/tree/main>



initially deposited. A token-protected note can be differentiated from a principal-protected note, where the *dollar value* of the deposit is returned at the end of the product cycle. Both types of notes will be possible on YieldFusion. This PolyFusion product will distribute his ETH across Pendle PTs and YTs, Compound leveraged strategies, and LIDO stETH for a set term. Bob's tokens are placed in the highest-yield positions and compound over the term of the product. The positions are monitored with the structured products token ratios distributed to the highest yield throughout the fusion's term.

At the conclusion of the pre-determined period, the yield and principal are collected and attributed to depositors based on their holding of the fusion's tokens. If we assume that Bob purchased a senior tranche (NFT + ERC-20), he might have received full principal protection on his positions such that, even if the Compound strategy were liquidated, he would still receive his initial deposit. Ownership of this NFT may also give him early access to experimental new fusions or first rights to NFTs in the subsequent product issuance. In the other case, if he purchased the junior tranche (ERC-20 only), Bob might receive a boosted yield taken from the senior tranche's portfolio. This layering of risk and return now. In either case, Bob now has access to algorithmically managed structured products with minimal barriers to entry (ERC-20) and preferential features (ERC-721).

YF can tranche yield fusions using the DN-404's base unit function. This part of the token contracts defines a correlative relationship between the number of ERC-20 tokens a wallet possesses and the minting of a specific number of NFTs. Thanks to this code snippet, this relationship does not need to be 1:1.

```

/// @dev Amount of token balance that is equal to one NFT.
function _unit() internal view virtual returns (uint256) {
    return 10 ** 18;
}

```

In the above example, one ERC-20 mints one NFT. So if Bob purchases 10,000 of the 100,000 DN-404s for the PolyFusion product, he would receive 10,000 ERC-20s and NFTs. Let's change the value and see what happens.

```
/// @dev Amount of token balance that is equal to one NFT.
function _unit() internal view virtual returns (uint256) {
    return 2000 * 10 ** 18;
}
```

In this new code snippet, we've set the `_unit()` function to return 2000, meaning one NFT will be minted when the wallet mints 2000 ERC-20s. This is incremental up to the maximum deposit allowed by the PolyFusion contract. By doing this, we can enable the YieldFusion token contract to differentiate between those who purchased a limited portion of ERC-20 tokens (representing rights to the yield fusion's yield) and those who bought the ERC-721 (rights to preferential tranches or distributions). We will look at an example to understand how this translates to yield fusing itself.

PolyYield Multi-Strategy Fusion (PolyFusion)

1. **Underlying Assets:** Diversified portfolio including:
 - a. Pendle's Yield Tokens (YT) and Ownership Tokens (OT)
 - b. Compound's interest-earning cTokens (e.g., cETH, cDAI)
 - c. Lido's staked Ether (stETH)
2. **Term:** 1 month (with options for early exit subject to terms or penalties)
3. **Minimum Investment:** \$500 equivalent in ETH, ARB, or stablecoins
4. **Principal Protection:** 100% of principal amount at maturity
5. **Participation Rate:** 95% of the positive performance of the underlying DeFi strategies
6. **Cap:** Maximum return capped at 40% over the term, balancing potential high returns with risk management
7. **Interest Payments:** Yield is compounded and paid at maturity
8. **Maturity Date:** August 1st, 2024 (3 months)
9. **Secondary Market:** YieldFusion ERC-20 and ERC-721 tokens are tradeable on select DEXes, offering varying degrees of liquidity depending on market demand and strategy performance
10. **Yield Bonus for NFT Holders:** Holders of YieldFusion's ERC-721 NFTs are entitled to a 75% share of any yield generated above the vault's expected rate.

The PolyFusion product aggregates yield-bearing assets from several different sources, as shared in point one. The term will generate yield for one month with an early withdrawal penalty, a minimum deposit of \$500, and protection of 100% of the deposit minimum. Across the total PolyFusion product, 95% of the yield will be distributed to the depositors, with 5% going to the protocol for reserves, future fusions, etc. The maximum return on this yield fusion is 40% of the deposited value, with NFT holders gaining access to anything above that rate (see point 10).

Disbursement is set after one month on August 1st, with full composability on secondary markets. By holding the NFT, Bob gets access to the yield fusion itself and the bonus access to interest generated above the cap. As different fusions are created, NFT holders might gain even better bonuses for higher-risk products. The core differentiator for these fusions will be decreased principal protection and higher-risk products using leverage or on-chain derivatives.

Yield fusing differs from yield farming in that the position is distributed across numerous protocols and risk-adjusted for returns. YieldFusion products can also incorporate derivatives to protect the downside when leverage or risk strategies are employed. It differs from vaulting and other structured products in that positions are not uniformly aggregated, are highly flexible, and can be internally distributed to produce variable risk tranches. The DN-404 standard enables YieldFusion to offer both fungible and non-fungible tokens, marrying the benefits of liquidity and unique asset ownership. This dual nature allows for innovative DeFi products, such as fractional ownership in high-value DeFi strategies and customizable yield-generation opportunities.

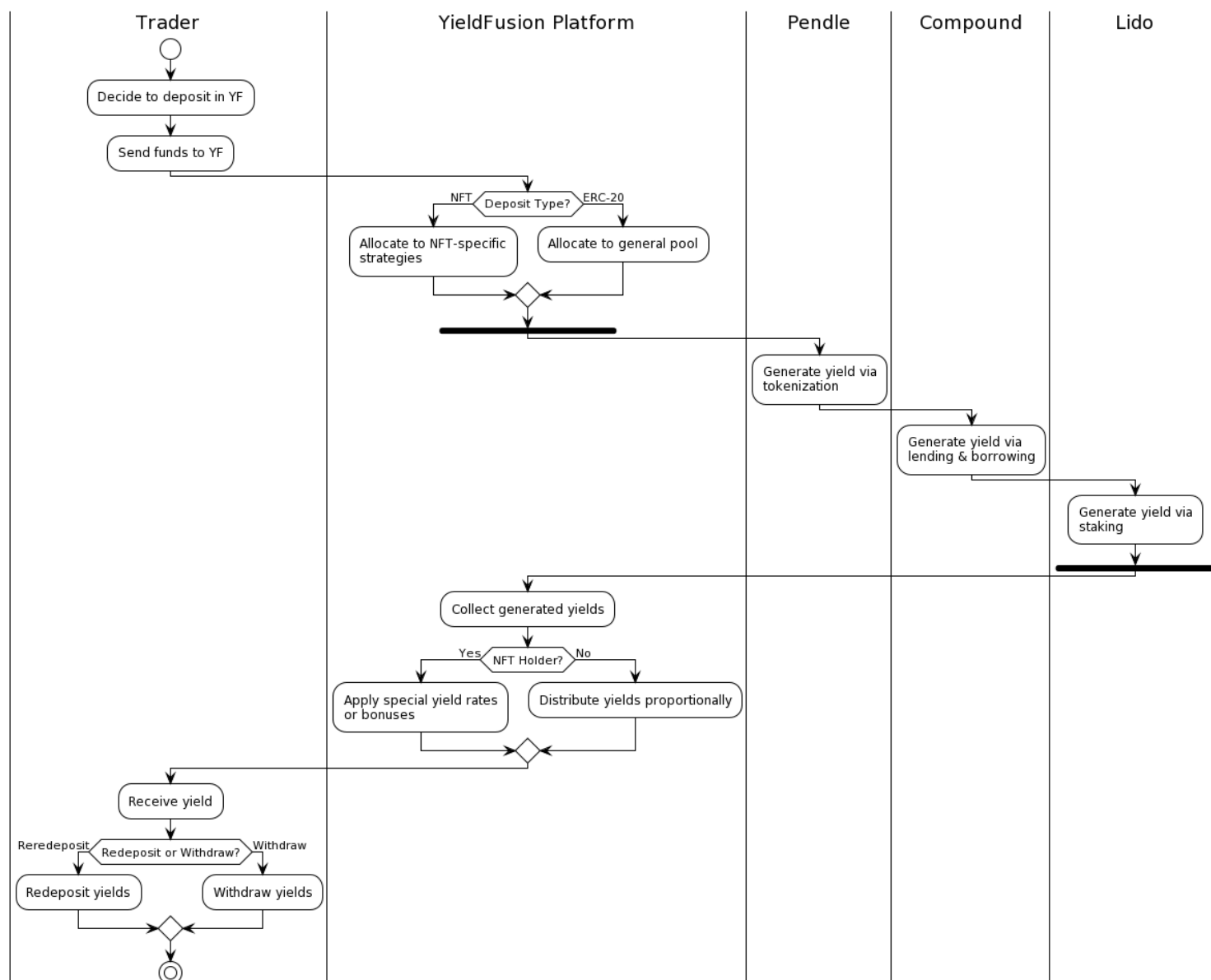
5. Yield Fusion Composition

For a deeper understanding of yield fusion architecture, we will examine an activity diagram of the PolyFusion product's yield management process. This process integrates several complex systems, beginning with the NFT-specific strategy. For example, the preferred NFT strategy can be structured around a priority yield distribution approach where yield is first allocated to NFT holders to the target amount, and the remaining yield is attributed to the ERC-20 token holders. Another option includes using leverage for NFT holders' deposits versus simple yield loop strategies for ERC-20 token depositors. A third option has performance-based rewards where performance that exceeds the fusions target is first distributed to the NFT holders.

Once one of these strategies is decided upon, the fusion deposits are allocated to the integrated protocols in a manner that balances yield with risk, such as 30% Pendle, 30% Compound, and 40% Lido. The system rebalances these deposits to maximize return and aggregate risk per pool. At the end of the fusion term, the positions are unwound, and the initial tokens plus yield are returned to YF. The yield division is calculated based on the yield fusion strategy and DN-404 token holdings and returned to the user for withdrawal or redepositing for the next product iteration. In the event of a loss for such reasons as liquidation, protocol exploitation, or otherwise, the principal will be re-disbursed according to the terms of the yield fusion. This could be another opportunity for NFT holders to receive preferential positioning.

Such an active system will require continuous monitoring, with risks and limitations being discussed in the following section. It is essential to understand that the PolyFusion product is just one example of the dozens of types of products that can be created on YieldFusion. Systems for arbitrage, spot trading, leverage, options, perps, futures, or any other DeFi system can be integrated into the DN-404 standard and deliver any type of structured return over time. Alternative payout, yield, and ownership standards can also be included in novel yield fusions. The nature of DN-404 tokens also allows for a new class of *perpetual structured products*, but such a vehicle is beyond the scope of this paper.

Yield Fusing and Yield Generation Process



6. Risk and Market Observations on Yield Fusions

Several technical challenges emerge when assessing yield fusion operations. The first is the computational demand associated with active risk management and asset allocation on various DeFi protocols. Depending upon the fusion's rebalancing frequency, gas costs to shift liquidity or check market prices via on-chain oracles could become expensive. One solution would be to leverage L2s or low-gas-cost blockchains and shift computationally demanding functions off-chain. Existential risks exist around the security of the underlying protocols, meaning audited, well-established platforms would be ideal foundational projects. Market fluctuations for speculative-based fusions would also be an important aspect to manage. Flashloan attacks targeting specific liquidity pools may disrupt the

stability of an asset. This can be offset through regular analysis and monitoring of target pools and selecting the right sources of truth.

Monitoring the financial risk of each yield fusion can be initiated by leveraging a handful of well-known mathematical models. Some of the key equations include Value at Risk

$$1.1 \text{ VaR} = P \times Z \times \sigma,$$

which measures the level of risk within a position over a set time frame. Another equation for observing risk is the Monte Carlo simulation

$$1.2 \text{ E.}[P] = \frac{1}{n} \sum_{i=1}^n P_i$$

Both of these formulas, and more, are leveraged by leading risk management firms such as CHAOS Labs, Gauntlet, and LedgerWorks. Several additional equations exist for managing specific aspects of YieldFusion products, such as the Black-Scholes model for pricing options and copulas for co-variant risk measurement, but such equations will be reserved for another class of whitepaper.

7. Future Applications of DN-404 Architecture for Structured Products

The DN-404 architecture opens the door for a host of future products, as alluded to throughout this paper. The first class of future yield fusions would be speculative-driven products employing some form of spot trading to drive higher returns for the product with higher risk. The second class of fusions would incorporate leverage and more complex financial systems such as options, perpetual, futures, and collateralized borrowing. Together with yield-based products, these can create a perpetual structured product portfolio that offers indefinite returns and continuous participation for as long as that yield fusion is being supported.

Various other product terms can be introduced as well, including pre-programmed yield payments where the product disburses interest at set periods or upon reaching pre-set ceilings. Such a term would be very applicable to perpetual structured products. High-value tranching is another area of yield fusing that will doubtlessly drive interested analysis. As the 404 standard evolves across the blockchain space, the ability to mint discrete classes of tranches (senior vs. junior, A, AA, etc.) will aid in risk management for all parties. Traditional institutions interested in entering DeFi markets can leverage YieldFusion to test the waters with managed products that meet their risk and return goals in a variety of DeFi market segments.

8. Conclusion

Beginning with the creation of the joint ERC-20 and NFT-721 standard, Pandora Labs has opened a proverbial Pandora's box of opportunities with their ERC-404 architecture. Having been iterated upon, the DN-404 token structure, led by Ethereum developers @optimizoor @0xCygaar @0xjustadev @0xQuit @AmadiMichaels, allows for creating more complex DeFi assets, including

multi-protocol, multi-token, tranching structured products.³ YieldFusion is the first-of-its-kind, 404-based DeFi structured products platform. Through the programmable minting of ERC-20 tokens and NFTs, YieldFusion will allow for creating and participating in novel yield fusions, blending diverse DeFi yield opportunities with continuous monitoring to normalize market yields. These yield fusion products will offer set terms, caps, or other parameters appropriate to their architecture.

The DN-404 token structure opens these products to buyers by creating ERC-20 tokens at the deposition of assets such as ETH, ARB, or Stablecoins. Each minted ERC-20 represents the rights to a certain percentage of the product's yield. Users who deposit over a certain amount will also receive an NFT giving preferential access to additional yield, experimental new yield fusions, and more. In future iterations, these NFTs can be used to tranch segments of structured products by risk, asset breakdown, or any other meaningful measurement. Yield fusions will be managed either on-chain through algorithmic rebalancing contracts or via off-chain calculations leveraging blockchain market data and/or oracle feeds. At the end of the term, principal, and yield are redistributed to the ERC20 holders. Given the composability of DN-404 assets, markets can be made for both the yield-generating ERC-20 and ERC-721 assets.

Significant opportunity exists to iterate upon this new architecture to create novel yield fusion implementations using speculation and derivatives. The emerging RWA market also means that crypto-assets can be seamlessly combined with any real-world product. Brought together, an entirely new class of DeFi derivatives, perpetual structured products can theoretically be created, benefiting from all of the above-mentioned innovations. YieldFusion represents an exciting new step in the DeFi space and is doubtlessly only one example of the broadscale creative potential that is leverageable by developers of 404-series tokens.

³ X (formerly Twitter) handles