

NODES NFT

Project White Paper

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Abstract – Nodes is a mirrored on-chain, interactive, generative art experience. Aside from the art itself, users will be able to use a unique breeding mechanic, called "fusing," that involves a "trait token" system. Your piece will generate a set amount of non-tradable trait "tokens" that can be spent to influence the outcome of a secondary piece or "fused piece". This essentially allows you to customize (with limitations) your art in your own way to achieve an outcome that either you desire, is deemed rare or unique, or to just have fun with seeing what you can come up with.

Keywords – On-Chain, Generative Art, Graph Theory

I. PROJECT OUTLINE

Nodes is a mirrored on-chain, interactive, generative art experience. Aside from the art itself, users will be able to use a unique breeding mechanic, called "fusing," that involves a "trait token" system. Your piece will generate a set amount of non-tradable trait "tokens" that can be spent to influence the outcome of a secondary piece or "fused piece". This essentially allows you to customize (with limitations) your art in your own way to achieve an outcome that either you desire, is deemed rare or unique, or to just have fun with seeing what you can come up with.

A. Goals

Our goal is to provide a unique art experience for people who love generative art, and are interested in furthering innovation and education in on-chain NFTs. Our project is experimental, focused on pushing boundaries, and innovation in the space. We hope other projects use our concepts and tech, and take it even further.

II. SYSTEM ECONOMICS

Nodes supports a maximum supply of 1024 Genesis Nodes, and a 2048 Fused Nodes for a grand total of 3072 Nodes. 1,000 Genesis Nodes will be offered to the community, while 24 will be reserved from the project creators. None will be held in additional reserve. The 2048 Fused nodes will be a race condition and will not offer protections to control supply of any individual users. Once the fuse cap is hit, additional fusions can still occur, but only as described in the Fusing Mechanics section of this document.

A. Minting Phases

1) *Mint List*: Protected mint enforced by Merkle root. Each minter will be allowed to mint a maximum of 2 Genesis NODES, though they may choose to only mint 1.

2) *Public mint*: In the event that all mint list spots do not mint, an opportunity to mint the remaining supply will be offered by raffle and additionally protected by a Merkle root.

B. Pricing

Nodes will be priced at 0.05 ETH per node, for a maximum of 0.1 ETH per minter (not including gas fees). These funds will be used to reward the creators for their hard work as well as pay for the long term costs of the project as described in the Project Lifecycle section.

Fusing will not carry an additional cost over the gas fees needed to perform the transaction. Server costs for this activity are covered by funds as described above and below in the Project Lifecycle section.

All Node transactions carry no royalties on Transfer.

III. MINT MECHANICS

Each mint list role, either through initial mint or public mint can mint up to a maximum of 2 Genesis Nodes. You may choose to mint 2 in a batch or 1 and then 1 later on (provided mint window hasn't expired), though the batch will optimize for gas.

All Nodes will be instant revealed - caveating this with server image generation time which may delay the creation of your preview image by as much as 50 minutes. All animated artwork and traits will be available from contract instantly on mint.

IV. TRAIT GENERATION

Nodes uses the concept on an animation system which is governed by a limited set of traits. Each Node contains two separate animation systems to provide visual interest and the ability to mix system traits during fusing.

Nodes has the following traits for any given piece:

1) *Burned*: Indicates if the piece has been sacrificed in Fusing. Pieces sent to your favorite burn wallet will not gain this trait.

2) *Fused*: Indicates if the piece is a fused or genesis piece.

3) *Color*: The color palette of the piece.

4) *Connectivity*: The connectivity of the piece represented by a pair of values N and R where N is the maximum number of nodes on the canvas and R is the distance maximum distance at which any two nodes will form an edge.

5) *Node Size*: The node size is simply the size of any given node in the graph.

6) *Symmetry*: The Symmetry describes the overall direction in which nodes will animate across a canvas.

7) *Node Type*: The Node Type describes the math functions used to animate the nodes.

8) *System 2 Connectivity*: Same as above but for the secondary animation system on the node.

9) *System 2 Node Size*: Same as above but for the secondary animation system on the node.

10) *System 2 Symmetry*: Same as above but for the secondary animation system on the node.

11) *System 2 Node Type*: Same as above but for the secondary animation system on the node.

A. Drawing Traits

For Genesis Nodes both animation systems will have their traits set to the same value. For example in a genesis nodes, Node Size and System 2 Nodes size will have the same value. There is no such requirement for fused pieces - allowing users to mix various traits between systems.

Each trait is generated by querying a “rarity tree” with a random number. The “rarity tree” contains all traits and the rarity of each. Depending on the value of the random number generated, a different trait is chosen.

Each trait is drawn independently of the others, so all possible combinations of traits is achievable though in practice this will not occur due their being many thousand more possibilities than 1024. In the case of Nodes for each trait, a random number between 0 and 10000 exclusive is drawn to determine the outcome of that trait.

No duplicate Nodes are allowed during genesis mint. Duplicate Nodes are allowed for fused pieces.

Fused pieces will be visually identifiable not only by their unique traits, but additionally by the presence of an image border. Burned pieces sacrificed during fusing will have their art replaced by a placeholder image containing the fire emoji.

V. ANONYMICE TRAIT HASHING

Nodes uses an extended version of trait hashing demonstrated by Anonymice. This system relies on a String of number representing each trait. Consider a simple example NFT of a Doughnut where we have 3 traits: Icing type, sprinkles and dough type. If each trait has less than ten values you might represent the traits for a dough like this:

451

Where 4 is the trait value for Icing type, 5 the trait value for sprinkles and 1 the trait value for dough type. Or in the event that there were more than 10 icing types we might pad the first trait with another 0, now offering up to 100 different icing types like this:

0451

This mechanic allows us to easily handle fusing between Nodes by way of simple substring magic.

VI. FUSING MECHANICS

Combining Genesis or Fused pieces to create a new Fused piece is referred to as “fusing.” Fusing allows you pass forward traits from existing Nodes or specifically select (with limitations) the traits of the newly generated piece.

When two Nodes are fused the user is expected to provide a “Phenotype” which describes the traits of the newly generated piece. The phenotype will be automatically generated for you by the fusing UI but high level details of what it provides are as follows:

- A Node’s phenotype can include traits from either of the input pieces to the fuse transaction.
- A Node’s phenotype can set the value of traits in the output piece to whatever the user desires, in exchange for trait “tokens.”

When fusing, the user will be shown a list of all traits on the input pieces and may select traits for their new output piece. However, on some traits, the user will also be offered the option to “customize” their node and to select the value for that trait manually. The user will be shown the cost of picking that trait and can evaluate if they want execute or not.

A. Fusing Eligibility And Burning

Pieces generated by “Fusing” will always result in a “Fused” node regardless of its inputs: Genesis, Fused or a combination of the two.

All pieces are able to fuse, genesis+genesis, genesis+fused, and fused+fused. All genesis pieces will enter a fusing cool down after participating in a Fuse. When pieces are sold / traded (any call that results in a Transfer event), the fusing cooldown restarts and will have to wait the FULL duration of the cooldown before being able to fuse again.

Fused pieces will be always burnt during fusing, Genesis will not. The following scenarios detail some possible fusing scenarios and describe the inputs and outputs to the fusing transaction:

TABLE I
Fusing Scenarios

Scenario		
Input	Result After Fuse	Effect On Supply
Genesis + Genesis	Genesis + Genesis + New Fused	+1 to supply
Genesis + Fused	Genesis + New Fused	+0 to supply
Fused + Fused	New Fused	-1 to supply

B. Trait “Tokens”

Trait tokens will be earned by ALL pieces (both genesis and fused). They are NOT trade-able, they are tied to a specific piece. Trait “Tokens” are not ERC-20 and are modeled as simple counters on the contract.

You will have access to the ENTIRE pool of traits for Node Size, Connectivity, and Node type via spending trait tokens.

Earning Trait “Tokens” does not require staking and will be earned passively. Each Node’s token balance will be set to 0

when Transferred.

Trait tokens will be earned at a rate of 1 per day per piece. Spending trait tokens works as follows - given two pieces that are held by the same owner:

- Preference one of the two pieces from which tokens should be spent.
- If the balance of this piece meets the minimum needed to perform the fuse operation the transaction will succeed.
- If the balance does not meet the minimum needed to perform the fuse operation then the remaining balance will “roll-over” and be consumed from the second piece in the transaction.
- If the combined balance between both input tokens does not meet the required cost then the transaction will revert (fail).

C. Fusing Costs and Selecting Traits

Nodes fusing system allows users to pass traits from the input forward into their output fused pieces. Some traits can additionally be set by spending trait tokens.

Every Node has TWO distinct systems of animation you can set traits for both system 1 and system 2 independently. All Genesis pieces have both system 1 and system 2 traits set to the same values, Fused pieces have no such requirement. The following traits must be selected from the 2 pieces that are fusing:

- Palette
- Symmetry

Fusing costs a base of 2 trait tokens + gas fees. The Cost of setting one trait in a single system is as follows:

TABLE II
Trait "Token" Cost and Applicability

Costs shown in trait "tokens"		
	Cost	Customizable
Base Fuse	2	No
Color	0	No
Connectivity	3	Yes
Node Size	4	Yes
Symmetry	0	No
Node Type	5	Yes

The HIGHEST cost for fusing is a total of 26 tokens:

- 2 to fuse
- 3 per system of N,R = 6
- 4 per system of node size = 8
- 5 per system of node type = 10

VII. RESIZING AND FRAME CAPTURE

In addition to to fusing, Nodes will additionally provide functions to resize your artwork either ephemerally (to take screen captures or what have you) or permanently via contract for use cases such as display on a token frame. By default all Nodes will be 500x500 but can be expanded to an arbitrarily large or small resolution. All Nodes will be reset to their default size on Transfer.

Nodes will have a method for frame capture so that users can create animated media from them as they choose. This will be a frame dump and any further encoding will be managed by the user.

VIII. PROJECT LIFE CYCLE

Nodes will be actively supported for 3 years from mint date. We plan to pay for all server costs from 3 ETH held in reserve from mint fees. After 3 years the project may continue to receive support, but may be retired at this stage. Retirement of the project includes shutting down the servers actively generating media for newly fused Nodes although all existing features will continue to work with no problems.

Upon retirement, all existing and new artwork will continue to live on, on the Ethereum blockchain. However support for preview images of newly fused nodes will cease to exist. All existing Nodes will have their preview images transferred to IPFS for long term storage and to ensure that all pieces will continue to have preview images on marketplaces like OpenSea until the heat death of the universe (or OpenSea whichever comes first).

Upon retirement, the RenounceOwnership function of the contract will be called terminating all future calls to OwnerOnly function on the contract, permanently locking the state of the contract.

IX. APPENDIX

A. FAQ and Notes on Fusing

Q: Can a piece be duplicated?

A: Yes, a piece can be duplicated (but it will have a border like all fused pieces). If the owner of a genesis piece WANTS to duplicate their piece, they can do so. Theoretically, others can duplicate your piece too if they save up enough tokens. We think this can add some cool market elements such as “commissioning” your genesis piece. Genesis pieces will never be directly duplicated via minting or fusing.

Q: How will I know the difference between Genesis pieces and Fused pieces?

A: Fused pieces will have an identifying feature: a border. We think some may like the aesthetic of fused pieces over genesis pieces.

Q: How do Genesis pieces hold value over Fused Pieces

A: Genesis pieces are able to use the fusing feature for eternity. Not only that, they are the OG pieces that the code output, which in itself is interesting as well.

Q: How do rarities work?

A: Rarities are an interesting concept in our project. While there will be “traditional rarities” ultimately, it is probable that the rarest pieces will be achieved through fusing. Someone may find a combination that is unique, and that may become the rarest since no other is like it. We think that rarity is something that shouldn’t be focused on in terms of art and beauty is, of course, in the eye of the holder.

B. Fun Notes

- Fused pieces will have more available combinations than genesis pieces. This is by design. We want this feature to be as fun as possible.

- Holding 2 pieces for 13 days will allow you to achieve any node you want within the set parameters.
- Our system rewards both holding, and trading.
- If the supply cap for fused pieces is reached, you may “free up space” by using a fused piece to fuse, or buy buying a fused piece and using it to fuse.

As always, thanks for being here and happy fusing!
- MS-DDOS and HOOX