



Decentralized music distribution using InterPlanetary File Systems (IPFS) on the blockchain.

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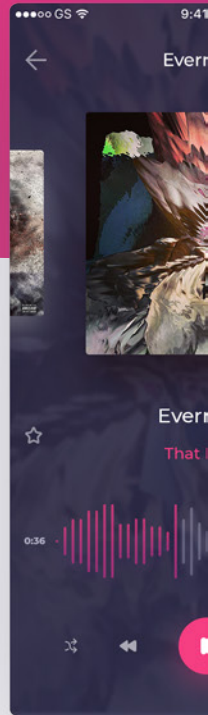
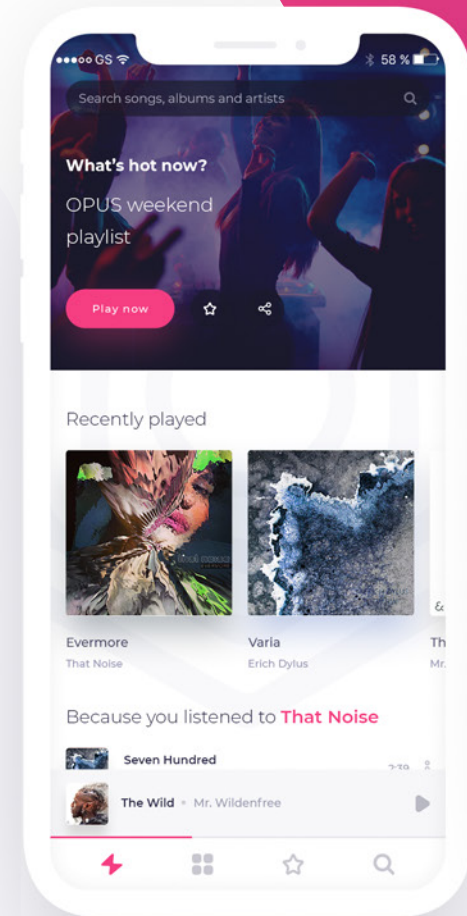
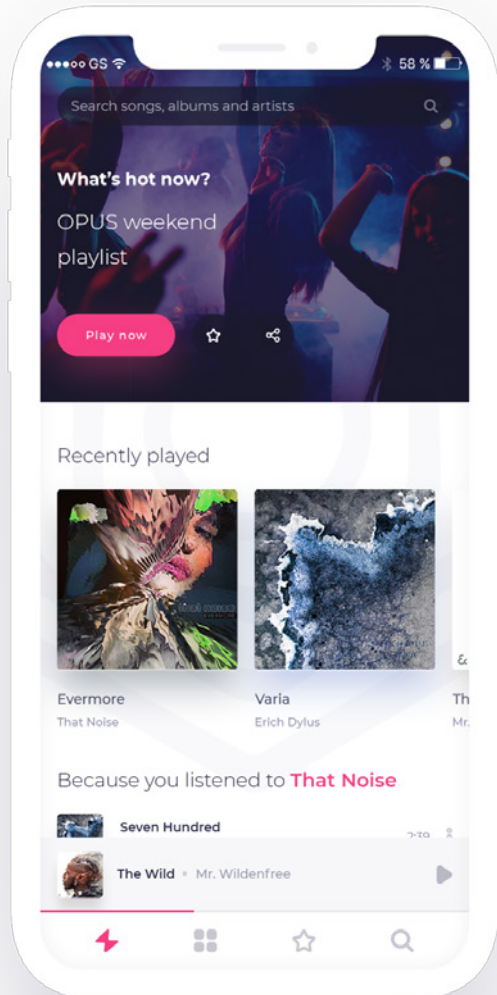


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Abstract



OPUS is a decentralized music sharing platform that leverages blockchain technology to guarantee fair compensation for artists, transparent and reliable payment rules; and extensive music content stored by the community. OPUS introduces its own digital token (OPT) for payments and revenue management for both artists and fans. These tokens give us new possibilities in the music industry: artists can decide how to split revenues between band members and for each song separately, can share their own revenue with the fans, who in turn can support their favorite artists or can purchase extra content. Leveraging the speed and redundancy of a decentralized and immutable file storage technology - IPFS (Interplanetary File System), OPUS can scale and deliver thousands of tracks per second in a very decentralized manner. This is achieved by encrypting music tracks on the go and storing the encrypted music files permanently on the IPFS swarm.

The smart contract on the blockchain collects hashes of the statistics of the played songs which are the basis for revenue calculations for each artist – this data are available for public and its immutability can be checked by comparing hashes.

When everything is transparently stored in the OPUS smart contract, we also consider introducing additional governance mechanisms such as an OPUS DAO (Decentralized Autonomous Organization) used for voting on new features, artists revenue sharing and a variety of other possibilities.

Due to the fast-paced emergence of blockchain technology, and high fees within the Ethereum ecosystem, OPUS has decided to start with hybrid technology stack: music files and payments are fully decentralized on IPFS and Ethereum and real time transactional data between players/web panels and the platform are API with off-chain data storage based. With technology growth and its business suitability OPUS will responsibly and gradually switch its remaining components to the blockchain.

Introduction

1.1 Problem overview

The global music industry is growing, generating \$42.93Bn in revenue in 2016. Despite the growing market for music services, the current bureaucratic system of labels, artist managers, and distribution services have largely choked the smaller artist that cannot negotiate sponsorship deals with big brands, and who rely on direct artist-to-fan sales

In addition, centralized streaming platforms take up to 80% of the entire revenue stream, harming many small artists. While direct artist-to-fan sales were possible in the past, artists today are forced to rely on monopolized streaming platforms, which pay as little as \$0.0003 USD per play. Established artists that rely on tours and sponsorships can handle this, but smaller artists who only have a fan base of a few thousand cannot survive in this industry with such a tiny revenue stream.

1.2. Why?

Artists have no choice but to choose the existing alternative pay-to-use low revenue model. In fact, many artists, such as pop star Taylor Swift, have taken their stance against the pay-to-use model by pulling tracks out of streaming services as a way to send a message. Unfortunately, this often results in friction between fans and artists. Fans today have to manage numerous different music platforms, while artists struggle for fair compensation.

1.3. Mission statement

"The OPUS foundation's mission is to create a decentralized music-sharing platform that is uncensorable, fair, and easy to use – a system that gives a greater choice to listeners and fair market value compensation to artists"

OPUS is a major disruptive force driving the way music is shared in the twenty first century. By cutting out major middlemen in the music recording industry – record labels, monopolized distribution platforms, label companies, and studios – that have a major stake in the music industry, OPUS will empower small artists and pose a new paradigm shift in the way people listen to and pay for music. No doubt, there will be resistance towards the OPUS platform from existing institutions holding artists hostage. However, OPUS is well positioned to take advantage of the decentralized nature of smart contracts and IPFS to revolutionize the music industry in a way never before seen.

Core Objectives

2.1. Engineering the world's most efficient music-sharing platform

Leveraging the bleeding-edge of distributed ledger systems like IPFS, and the immutable nature of distributed smart contracts on Ethereum, OPUS aims to build the infrastructure from the ground up in a highly network-efficient manner with minimum latency.

The OPUS core development team, led by a team of passionate industry-leading computer scientists and Engineers, are currently:



Finishing the development of the API, smart contracts, and transactional databases.



Finalizing the development of the OPUS player for web, Android and iOS.



Completing the development of the Artist and Fan web panels for content management and cryptocurrency payments.



Research for scalable and cost effective blockchain-based transactional systems.

2.2. Build a seamless user experience from the ground up

User experience is the key to successful long-term growth of a business. Amazon's CEO Jeff Bezos invested 100 times more in customer experiencing than marketing in the first 5 years, and Airbnb's CEO Mike Gebbia credits UX with building the company to be worth \$10 billion. Excellent userexperience is necessary to make the business thrive. Studies show that companies that invest heavily in UX see a significant increase in user uptake and adoption rates compared to similar products with a lower emphasis on UX.

The team at OPUS takes this concept very seriously; in fact, we have designed our platform based on a unique user experience. In the world of blockchain, many interactions are crude with complicated hoops and unintuitive interfaces. What we have managed to do is shatter this barrier with an infrastructure and UI/UX level experience that is intuitive and responsive to use with tested sub-second latency.

In an environment heavily focused on pure conceptual ideas, OPUS plans to invest resources into UI/UX to provide a groundbreaking user experience, poising us to capture a significant share of the \$40Bn-a-year music streaming industry.

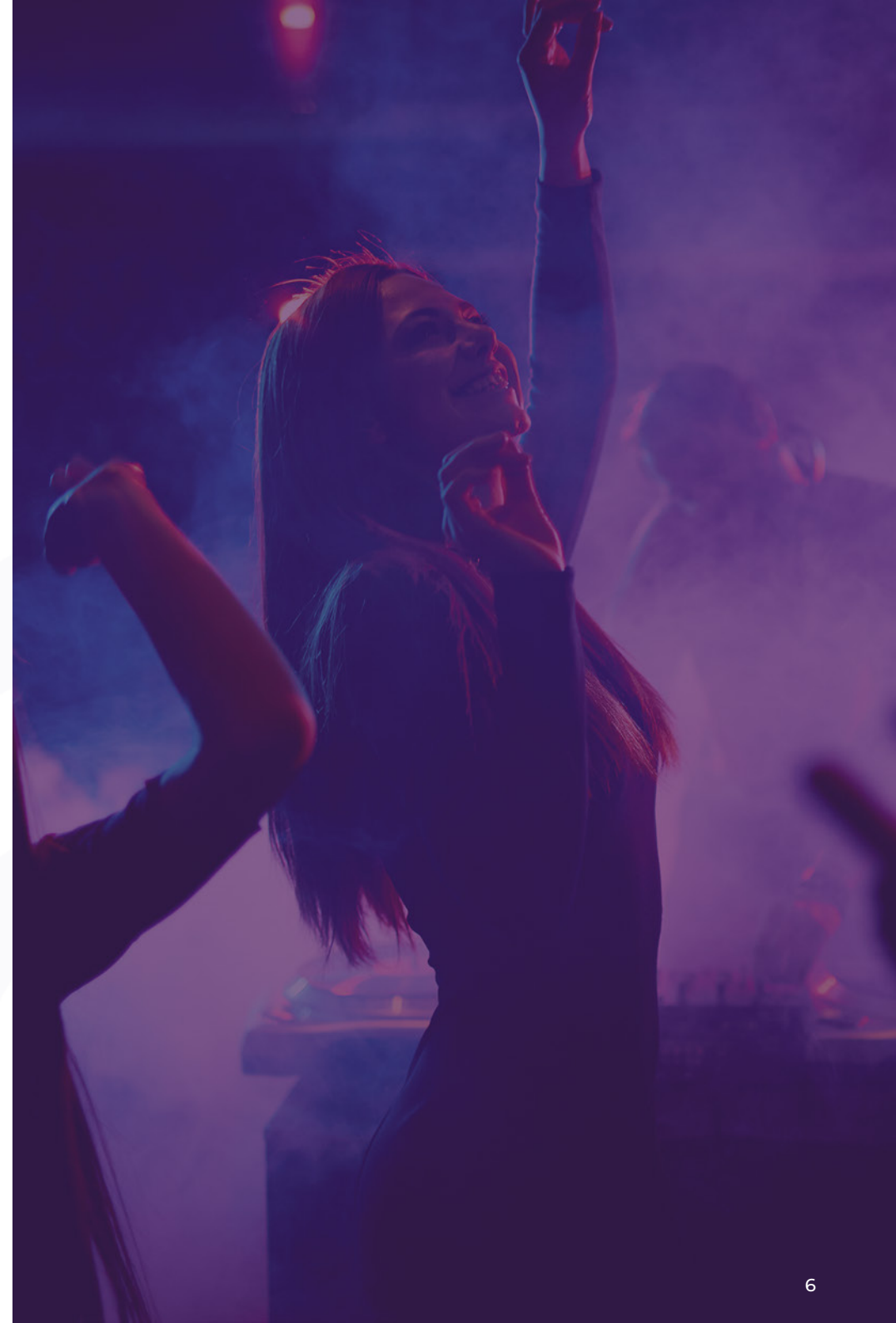
2.3. To implement modern, democratic governance

OPUS believes in transparency of rules, data immutability, and cryptography-based data integrity ideas that stand behind the blockchain. That is why smart contracts will store compensation rules for each person from a band, agreed upon after mutual confirmation, that is why smart contract will make transfers to artists and fans based on calculations collected from the platform usage data, that is why all this data and those rules will be publicly visible to everyone.

2.4. Implement a successful marketing plan to ensure long-term growth

After ensuring all the infrastructure is in place, OPUS will promote the platform through both sponsorships and indirect advertising. Our plan is to onboard artists while at the same time promoting the platform to fans. There are many new markets, particularly in countries with no established music platforms, for example China, a void OPUS can easily occupy.

Unlike many blockchain projects focusing only on a core concept, the primary goal of OPUS is to shine light on the technology to a mainstream audience. While we have invested considerable resources in producing infrastructure-level innovations, we are also committed to campaigning and transforming OPUS into a platform as ubiquitous as other global streaming platforms have become in the last 3-5 years.



Technology



Figure 1. Overview of the Opus platform

3.1. Overview

As engineers and computer scientists, we believe in designing enterprise-grade solutions that are scalable at heart and reliable in practice.

What we propose in this paper is a 4-layer system that utilizes IPFS as a file storage layer, an off-chain database as a transactional and directory layer, Ethereum smart contracts as a finance logic layer, and an API and applications as the front-end application layer. Due to the emerging state of the blockchain technology, with high Ethereum fees for collecting real-time data from players and effectively responding to users' requests, we designed our own system to currently use an established layer for transactional operations. All the data is collected there and the hash of song statistics is periodically sent to the blockchain; thus, we can deliver real-time user experience balanced with rational costs, and utilize the blockchain to the greatest possible extent, primarily for payments.

Technology stack of Opus platform:

API: node.js with StrongLoop/LoopBack framework,

File storage: IPFS public and own nodes,

Transactional data storage: PostgreSQL database,

Immutable storage and payments processing: Ethereum blockchain,
Web player and artist/fan panel: javascript React app with Ethereum
lightwallet,

Android player coded in Kotlin,

iOS Player coded in Swift,

Google Firebase for google/facebook/twitter auth,

Nginx server as SSL proxy layer.

Technologically, the Proof-of-Work blockchain is not suitable for handling transactional systems (high frequency and volume of data). OPUS has tested the blockchain-only solution and found it to be too costly, too slow, and to have a lack of privacy in storing decryption keys – and that is why we use a hybrid stack: the Ethereum blockchain, payments, and governance; and the already established PostgreSQL database with a node.js application server providing the API for transactional operations between the OPUS players and the core platform. We observe the growth of side-chain systems such as Raidos, BigchainDB or Ethereum sharding technology and look forward to its readiness for business.

3.2. Interplanetary File System - IPFS

3.2.1. What is IPFS

Interplanetary File System (IPFS) is a peer-to-peer distributed file system that connects computing devices with the same system of files. In many ways, IPFS is similar to the Web, but IPFS can be seen as a single BitTorrent swarm, exchanging objects within one Git repository.

In other words, IPFS provides a high throughput content-addressed block storage model, with content addressed hyperlinks. This forms a generalized Merkle DAG, a data structure upon which one can build versioned file systems, blockchains, and even a Permanent Web. IPFS combines a distributed hash table, an incentivized block exchange, and a self-certifying namespace. It has no single point of failure, and the nodes

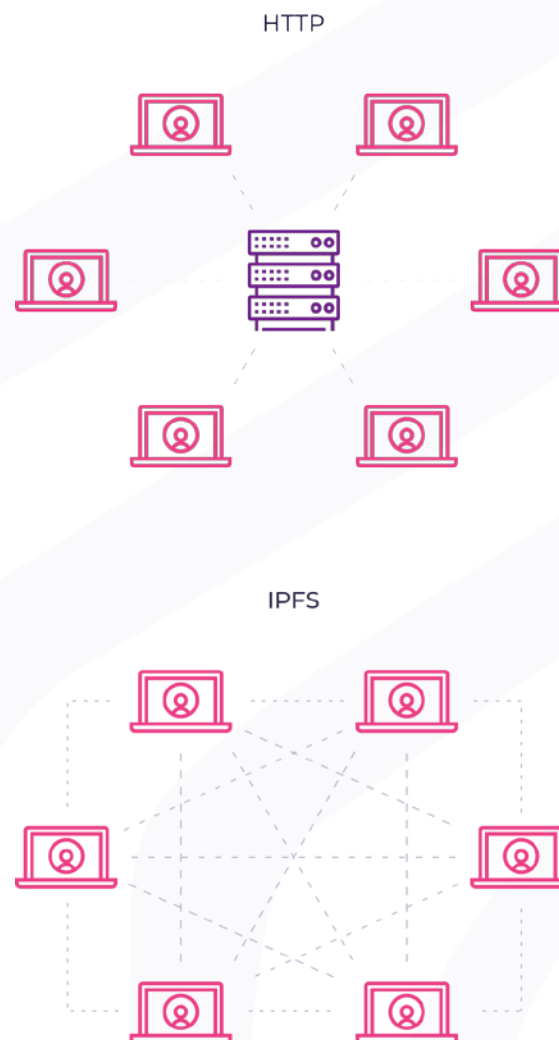


Figure 2. IPFS is a hypermedia protocol addressed by content and identities instead of traditional location addressing

do not need to trust each other.

At the IPFS protocol level, the system is fully neutral and the nodes can run over any transport protocol. In fact, IPFS nodes do not have to be referenced by a centralized IP. IPFS nodes can run through different network architectures such as NDN (Named Data Networking), XIA (eXpressive Internet Architecture) and more. This transport-neutral network protocol will ensure that IPFS can be transmitted through any network and resist censorship.

IPFS is an emerging, revolutionary paradigm in decentralized storage. By not storing any music files on a centralized server, no organization, including OPUS, can modify or delete any audio content uploaded by artists to the OPUS platform.

3.2.2. Scalability of IPFS

The IPFS protocol is a collection of protocols served from a swarm of IPFS nodes. However, the network layer can perform network activities through a single TCP or UDP port. IPFS can multiplex many point-to-point connections simultaneously.

For instance each node can:

- listen on a particular TCP/IP address
- listen on a different UDT/UDP/IP address
- have multiple streams open to node X,Y,Z
- multiplexes streams over HTTP2 to multiple nodes

With such a dynamic level of flexibility and scalability, just like HTTP, there is no limit to the scalability of IPFS. On opus, the total latency increases with $t = O(C)$, where

- C = constant, and capacity increases with $t = O(n)$, where n = Files on the network. As the network gets larger, the total latency should remain relative low with a smooth streaming experience.

3.2.3. Opus and IPFS

The IPFS system enables the OPUS platform to serve music files in a permanent and decentralized manner. Anyone can become a host of OPUS files by running their own IPFS node.

Take the hash

QmUhd25MRvghabeUxPxc7qBtzSnZvQn8DG2WgrbMkPRqRF

for instance. This hash is the permanent global reference to an unencrypted music track track (written by Arief Zulkifli) accessible through the IPFS swarm network.

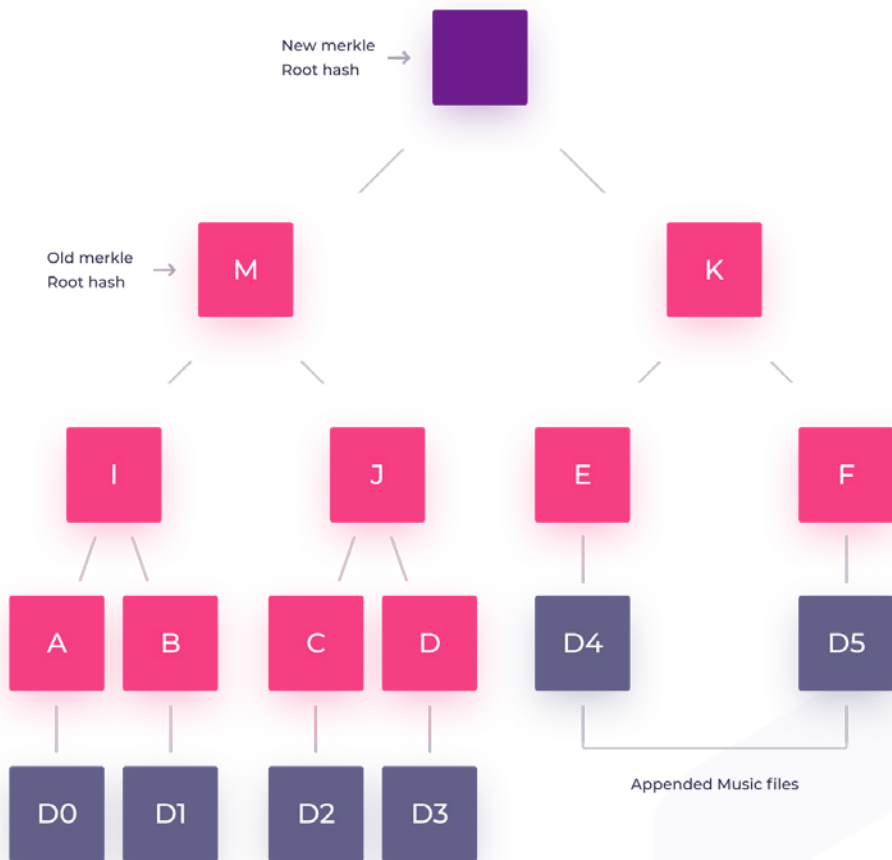


Figure 3. Merkle hash root diagram

We can verify that such a hash induces an immutable bijection between a unique file by examining the Merkle hash tree of the node files.

If a rogue node attacks the network, the majority network would recognize a change in the root hash and search for new nodes, ensuring that the network maintains an immutable storage of tracks. This immutable

nature of IPFS is important on a mainstream scale. Considering that Opus will have a profound effect on the music streaming industry. There may be political, social and economic incentives (government sanction) for nodes to "alter" the files referenced by the original hash. However, because this will change the hash tree of the file, it is computationally and cryptographically impossible.

You can play this track by accessing the reference hash through a locally-hosted Node.js IPFS access point. You can also access this unencrypted track through HTTP API gateways such as:

https://ipfs.infura.io/ipfs/<file_hash_id>

The OPUS team has found that to effectively serve OPUS tracks worldwide, we must run IPFS nodes on every continent, with 100TB of storage each, for 10M of 320kbps mp3 tracks with an average duration of 4 minutes. We consider the use of Filecoin-like systems, where nodes with OPUS files are rewarded for sharing their storage. The partner would have to provide the right download bandwidth as well as high amount of ram for caching, etc.

3.3. Smart contracts and Ethereum

Smart contracts are immutable programs that execute when certain conditions are met. These "smart contracts" can be scripted with a predetermined set of instructions or custom instructions on the virtual machine which will then be executed in an immutable and transparent fashion.

Smart contracts are much better than traditional channels because they can be verified quickly and cheaply, and are fully transparent. Logic can also be coded into smart contracts in the form of Turing-complete computer code. Doing so enables something revolutionary: a fully decentralized program. In such a decentralized crypto-graphically secured network, it is economically impossible to prevent the execution of the smart contracts, especially when copies of the code are verified and executed among millions of computers. Furthermore, it is still economically and efficiency impossible to use smart contract-enabled blockchains, like Ethereum, as the only logic layer. As such, we take the best parts from the blockchain and mature database engines, and combine everything together to work for the artists and fans.

3.3.1. OPUS logic on a smart contract

While the OPUS storage layer is able to deliver vast volumes of data (we have tested IPFS throughout to exceed 20Mb/s with 300ms latency), without a core payment and logic layer, artists cannot be compensated for uploading tracks to the OPUS protocol and curators also cannot be paid for their services in creating playlists and sharing music tracks. To achieve these features, OPUS needs a "logic layer" that processes payments directly from the artist to the curator and from the fan to the artist.

We do this using Ethereum smart contracts. Using smart contracts, artists and fans can rest assured almost 100% of the payments are delivered to the artists transparently, immutably and without intermediaries taking large chunks of revenue. Artists can also rest assured that their revenue stream will not change at the whim of corporate greed.

3.3.2. Ethereum instead of a custom blockchain

Creating a custom C++ optimized blockchain for OPUS is most certainly a possibility. In fact, the OPUS team experimented with C++ modifications of Bitcoin, which is also programmable. However, it was extremely time-intensive and prone to human error to develop such a system. Furthermore, the limiting set of default functions in the Bitcoin core meant that a lot of time had to be put into recreating common data structures.

Bitcoin default operations:

```
case OP_ADD:
case OP_SUB:
case OP_BOOLAND:
case OP_BOOLOR:
case OP_NUMEQUAL:      case OP_NUMEQUALVERIFY:
case OP_NUMNOTEQUAL:
case OP_LESSTHAN:
case OP_GREATERTHAN:
case OP_LESSTHANOEQUAL:
case OP_GREATERTHANOEQUAL:
case OP_MIN:
case OP_MAX:
```

Ethereum, on the other hand, has a much higher level of abstraction, common data structures, inheritance, encapsulation, and more.

Additionally, it would be economically difficult to use proof-of-work (PoW) to secure an independent OPUS protocol, as there are potential incentives for third parties to attack the protocol (e.g. existing streaming services). It would also be much more effective to utilize an existing programmable blockchain solution such as Ethereum which has significantly higher resistance towards attacks.

3.4. File IO

3.4.1. Between EVM and player:

Ethereum JavaScript web3 API is an interaction between a virtually instantiated OPUS node and the Ethereum virtual machine (EVM). This lightweight node can be instantiated within a browser or on a local client device such as a desktop or mobile phone.

Fans can pay for their subscription for access to the platform directly from their browsers, securely using their own wallets to pay in one of two ways:

- by single payment for a given timeframe of subscription,
- by allowing the OPUS Master Contract to charge the fan's wallet with a fixed number of OPT tokens – a similar mechanism to charging a credit card periodically, but with a cap defined upfront.

3.4.2. Between IPFS and browser:

Communication between the IPFS network and the OPUS platform is through the IPFS Remote Procedural Call (RPC) API. For more lightweight clients, it would be advisable to connect through IPFS gateways operated

by the third-party players. While this could be potential attack vectors, the lack of a large local node would give more people access to the OPUS platform.

3.4.3. Uploading tracks:

The OPUS artist panel provides an interface between IPFS and the platform. Artists can upload albums with songs and all data are stored automatically on the IPFS and off-chain database.

3.4.4. Playing back tracks:

The OPUS core music players are available for the web, Android and iOS platforms. They offer functionalities similar to other mainstream players, with decentralization-based advantages. Because of the decentralized mesh nature of IPFS, sometimes the song start play latency is even smaller than traditional platforms in more populated regions. In addition, OPUS will deploy its own IPFS nodes around the globe to secure low latency access to all stored files.

3.4.5. Incentivizing permanent song availability

IPFS hashes ensure that each hash corresponds to one unique track on the swarm such that if a new node joins the network, the entire network will get access to the track stored on the node. This will ensure the security of the files streamed from IPFS hashes.

However, there may still be issues regarding permanent availability of files. While there are incentives for artists to keep backups of the tracks

they release, it's not enforced, so there is a very slim chance that the swarm network may lose the "permanent" music track. Currently, the only way to ensure permanent availability is for nodes to accept swarm data and host them voluntarily like a P2P node.

Fortunately, there are currently in development many in-situ decentralized mechanisms to maintain IPFS solutions. One such mechanism is Filecoin, which pays decentralized storage nodes that host files to maintain copies of the music files. As music tracks are negligibly small, we can, in the future, incorporate a negligible fee per track sale and have it automatically transfer to a Filecoin host for hosting music tracks on the off-chance that files are not available from the IPFS swarm.

3.5. Encryption of music files

Music files, even though only a few Mb big, are too large to store on the EVM. Therefore, we store the files within the IPFS swarm. However, the music files can be viewed publicly and permanently by anybody on the IPFS swarm. OPUS employs a secure encryption algorithm to ensure that the music is accessible only to users who paid for the subscription. What OPUS uses is a lightweight public-private key-encryption model to restrict access only to subscribers. The AES 256-bit (Advanced Encryption Standards) encryption ensures that data can be efficiently encrypted in a lightweight manner while streaming the music file.

The files are streamed and decrypted on the fly between the IPFS network, through the OPUS API, to individual clients. To do this smoothly, we divide the music tracks into chunks (chunking) which will be decrypted and encrypted on the fly. OPUS intends to use an encryption library that

provides high throughput on-the-fly encryption and decryption of data files.

As all data on blockchain are publicly available, OPUS stores decryption keys on an off-chain database and decrypts files on the API, before sending it via the SSL secured http protocol to the player.

This technology, with the possibilities of partnership with a DRM company, is one step towards keeping the keys secure against malicious actors. It ensures that the artists are paid their fair number of tokens.

This encryption is also important in terms of piracy. OPUS has to implement a system to automatically verify artists' identities and songs' intellectual property rights. There are two options we are considering:

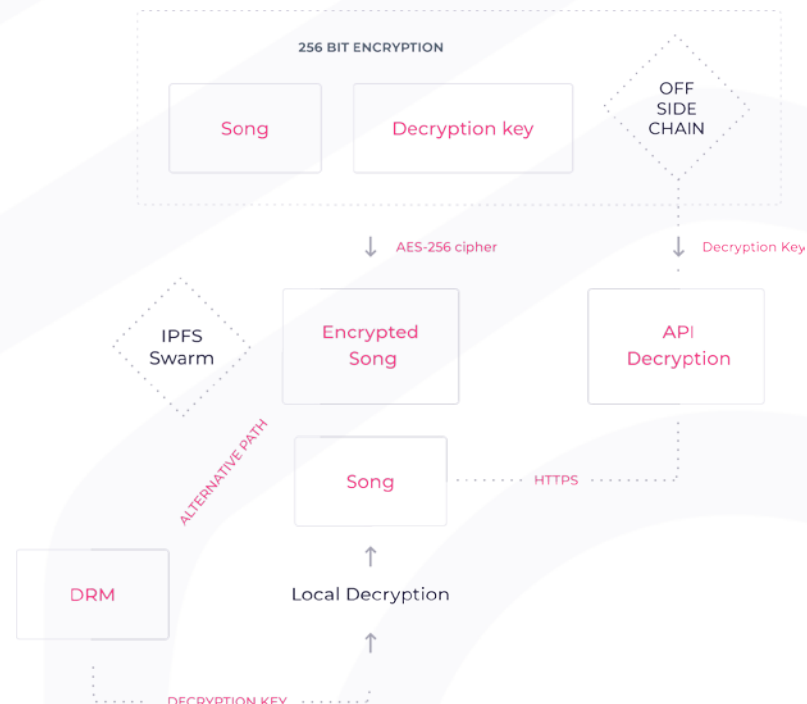


Figure 4. Diagram of the AES-256 bit Encryption architecture Opus uses

- A platform integrated procedure for artists and songs to be verified,
- Integrating the platform with the DRM company

3.6. OPUS UMRN

The book industry has ISBN, a standardized book referencing database managed by the ISBN central authority. Registering a single number within the ISBN foundation costs \$125 USD. While this is relatively cheap for professional authors, it is a significant expense for smaller, amateur authors.

What OPUS is considering is a novel high-throughput music relay registry known as UMRN. The registry for UMRN will be generated at a low cost within a Relay Ethereum smart contract, with the registry database hosted immutably on the IPFS swarm. UMRN is a novel music identification format and registry database for the music industry that enables small artists to register and the OPUS players to identify millions of tracks within a globalized and immutable ledger.

To do this, the OPUS UMRN smart contract registry will use the sigmoid function, commonly found in machine learning statistical normalization, to increase the cost per block to an exponential limit when a high number of registrations (e.g. 100 per block) are initiated. This ensures that when not under attack, the token cost will be virtually nothing to register a track. When a large number of registrations are made per block, the cost will scale rapidly, depleting the attacker of OPTs.

tCost function $C(x)$ for registering a track onto the UMRN database.

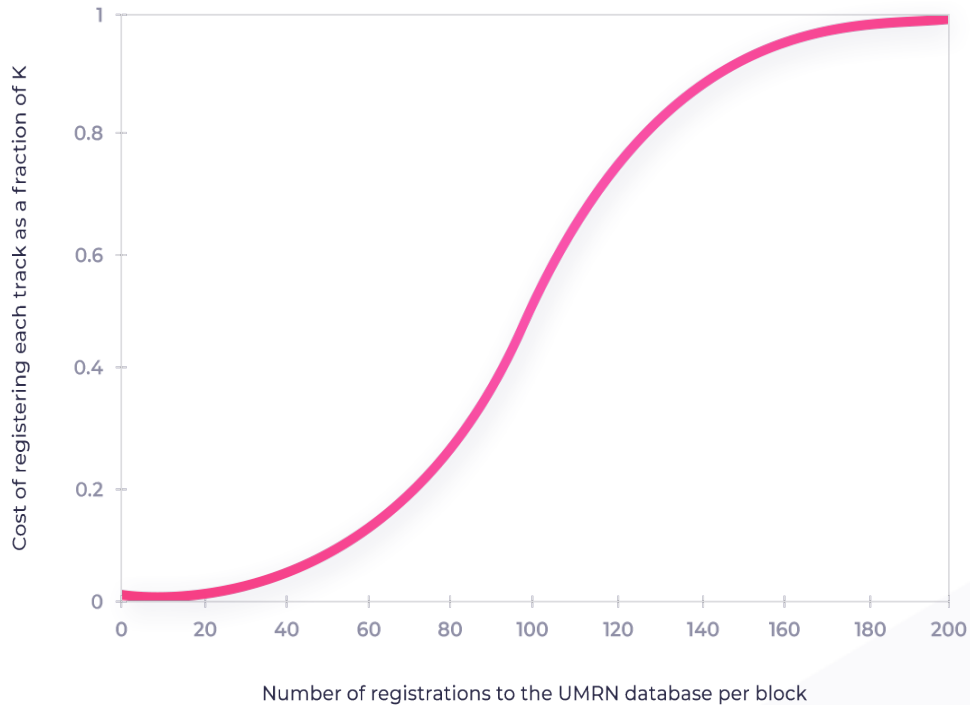
$$C(x) = \frac{\kappa}{1 + e^{-(\frac{x}{15} - 5)}} \quad (1)$$

Total cost $Tot(x)$ per block a function of the number of transactions x within the block.

$$Tot(x) = \int_0^x \frac{\kappa}{1 + e^{-(\frac{x}{10} - 5)}} dx \quad (2)$$

$$Tot(x) = \kappa 20 \log\left(\frac{e^5 + e^{\frac{x}{20}}}{1 + e^5}\right) \quad (3)$$

Cost function $C(x)$, with respect to tracks registered per block.



The UMRN relay contract permits a large number of transactions at a low price before increasing quickly to an asymptotic limit. This is to deter spam while also creating a theoretical ceiling to enable artists to release tracks at a slightly higher fee during a spam attack. Such a defense is crucial as there are incentives from existing large streaming platforms to attack the OPUS protocol, especially the OPUS UMRN database.

3.6.2. Music upload format standards

OPUS will define a set of guidelines for artists publishing tracks on the OPUS protocol that are compatible with the OPUS API. Because of the immutable nature of Ethereum smart contracts and files stored on IPFS,

we introduce a universal music metadata format for each track stored in the same location as the UMRN JSON file.

The meta data format standard will be in compliance with existing database systems as dictated by the guidelines published by the Music Business Association [Towns]. This music meta data style guide represents many corporations such as, but not limited to:

Amazon, Beats, BMI, Disney Music Group, Google, Epitaph, iTunes, Microsoft, and Sony. OPUS intends to be as user-friendly as possible, including for the artists. Therefore, by complying with existing meta data standards, we will ensure compliance with many of today's existing infrastructure.

Metadata guidelines:

- Artist Name and multiple authors in CSV form
- Track title in Unicode
- Genre of the track
- Length of track in ss:hh:mm
- Country of publication
- Album/single. (If album, use the same album reference number as generated by the OPUS relay contract.)
- Sampling of the audio file
- Publisher (optional)

3.7. Artist bounty and curation

3.7.1. Artist bounty

Smaller artists often lack a way to promote their music. Traditional marketing channels involve large upfront payments and obtrusive direct advertising, which do not correlate with any potential revenue.

On the OPUS platform artists can engage with fans with digital marketing activities.

Artists can share a part of their revenue with fans, when fan responds to the offer, the fan's Ethereum wallet address is added to list of addresses to receive the artist's OPT tokens.

3.7.2. Curator incentives

Another piece of the music industry often ignores is the numerous curators and music specialists that publish music playlists and charts for your enjoyment. At OPUS, we wish to ensure that everybody is fairly treated so that popular and reputed curators can generate revenue when songs are played from within their custom playlists.

Fan bounty: Regarding fan royalty distribution, it is possible to set up a smart contract that would automatically distribute part of the artist's revenue to selected fans. Crowdfunding music production is also very much doable. Engaging our community is something we take very seriously and want to do as much as possible. The implementation of both functions will depend on extensive tests we will carry out after the

release of the platform and the subsequent reaction of our users.

3.8. Augmenting Ethereum smart contracts and IPFS

Ethereum defines the logic, value transfer, and governance of OPUS while IPFS stores the data used by the OPUS platform. By merging the two systems, we overcome the storage and latency limitations of Ethereum while incorporating the immutable logic attributes of Ethereum.

3.8.2. Interfacing between Ethereum contracts, and the IPFS swarm

Ethereum and IPFS are to the blockchain world what DNS providers and servers are to the World Wide Web. The DNS was created in the 1980s ARPANET to solve a crucial issue of directing traffic to different computers based on a centrally maintained file called Hosts.txt kept at Stanford. This ensured that traffic could be directed easily within the network.

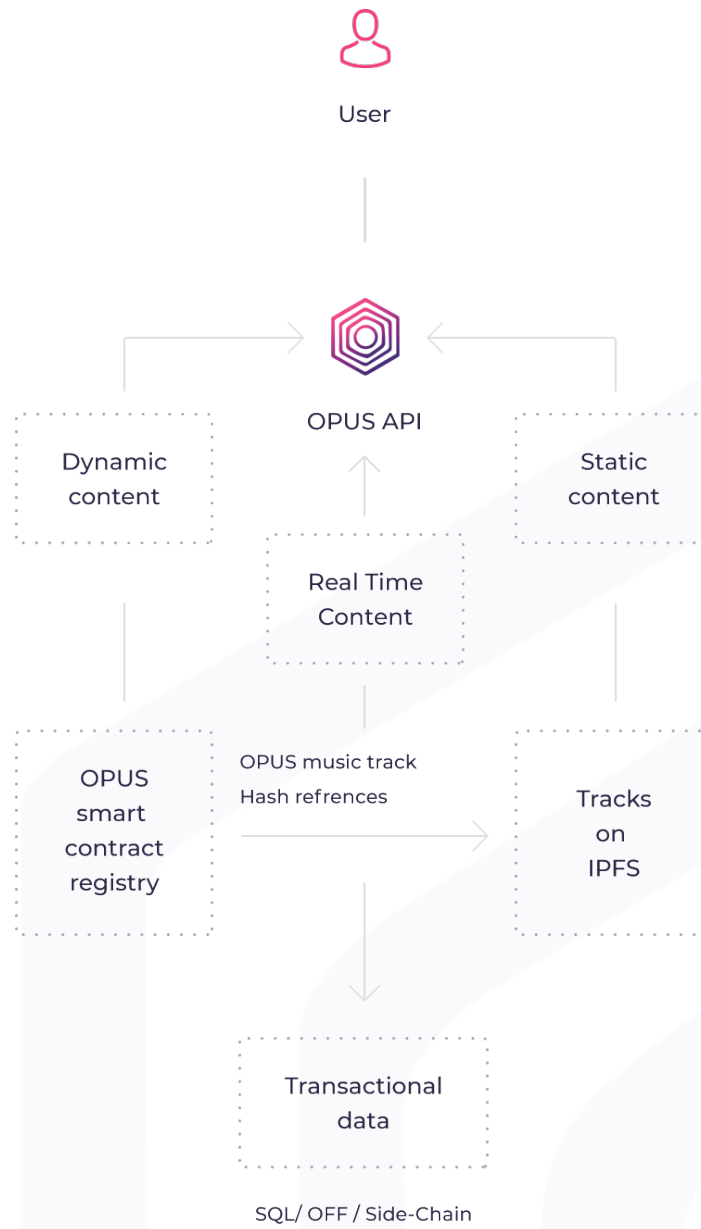


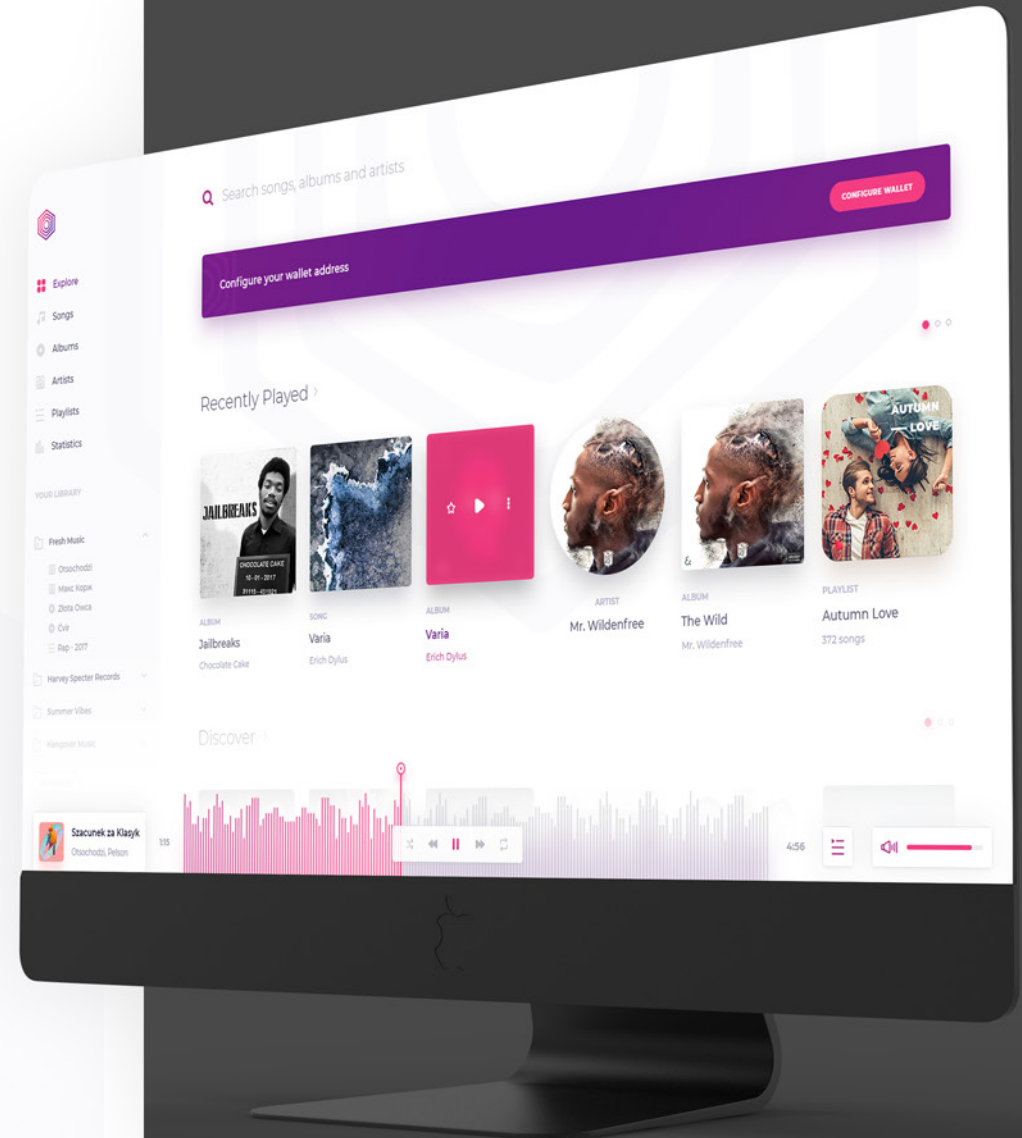
Figure 6. Opus IPFS content referencing

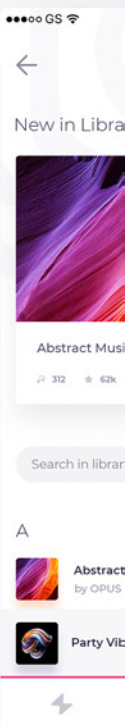
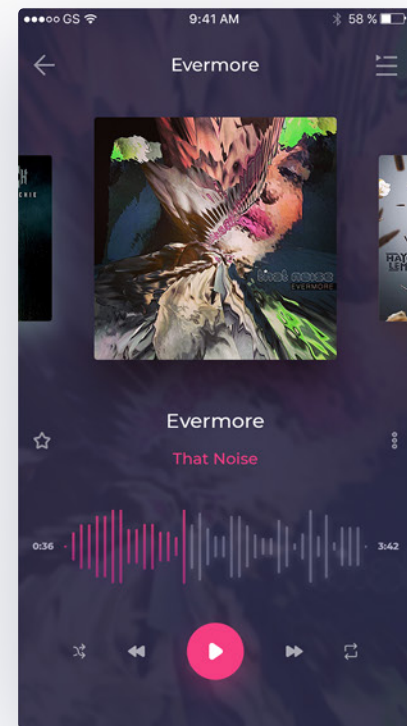
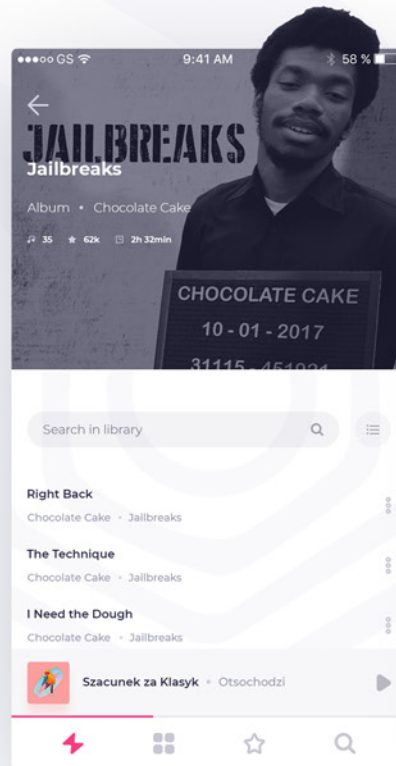
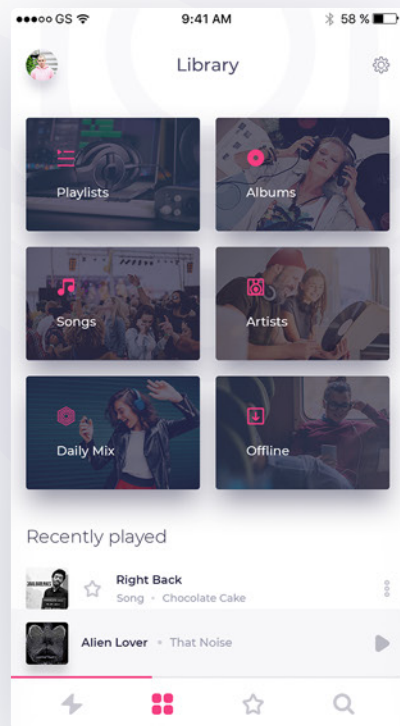
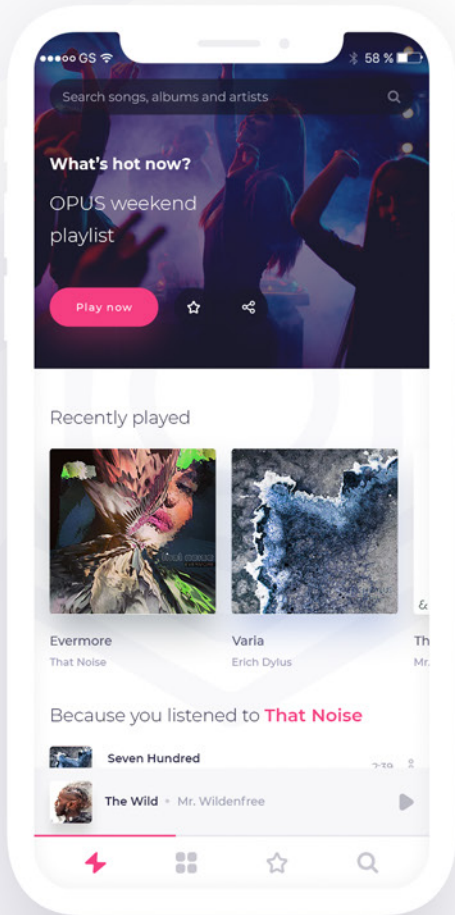
Front-end user applications: OPUS core players

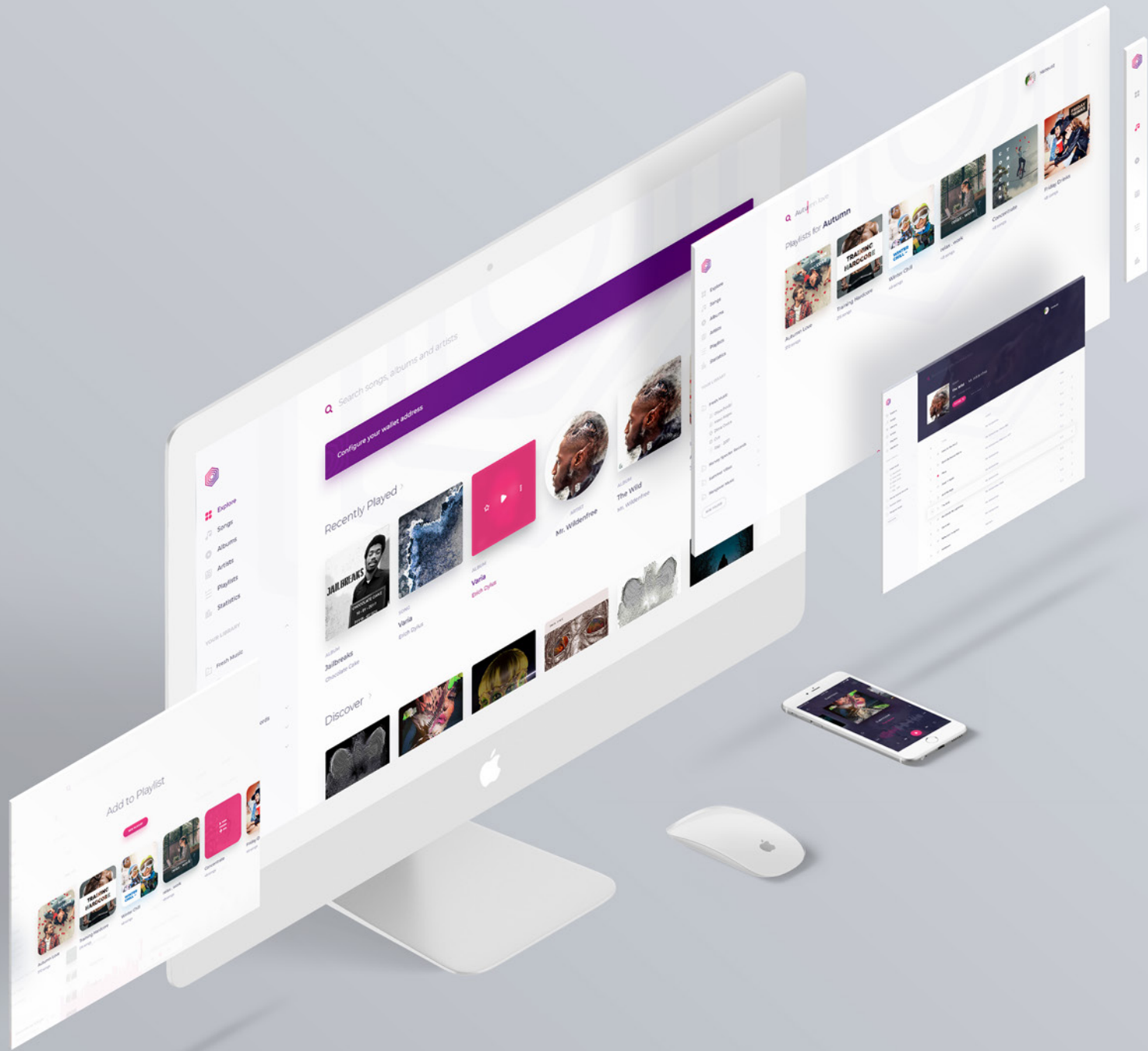
The OPUS team has developed players for three platforms: web, Android, iOS. Third-party apps will be able to use the OPUS API to create their own players (e.g., different Bitcoin wallets).

While the OPUS core players will be a stable platform to access the OPUS API, we will be releasing documentation and API guides to third-party developers. The OPUS team believes in open-sourced decentralization and so will be encouraging external developers that take advantage of the OPUS API in their products.

Nevertheless, we encourage third-party developers to reach out to us at info@OPUS-foundation.org for advice on OPUS design guidelines that will ensure a premium user experience.







4.1. Mobile application wireframe:

4.2. OPUS web-player wireframe:

Token mechanism

5.1. Specification

TOKEN NAME

OPUS Token (OPT)

CIRCULATING SUPPLY

133,308,531

FORMAT

ERC23 compliant

DIVISIBILITY

10^{18}

TRADEABLE BETWEEN USERS

Yes

5.2. Token standard

The ERC20 format provides a common interface for digital assets on the Ethereum blockchain, making integration between different wallets, players, and exchanges a seamless experience.

OPTs are designed to be fully compliant with ERC23 standards in order to ensure that the tokens are compatible with all players, wallets (Mist, Geth,

Metamask), and future services (e.g., decentralized exchanges).

5.2.1. ERC23

The ERC23 standard is a new, backwards compatible, token format that solves some issues existing in ERC20:

- Handling of incoming transactions from the receiver contract
- Ensuring that transactions for one token will not be received by the receiving contract of another
- Ensuring uniformity within Ethereum such that the transfer() function is called for both contract and account deposits.

As these improvements are backward compatible, the OPUS Protocol will fully embrace these new token standard updates.

ERC23 token functions:

function totalSupply() constant returns (uint256 totalSupply)

function name() constant returns (string _name)

function symbol() constant returns (string _symbol)

function decimals() constant returns (uint8 _decimals)

function balanceOf(address _owner) constant returns (uint256 balance)

function transfer(address _to, uint _value, bytes _data) returns (bool success)

function transfer(address _to, uint _value) returns (bool success)

function tokenFallback(address _from, uint _value, bytes _data)

Platform mass-adoption incentives

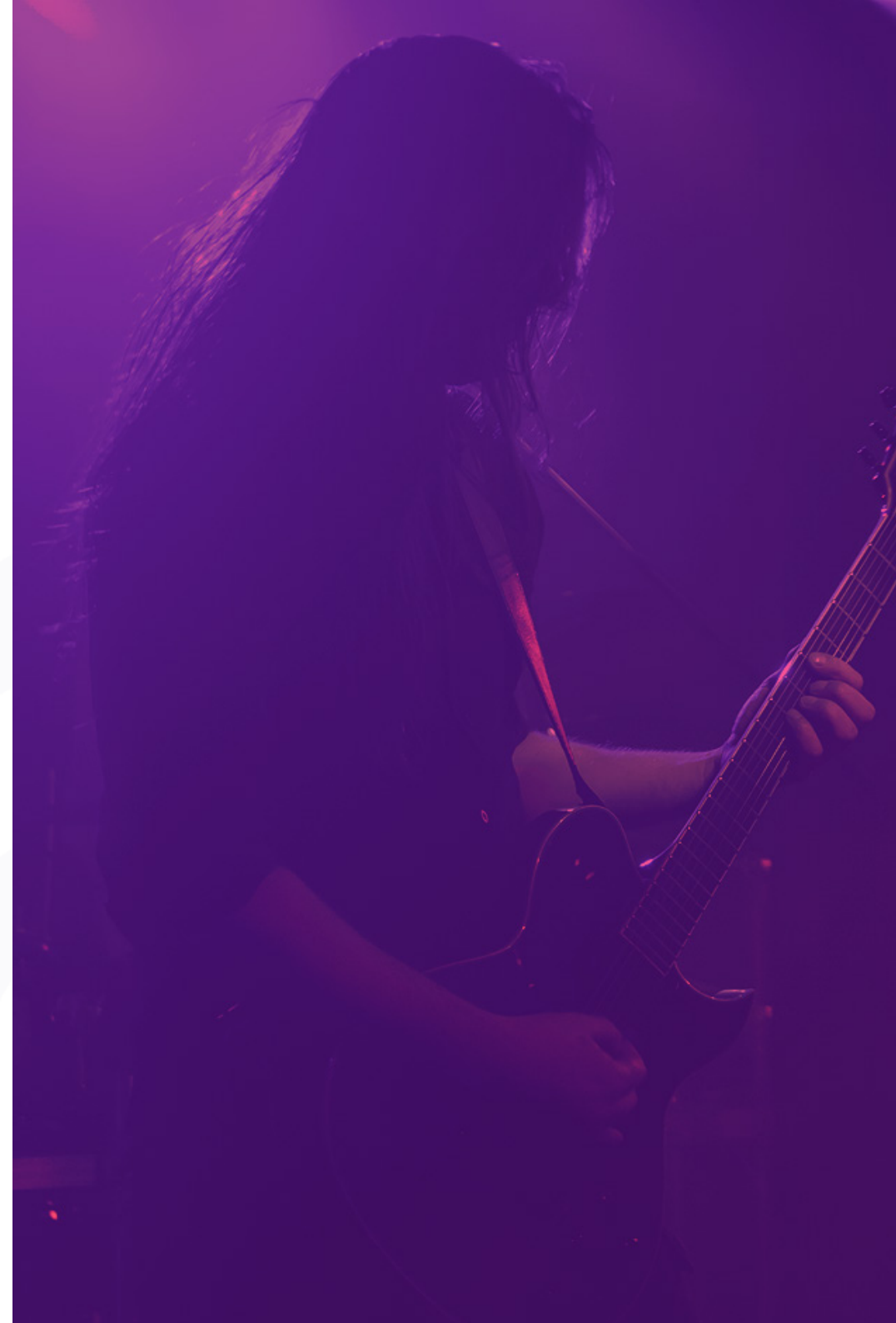
6.1. Business model

6.1.1. Artists on OPUS

Rising artists

Rising artists are inclined to release tracks on OPUS because it allows them to take home nearly 100% of the revenue they generate and track where their revenue is going in a transparent manner. It also allows artists to diversify into a new audience, and revenue streams traditionally not available through existing platforms. These less established artists will be relieved to learn that they do not need to sign long-term deals or pay hefty registration fees to list their work on the OPUS platform.

Artists who are less established can release a preview of their track in the form of a 30 second unencrypted portion of their music file. If a fan wishes to listen to the rest of the track, he or she will be able to purchase a subscription providing access to the full versions of the songs on the



platform.

Established artists

Established artists will also greatly benefit from the OPUS protocol. Unlike existing streaming platforms that take up to 80% of the revenue, the OPUS protocol only takes 1–3% for maintenance of the platform. In addition, there is no possibility that tracks will be de-listed from the platform or banned due to government restrictions.

The fact that the underlying OPUS protocol and infrastructure can be used by any OPUS-API player around the world means that the artist will have access to a much bigger global audience and thus have a much greater reach.

6.1.2. Music fans

OPUS offers a revolutionary platform for music fans that gives them access to their music collection straight from the Cloud permanently, rapidly, and wherever they wish.

With the low barriers to entry, switching incentives, and the immutable nature of the blockchain and IPFS swarm, we can expect more artists releasing their songs on OPUS than on traditional platforms. This will offer the average music-fan a much wider selection of tracks through the OPUS-API players compared to existing fractured platforms.

With the artist bounty system, fans that are popular within their social

circles can also generate an income by sharing their purchase contract address. Fans make a small cut (optionally determined by the promoting artist) for every purchase made through their bounty address. This could be attractive to music listeners looking to make some side income

6.2. Network effects

6.2.1. Existing network effects in the music industry

While brand loyalty exists within specific streaming platforms, the overall entrenchment of the industry is relatively low. Most streaming services are less than 10 years old, and many fans already use multiple platforms. Many albums are fragmented, available on some platforms and not available on others.

In addition, most existing platforms have adopted streaming models but not song sales. Because existing platforms are mostly streaming-oriented, music fans don't have a lot of "sunk cost" regarding purchased songs when switching platforms.

It doesn't hurt to switch to OPUS.

6.2.2. Switching incentives

OPUS will provide switching incentives through bounties and campaigns, but will also provide a superior user experience to existing platforms with a highly skilled team User Interface/User Experience designers on board. As research has found, better UI/UX is often the determining factor for most people looking to switch platforms. By having a comparable

or better user experience, low latency and high scalability, we hope to overcome the network effect.

Governance and marketing: Opus DAO

OPUS is an active member of the modern token economics era of trust-by-computation, where the paradigm switches from trusting people to trusting mathematics.

This includes:

- cryptography based data immutability assurance,
- transparent and immutable computer code-based token transfers and financial data storage,
- bounty programs – where every fan can generate revenue by promoting their favorite artists,
- curator's revenues – where content quality manager can be rewarded for his/her labor on making the best song playlists,
- DAO – where every token's holder is a business co-owner, with the right to decide about its future: a form of digital direct democracy among a digital society.

Being able to evolve separately from the core team is important. Therefore, we are also considering implementing a DAO system within the OPUS code. This system would allow music listeners to vote on what

improvements need to be made to OPUS. This democratic system allows agile polling while ensuring that voters are represented and prevents Sybil voting as happens in other non-blockchain products. If we decide to implement this, it would have the following features:

7.1. OPUS Treasury

The OPUS marketing & development fund will be a fund derived from all music sales on the OPUS smart contract. Our current plan is to take approximately 2-3 % of the music sales, but this can be changed depending on what the community wants when the Main net is released. We are currently tweaking the numbers for the OPUS treasury.

We will be using this OPUS treasury to sponsor programs, not unlike the Dash Master node fund [Duffield and Diaz]. However, anybody will be able to vote, and their vote will be weighted accordingly based on how many OPT they own. We weigh each vote by the amount of OPT the voting address owns in order to protect against Sybil attacks.

7.2. Opus DAO

Any individual will be able to propose a request to the OPUS network. However, proposals will burn 1000 OPT to stop spam. There will be a 1-month period for voting and submissions where the number of Yes/No votes are weighted by the number of OPT tokens the voter holds. Anybody can participate in this voting procedure.

7.3. Voting

framework, like the DAO in Dash. [Duffield and Diaz]. Users who own a significant amount of OPT, and who have the network's best interests at heart, are more likely to appreciate new features, and will be able to vote monthly on budget proposals submitted to the network. At the end of each month, OPT will be granted to the winning feature proposals. This will be paid directly by the platform to develop new features or attract new artists.

Unused funds will be burnt each month, reducing the overall OPT supply and increasing the music value of each individual OPT token by allowing OPT holders more access to music than before.



OPUS actually can revolutionize digital music through blockchain

To make the best use of these funds, we will implement a monthly voting

Case studies

8.1. Why OPUS needs to be decentralized

Just two days after Frank Ocean's "Blonde" - one of the biggest releases of 2016 - released on Apple's iTunes, Lucian Grainge, CEO of Universal Music Group (UMG), and widely regarded as the most powerful executive in the music industry, reportedly ordered the company's labels to stop the practice of making "exclusive" distribution deals with streaming services. One day later, the tracks were ordered to be shut down from Spotify and Apple music by UMG against Frank's wishes. These centralized services had to comply. Frank Ocean could be facing charges of up to \$2 million USD against UMG and other recording outlets.

Issues like these are the reason why centralized platforms and contracts are currently plaguing the music record industry. They tear artists between dwindling traditional sources of revenue and exploitative online services.

We wholeheartedly agree that 'decentralization' and 'blockchain' are the buzzwords of today with numerous companies and institutes creating "blockchain products" simply because of the growing popularity of the blockchain. Many of these projects either fail to understand the meaning of "decentralized" or simply don't implement a fully decentralized product, selling a pseudo-decentralized platform. The OPUS protocol is completely, fundamentally, and technologically different. Our protocol delivers a truly

blockchain-based service that is almost entirely decentralized, unlike many other "decentralized" platforms in existence today.

If Frank Ocean had published his album on the OPUS platform instead, it would have been immutably stored within the IPFS swarm with corresponding smart contract IPFS hashes running on Ethereum. This means Frank's album would not have been able to be taken down by UMG, freeing Frank from his legal hassles and ensuring that he will always receive nearly 100% of the revenue his album generates.

8.2. The voracious musicophile who listens to a wide selection of artists

Todd from Monaco is a heavy music listener. He listens to all types of music including pop, metal, country, and folk. He also likes to travel the world and enjoys listening to a wide variety of local songs such as Congolese rumba, K-pop, and C-pop. His favorite artists are Aaron Parker, Taylor Swift, and Thom York.

Unfortunately, there are many obstacles between Todd and his favorite artists.

Todd's local music library is over 30Gb large. He doesn't want to carry it around with him, so he uses streaming services. One existing platform, unfortunately for Todd, is censored in Monaco. In fact, this platform is banned in over 80 countries. Todd then turns to an alternative platform. However, much to Todd's dismay, many of his favorite artists, including Taylor Swift, are not available on this service because of the standard

pricing scheme streaming services enforce. International music is also very limited and fractured in the music streaming industry since every streaming service uses their own infrastructure. This means that Todd has to use many international platforms in addition to the ones he already uses.

Nevertheless, Todd now uses a mix of platforms to listen to everything he wants. This is very frustrating to Todd, and he wishes there was a more unified solution.

This is where OPUS comes in. Using OPUS, Todd can purchase access to the platform and listen to all songs stored on IPFS without any censorship and limitations.

8.3. The music collector

Peter is in his late 40s. Throughout his life, his favorite hobby has been music collecting, yet now he is disappointed that music in the digital age is fleeting and streamed. He wishes he could “own” songs online and be able to stream even after “streaming sites” are abandoned.

The OPUS protocol revitalizes Peter’s dreams of being a music collector. With OPUS, songs are stored forever on the permanent IPFS swarm, which means that access to the songs is practically only limited to situations when the subscription is not paid.

8.4. The Audiophile

Jupiter is an audiophile who only listens to HD, 640Kbps audio. He finds

it extremely difficult to find audio of this quality to listen to. Even though he is willing to pay more for this quality, artists often do not release HD versions as streaming platforms often restrict the bit rate to 128Kbps.

Using OPUS, however, Jupiter can enjoy music at 640Kbps as long as artists are willing to upload HD audio (and artists will, because they can generate more revenue this way). Served straight from the scalable IPFS swarm, Jupiter and many other audiophiles like him can now enjoy a wide selection of HD audio straight from any OPUS core or third-party player.

8.5. The amateur hip-hop artist releasing his first track

Claire writes music to her small group of fans on Facebook in her free time. She wants to release a track on an already established platform to both broaden her reach and monetize her work. However, for emerging artists like Claire, releasing a track is not easy. The high cost of registration - along with publishers, labels and exploitative streaming platforms - means that Claire cannot receive the money she deserves.

With OPUS, however, Claire can register her track on the platform through the relay contract easily and cheaply. Claire can now reach a big audience without the need to sign contracts. She can set the price she wants for her niche audience and know that she will receive all of her money transparently from any OPUS player.

8.6. The established artist seeking a bigger audience

Frank already sells his tracks on other big platforms. He is tired of the fees

these platforms take, giving him only 20–30% of the total revenue.

Using OPUS, Frank not only cuts out all the red tape surrounding these centralized platforms but also generates much more revenue than he ever has before. In addition, Frank feels more secure knowing that OPUS will not suddenly increase fees or remove his songs from the platform.

8.7. The playlist wizard

People love the musical tastes of Marcus Stephan. In his spare time, Marcus expertly crafts playlists enjoyed by millions of people across the world. Marcus wishes there was a way he could make money from his work.

On OPUS, Marcus generates revenue on songs being played from his playlists by fans. Marcus is ecstatic. He can now create playlists containing these tracks and get paid for sharing artists' music. Marcus now does full time playlist-crafting and earns a living doing it.



JULY 2016

Started development

AUGUST 2016

Formed official OPUS development team

SEPTEMBER 2016

C++ custom Blockchain infrastructure.

OCTOBER 2016

Storage layer / infrastructure implementation (Sia, Storj, IPFS)

NOVEMBER 2016

Technical alpha

DECEMBER 2016

OPUS Ethereum smart contract development

JANUARY 2017

Seed round

MARCH 2017

Audit Opus Ethereum contract. Team expansion Opus API development

APRIL 2017

Optimizing the Opus UMRN registry. Added UI/UX and web designers. Working with small artists. Development on Artist bounty system

MAY 2017

Beta release and optimization.

JUNE 2017

Security audit and press release, opusDAO beta testing. Official launch.

OCTOBER 2017

Move offices to Gdansk, Poland, and expand team by hiring new developers.

MAY 2018

Beta1 release (Ethereum testnet).

JUNE 2018

Onboarding hundreds of independent artists

JULY 2018

Outreach to the record labels

AUGUST 2018

Beta2 release (Ethereum mainnet).

OCTOBER 2018

Integration with Raidos / BigchainDB or others. Scaling. Off-chain / side-chain / sharding exploration.

Market analysis

10.1. Overview

OPUS solves this central issue by utilizing a permanent and immutable IPFS swarm file storage system along with permanent smart contracts. Our solution is a decentralized subscription based system with immutable content, assuring that songs will be available anywhere and anytime.

10.2. OPUS market breakout

Initial adoption will always be a challenge for any platform. To overcome this hurdle, what we plan is to target specific market segments.

10.2.1. International

Music today is often listened to by people from all around the world, even by people who may not necessarily understand the language in which a particular song is sung. This international market segment is set to expand rapidly in the next few years. Currently, there does not exist a unifying service that aggregates music from all over the world.

Our unique global API-based platform will enable this service from inception. Music published from any part of the world will be instantly referenced and searchable from any other location through the OPUS



UMRN registry, enabling OPUS to take advantage of the growing international audience.

10.2.2. Niche markets

The music market is extremely niche-focused. Some existing platforms target the middle-income family audience while others target a younger college-age market. This is interesting, as music is a very identity-focused medium. People like to associate with their specific brand or service which is what allows them to connect with the music services.

OPUS, unlike existing streaming services, is API-based. This means that any company will be able to integrate the OPUS protocol and environment within their own player. Doing so allows OPUS a significant competitive advantage. It allows OPUS to act as the foundation upon which different players can operate within the music space.

OPUS has the potential to be greater than each music platform as it can target every niche market simultaneously with third-party API-based players.

10.2.3. Marketing

OPUS has dedicated resources to implement an aggressive marketing strategy. While the blockchain is still an emerging technology, OPUS will aim its marketing primarily at people already familiar with this technology and its benefits. These enthusiasts will form the group of first users of the platforms. This will be achieved by establishing OPUS as a global leader in the blockchain, sponsoring specialized conferences worldwide, organizing events, and partnering with other blockchain startups.

Furthermore, OPUS is in the process of on-boarding hundreds of independent and less established artists seeking fair compensation for their work. This is achieved by working closely with small, independent labels, music executives, artists with a vast network within the music industry, and word-of-mouth.

Once OPUS has an established fan-base and extensive choice of music, the marketing will shift somewhat to appeal to a larger audience. OPUS will reach out to world-famous artists with fan-bases of millions of people, who will convert to OPUS. These artists will become brand-ambassadors for the platform and will encourage their fans and other artists to join OPUS and reap the benefits of the blockchain. This will create a domino effect, with an increasing number of artists joining OPUS.



Conclusion

With the advent of blockchain smart contracts and IPFS, there now exists the ability to construct an attractive way to securing both the content: tracks, its metadata and playing statistics of an immutable physical file and a market-fair, automatic and transparent pricing and payment system between the artist and fan.

This novel transparent, code-based governance system enables many exciting new opportunities in the music-distribution stack. What OPUS proposes is a revolutionary concept of a fully decentralized music platform that resists loss-leader pricing and predatory fees - a system where artists are paid fairly, and fans enjoy the music they love, wherever they are. With a fully functional OPUS beta1 release based on IPFS, Ethereum, API, off-chain database and Web/Android/iOS players we have made this concept a reality.

With contributions provided by Philipp Siemek, Konrad Szałapak, and the whole OPUS team.

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info@opus-foundation.org



Bitcoin Talk



Youtube



Twitter



Reddit



Telegram



Facebook



WeChat



Blog

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