



Whitepaper:

Peer-to-peer marketplace and ecosystem for fair and trusted stock photography

Glossary

DAO Decentralized autonomous organization.

DApp DApp is a distributed application, that has its backend code running on a decentralized peer-to-peer network.

DCC Photochain Digital Copyright Chain.

Photon Trading Token in the Photochain Ecosystem.

PHT Trading Token in the Photochain Ecosystem.

RF Royalty-free license.

RM Rights Managed license.

1 Motivation	5
1.1 Complicated Sales Conditions for Artists	5
1.2 Photochain DApp as a Solution to the Artist's Problems	6
1.3 Photochain's Mission	6
1.4 Business Case	7
1.4.1 Stock Photography Market	7
1.4.2 Photography Stock Business Model	7
1.4.3 License Models	8
1.4.4 Customer Groups of Photography Stocks	8
1.4.5 Market Opportunities for Photochain	8
2 Photochain Platform	9
2.1 Rulebook of the Platform	9
2.1.1 Photochain Network Governance	9
2.1.2 Onboarding	10
2.1.3 Roles and Permissions	10
2.1.4 Ranking-system and Reward	11
2.2 Photochain's Ecosystem	11
2.2.1 Payment (Rewarding) Process	12
2.2.2 Anonymous Transactions	12
2.2.3 DApp Fees	13
2.2.4 DApp Reserve	13
2.3 Copyright	14
2.3.1 Copyright Infringement & Machine Learning	14
2.4 Security Considerations	15
2.4.1 Processing of Claims, Anti-Spam Mechanism and Sybil Attack Prevention	15
2.4.2 Major Incidents	16
3 Photochain DApp	16
3.1 Photochain DApp Requirements	16

3.2 Photochain DApp Architecture	17
3.3 Open Source and Github	17
3.4 DApp Development	17
3.5 Third-Party Extensions	17
3.6 Photochain Client	18
3.7 Ethereum Gate	20
3.8 Ethereum Network	20
3.9 Photochain DB und IPFS Network	20
4 Photochain DAO	21
4.1 DAO Proposal and Voting	22
5 Photochain Token – PHOTON	22
5.1 Ethereum ERC20 Token	23
5.2 Core Properties of the PHOTON Token	23
6 Photochain Roadmap	23
6.1 PHOTON Crowdsale Facts	25
6.1.1 PHOTON Token Mechanics	25
6.1.2 Photochain Pre-Sale	25
6.1.3 Photochain Main Sale	26
6.2 Financing the Photochain Project	26
6.3 Revenue Projections	27
7 Team	29
References	30

1 Motivation

Today blockchain technology is enabling a global network of people to perform transactions of various kinds, peer to peer, without the need for a central governing authority. These new innovations allow people to verify these transactions safely and securely at any time.

Using Ethereum blockchain Smart Contracts, people are able to make digital agreements circumventing the need for a third party. Both parties must comply with the conditions of the contract which can be easily verified on the blockchain. Being decentralized, tampering is prevented.

Photochain is a peer to peer platform, releasing new concepts for a next generation stock photography platform. Photochain will be a vehicle for fair trading of digital works between artists and buyers.

The terms of use ensure a secure, easy to use and fair trading process for both parties. Artists will receive up to 95% of the final selling price of their digital works.

1.1 Unfavorable Sales Conditions for Artists

Currently there aren't many options available to photographers or designers who want to earn money in a fair way, selling their digital work. This is particularly concerning for amateur photographers and hobby artists who have not yet attained a high level of name recognition, which would enable them to sell their works at higher prices. For this group of artists, there are stock photography microstocks such as Shutterstock and Adobe Stock available (see [1.4.1](#)).

Although artists can reach lots of potential buyers by putting their digital works on these platforms, they only receive a tiny percentage of the sales price. Current centralized photo stocks can receive up to 90% of the profit margin^[2]. Also, the platforms have stringent requirements for the sellers. Due to these challenging conditions, the artist is obliged to publish a substantial number of images in hopes of being able to compete against high levels of competition.

Other problems include sellers being unable to set their own pricing, long waiting times for verification of the content, a large number of rejections of the work by the photo stock platforms, as well as long time intervals between payments.

1.2 Photochain DApp as a Solution to the Artist's Problems

By developing the Photochain platform, we present the possibility for artists to sell their works directly to their customers, on their own terms. Mediated by Smart Contracts, when a sale is made, the seller is paid, and the buyer receives the purchased picture immediately. Thus, Photochain doesn't require a centralised authority to ensure the correctness of transactions. This reliability is inherently contained in the blockchain technology.

The Photochain platform has been engineered from the ground up, to solve the problems of traditional stock photography platforms. For ongoing development, the wisdom of the community oversees the platform and machine learning is employed to find solutions for other problems (see [2.3.1](#)).

1.3 Photochain's Mission

Photochain has clear advantages for contributors and customers. Contributors at Photochain benefit from an extremely low fee - only 5% of the selling price. Keeping 95% of the final sale price allows contributors to offer their work cheaper. Consequently the market becomes more affordable for customers. This type of fair market not only benefits the users, but should benefit the photography industry as a whole, as the possibility of increased income incentivizes contributors to perform better.

These profound market changes are only made possible by using blockchain technology, Smart Contracts, machine learning and Photochain's own user community. Most of the processes become automated and decentralized, significantly reducing costs of platform governance. It's unavoidable that more and more stock photography contributors and customers will prefer to use Photochain.

The development of the Photochain platform is an ambitious and organically growing process. Our main aims for the project come under three significant prongs:

- **P2P Marketplace**

It's very important to us that only the artists themselves can determine the value of their work and they're given the opportunity to offer their work to many potential buyers.

- **Crypto Economy**

Photochain appeals to a broad audience of people that aren't yet adopters of blockchain and cryptocurrency technologies. The relatable use case of "Photochain" will appeal to this audience. The easy-to-use GUI and the trading process facilitates the onboarding process and supports the Crypto Economy in becoming mainstream.

- **Photochain Digital Copyright Chain: [DCC](#)**

Over the course of the project, more and more artists will be able to strengthen their copyright using the Photochain platform, since their works will be linked to their name. This link is manifested as a transaction in the Ethereum blockchain and is therefore visible to all users at all times. This means that the artist's

ownership of the image can be accounted for. The database with all manifested links has been constructed in a decentralised way, (for further details, see chapter 2). We call this database a [DCC](#).

1.4 Business Case

In this section we'll analyse the stock photography market and to who this project will appeal to.

1.4.1 Stock Photography Market

First, the characteristics of the photography microstock market, being a significant part of trading digital works.

Photography microstock is a steadily growing industry that can be defined by the following key points:

- Sales through the Internet
- Relatively uncomplicated acceptance of amateur photographers, as opposed to traditional photo-editing agencies
- Cheap pricing - from \$ 0.20 to \$ 50.00 for royalty-free (RF) licenses of images

The stock photography market is currently split among a few key players such as Shutterstock, Adobe's AdobeStock, Getty Images and several other smaller platforms. The estimated annual turnover of this market is currently around \$3 Billion. According to an analysis by Technavio, market turnover will grow to \$4 Billion by 2020[3].

1.4.2 Photography Stock Business Model

Since prices for digital content on photography microstocks are kept low, one can only achieve a high turnover if they were to sell a large number of works. Based on the data of a well-known photography microstock, it's possible to estimate the trading volume of an individual to earn \$1,000.

On average, in 2015 an image on this microstock cost \$2.80 and the company generated revenue of \$134 million per quarter. This equates to 47.8 million transactions per quarter (\$134 million/\$2.80), or approximately 530,000 downloads per day [4].

On average, an artist would earn \$0.25 per sold work, meaning they would have to sell 4,000 works in order to earn \$1,000. From this model, it becomes evident how difficult it is for an artist to obtain sufficient revenue on traditional platforms.

1.4.3 License Models

New and diverse license models have also come about with the development of stock photography technology. All these models have simplicity as their common goal, and serve to provide the opportunity for sellers and buyers to trade their products at low prices, without legal complications.

Rights Managed (RM):

The term "RM license" refers to the type of copyright license in which the user is only allowed to use the purchased work once. This explains the nature of use specified in the license. If the user wants to use the photo for another case, an additional license must be purchased. This kind of licensing is expensive, but in some cases still used.

Royalty Free (RF):

In the photography and illustration sector, the RF license is a copyright license in which the user has the right to use the work without limitations, based on a one-time payment to the licensor. This allows the user to use the work in several projects without having to purchase additional licenses. This less complicated approach to licensing is used on all Photography Microstocks.

We would like to make the licensing as easy as possible on the Photochain platform in order to ensure the simplicity of the purchasing process. This will enable large purchase volumes and is the reason we will suggest using RF as the standard license. However, Photochain is ultimately about giving the contributors freedom to decide their own terms, so they can freely choose between RF and RM licensing.

1.4.4 Customer Groups of Photography Stocks

Business and Marketing Agencies

Business customers and marketing agencies need the content for a wide range of internal and external uses such as websites, prints, ads, annual reports, brochures, employee communications, newsletters, email marketing campaigns and presentations.

Media Organizations

Media professionals need digital content for publications, newspapers, books, magazines, TV and films. These companies include everything from independent bloggers to multinational publishers to radio broadcasters.

1.4.5 Market Opportunities for Photochain

According to information from a well-known photography stock, its turnover in 2016 has been estimated at \$756 million. There are a total of 1.7 million active buyers and 100,000 artists on this platform. These figures could

increase significantly for 2017.

These key figures demonstrate the vast potential of this market. Moreover, allowing artists to receive up to 95% of the profit margin, significantly increases the platform's potential for adoption and standard use.

2 Photochain Platform

With all currently existing stock photography platforms, the only way security of transactions can be ensured is via central control. Our platform works autonomously, securely and efficiently based on predefined rules.

We are developing the Photochain DApp [\[5\]](#) on the Ethereum blockchain. Additionally, Photochain also uses computer vision (machine learning) to fulfill the specific technological requirements of stock photography.

The Photochain DApp is a platform on which artists have the opportunity to sell their work to a broad audience at a price they themselves set, and where sellers are also fully and solely liable for the works they sell themselves.

The Photochain Team does not have any liability or responsibility for illegal behaviours of the sellers. The artist is responsible for the legality of the works they are selling, and is held fully accountable for any illegal activity. However, Photochain will uphold users' copyright protection, by preventing any unauthorised sale of photography.

2.1 Rulebook of the Platform

To ensure the self-sufficiency of the Photochain DApp and to reduce the governance of the platform to a minimum, a technologically supported rulebook was developed.

2.1.1 Photochain Network Governance

Photochain's Governance team is tasked with accompanying the Photochain DApp on its way to being a fully-formed [DAO](#). Photochain Governance develops new versions of the clients' as well as Photochain's Smart Contracts. It also implements the rules as well as running the infrastructure (IPFS Node, Ethereum Node), which will be initially necessary. Furthermore, Photochain Governance offers a team of moderators that will, especially in the initial phase of the DApp, be needed to resolve claims.

Photochain Governance will not take part in any of the following activities when using the DApp Smart Contract:

- Changing the initial rules / Smart Contracts on the network. These changes can only be accepted as a proposal, by a majority vote of all users, and only then implemented
- Affect the circulating PHT supply. Once the PHOTON tokens are initialized, no additional tokens can be produced in the future. The value of the PHOTON token on the market is subject to the law of supply and demand
- Freeze accounts
- Withdraw funds

Photochain Governance is authorised to undertake the following activities:

- Block a buyer according to an entitled claim
- Develop new versions of the Web client
- Develop new versions of the Photochain Smart Contracts until Photochain becomes a DAO (planned Q4 2019). From that point onwards, future change proposals can be determined by the coordination of all Photochain users.

2.1.2 Onboarding

A simple design is of great importance in the onboarding of our DApp. When opening the web client, the user can either generate a new address in the Ethereum Network or import an existing one. This address counts as the wallet address of the user and can be saved in the Main Smart Contract. Thus the user becomes a member of the Photochain community and is saved in the Photochain User DB (See chapter [3.9](#)).

2.1.3 Roles and Permissions

As for permissions, we distinguish between the seller and the buyer.

- **Seller:** An artist has to reveal his identity to become a seller on the Photochain DApp. This step is necessary for the [DCC](#) to be filled with works while preserving copyrights. It maps artists together with their work. The registration process is largely automated: The user holds his ID card in front of the webcam, and the computer vision algorithm used by us extracts all relevant data. The addresses of the sellers and buyers will not be mapped with the corresponding names because of an anonymization mechanism. (see also [2.2.2](#)).

The following personal data of the sellers will be saved in the Photochain User DB:

- Name and address from the ID card (entitles them to solve claims and serves in the prevention of abuse of the Photochain DApp via spamming)

– Accounts in social networks (not a required value)

This data is encrypted according to information security best practices and saved in the license DB (see chapter [3.9](#)). Here, only the seller can see his wallet address, whereas their name is visible to all buyers.

- **Buyer:** Every Photochain User can act as a buyer. For a purchase, no personal data is required (like it is for the sellers). It is, however, still recommended that buyers register using their personal data. If the personal data of a buyer is present, a seller can enter these into the issued invoice. If they are missing, the wallet address is used instead. Should proof of the purchased license be necessary, the wallet address would be displayed in place of the personal data.
- **Moderator:** The chief responsibility of moderators is to resolve claims. Thus they act as the keepers of the Photochain ecosystem. This task is rewarded both monetarily and by a ranking-increase ([2.3](#)). The duty of a moderator can, in theory, be taken up by any Photochain user. A seller can become a moderator after registering. A buyer has to register with his personal data in order to become a moderator.

Studies on 'behaviour in social networks' has shown that there are always enough people that wish to help sustain the community. The only sufficient incentive that could be determined for this was the reward of elevated ranking [\[6\]](#).

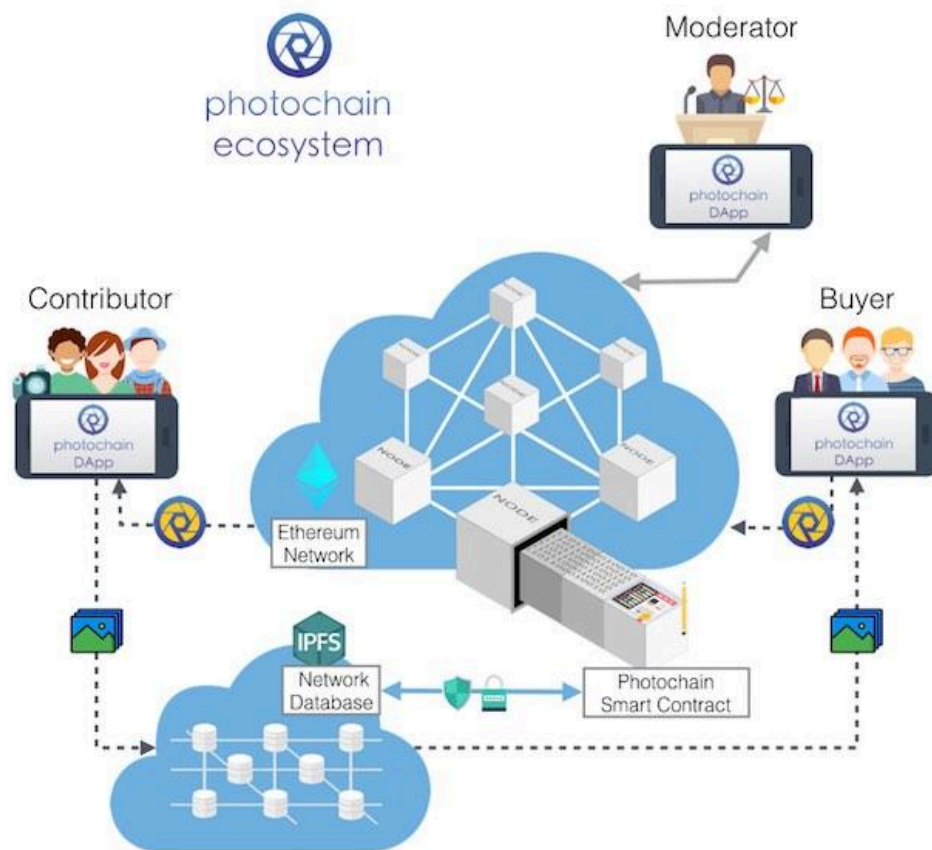
2.1.4 Ranking-system and Reward

We have developed a ranking system that serves as motivation, ensuring the maintenance of the Photochain Community through fair rewards. The increase of rank correlates to an increase of trust to the trade partner and also of the Photochain DApp. The minimum requirement for joining the rankings is registration with a name.

- The moderator gets one point for their contribution to solving one claim (+1)
- For each sold image, the seller receives one point (+1)
- The pictures of sellers are placed according to their ranks in the search results
- An increase in ranking by one point (+1) corresponds to 0.1 PHT. Once the rank of the moderator has grown to 100 points, a payout from the reserve will take place, and the amount in PHT will be transferred to their wallet address

2.2 Photochain's Ecosystem

The Photochain DApp is a platform specialized in the trade of stock photography, in which processes are reduced to a necessary minimum in order to guarantee simplicity and transparency.



2.2.1 Payment (Rewarding) Process

The payment (or rewarding) process is simple. After selecting the works of interest to them, the buyer is prompted to reward the sum in **PHT**. The **PHT** tokens are the means of reward of the Photochain DApp and can be purchased in the Crowdsale (more on that in chapter 5).

Further along the process in developing the Photochain DApp, we will offer an exchange service between cryptocurrencies within the Photochain Wallet module (see chapter 3.6).

To ease the start for people unfamiliar with Blockchain and cryptocurrencies, Photochain will seek to establish a partnership with prominent fiat to crypto services. This makes it possible to pay into fiat money and eases onboarding onto the Photochain DApp. Further explanations follow in chapter 3.8.

2.2.2 Anonymous Transactions

An important point is the anonymity of the transactions. The two trade partners can see each other's names, but will not be able to establish any link between personal data and the Ethereum addresses from which transactions are made. The mechanism of anonymization used by the Photochain DApp will be described here in a simplified manner.

All transactions run through a Smart Contract which ensures the names of the artists and their Ethereum addresses cannot be connected to each other. Rather than payout immediately, the trading Smart Contract pays out to all the sellers either once per day, once every four days, or once every seven days. The frequency of the payouts can be chosen by the seller themselves, however the order of payouts is wholly randomized.

The more frequently payouts happen, the more likely it is that the trade partners can find out each other's Ethereum addresses, so a lower payout frequency is recommended. But likelihood of this also depends on the frequency of a specific piece being bought in one payout period. If a piece is bought multiple times during a payout period, the trade partners couldn't locate each other's addresses, because they wouldn't know who is behind the additional purchases.

2.2.3 DApp Fees

Photochain Governance will be developing the new version of the DApp clients, offering new microservices and maintaining the vitality of the platform, until Photochain has finished transitioning into a DAO. These functions require financial support, because the team members work fulltime on these tasks. Additionally, the team runs the fundamental infrastructure necessary for the Photochain DApp to function, such as an IPFS Node, load balancers, etc. These support functions are why Photochain Governance takes min. a 5% fee - deducted from successful transactions. Since prices for the micro stock photography are very low, for example, if there's a stock photo for 5 EUR, the fee is only 25 cents. Depending on the chosen premium model, the fees vary between 5% and 15%.

The 5% min. fee is divided as follows:

- 0.02% as an Ethereum network fee, which is paid to miners and for interaction with the Photochain Smart Contract
- 0.98% for data storage, as pictures or digital works require vast storage space
- 2% is devoted to the Photochain Governance Team for further development and moderation
- 2% for the Photochain DApp reserve

2.2.4 DApp Reserve

Some processes in the Photochain DApp, such as the rewards for resolving claims, or the remuneration for a breach of copyright, require a reserve. This reserve is filled via a transaction fee of 2% (included in the overall fee) and is paid into a dedicated Multisig Ethereum wallet. Thus, higher payouts from the reserve funds (such as repayments for a violation of a copyright), need to be approved and signed off by two moderators of the highest level and the Photochain Governance Team. Smaller payouts (such as the reward for resolving a claim) are processed automatically.

2.3 Copyright

With Photochain we'll create a Digital Copyright Chain - **DCC**, which aids in many aspects of copyrights. This is because the DCC fully maps the link between a piece of work and the associated author of that particular work.

Generally speaking, a transaction on the Photochain DApp has already served as proof of a proper license acquisition for the buyer. Exceptions are posed when sufficient proof exists the seller has infringed on the copyrights of third parties.

It must be taken into account that a unified global digital image database, containing works with a direct and traceable link to its original author, does not yet exist. By adding new artists and their works to the Photochain **DCC**, a decentralized copyright database will be implemented using the Blockchain. The growth of the Photochain DAO complements this decentralized database and focuses on solving issues in relation to copyrights in digital works. Everyone can see when, and by which artist, a work was uploaded.

2.3.1 Copyright Infringement & Machine Learning

One of the main issues of stock photography are the various violations of copyright law. For example, cases emerge when a person, other than the author themselves, unlawfully offers a work for sale. We have developed a four-stage scheme against this type of infringement while using both technology enabled methods, machine learning, and the knowledge of the Photochain community.

Stage 1:pHash

It's essential to ensure that each work only occurs once within the Photochain DApp. This problem is solved by the perceptual hashing algorithm^[7], which can classify images according to their similarity and identify all identical pictures by setting up a threshold where they can be matched. The pHashs of photos are stored in the pHash database and a link with the names of the artists will be set up accordingly. This ensures that the work only occurs once and is assigned to only one author. If another author tries to offer an already saved work on the Photochain DApp, the technology will automatically prevent this action.

Stage 2: Claim

If a work being traded on the Photochain DApp infringes the copyrights of third parties (for example, stock

photography downloads), after a report by a community user, a claim may be filed. The plaintiff must prove (for example, by providing a link to the work) that the same work already exists and was created by another artist. Our computer vision algorithm compares the works and calculates the similarity.

- If the algorithm detects substantial differences, the claim is automatically closed
- If the works are considered to be identical (or near-identical), the claim proceeds to **step 3**

Stage 3: Claim and Wisdom of the Community

If the images are identical, the claim can be seen in the claims tab of the Photochain Client and will be visible to all users. To determine the validity of the claim, ten ranked community artists need to view the request manually and decide its legitimacy. These artists are classified as moderators (see chapter 2.1.3).

They will receive a commission from the reserve fund as compensation for their work. The provider of the copyright infringing image will be blocked, and their Photochain account will be frozen. However, if the claim is found to be illegitimate, the case will be closed. Action may be brought against the plaintiff should their motivations to make false claims be deemed malicious.

Stage 4: Appeal

If, at **stage 3**, it has been democratically decided that the artist has infringed the copyrights of third parties, the appellant's Photochain account including its funds, will be frozen for three months. They have the possibility, however, to submit an appeal to the Photochain Governance. The Photochain Governance will resolve the claim to the best of its knowledge and belief. If the request is seen as justified and is upheld, then all available funds from the Photochain wallet of the appellant go into the Photochain reserve fund.

2.3.2 Problems with Illegal Content (Pornography, etc.)

Another potential issue is the uploading of illegal content. This applies especially to pornographic and other offensive content. To avoid this, we use advanced technology for image analysis based on neural networks. For the recognition process, we utilize Yahoo's Open Source solution[8] and its Deep Learning Algorithm, which recognizes pornographic content. Every image exchanged in the Photochain network will be analyzed on a scale of 0 to 1 of pornographic content.

After various experiments, we lowered the threshold to a level where images that display pornographic content are not able to get through Photochain. The error rate currently lies between one image per 10,000 uploaded images. Should unauthorized pictures gain access to the Photochain network, despite constant improvement of the porn filters, we will use human intervention. Similarly to the copyright problem, a claim for offensive content can be opened by members of the network. This claim should be confirmed by ten other users in exchange for rewards. If this is the case, the picture is deleted and the provider will be blocked.

2.4 Security Considerations

The Photochain DApp has been developed in accordance with the latest security standards and is subject to a Continual Improvement Process. The Photochain Governance Team is dealing with a tracking issue and will use their best practices to improve the Photochain Client. This applies in particular to the security updates within Photochain Smart Contracts.

2.4.1 Processing of Claims, Anti-Spam Mechanism and Sybil Attack Prevention

The forwarded claim appears in the claim tab (3.6) of the Photochain DApp. An authorized user (see chapter 2.1.3) decides whether the claim is legitimate and delivers his vote. To prevent spamming or random voting, we use the best practice of online voting and set up the following obstacles for attackers:

- In general, a user holds one vote
- A ranking of at least five to solve a claim (five sales, account existing for at least one month, two successfully solved claims)
- CAPTCHA query for voting
- Only three votes per moderator per day

We are convinced that this procedure can effectively prevent a Sybil attack on the Photochain DApp. While the attacker can generate many identities, there cannot be an increase in their ranks without being active on the Photochain DApp by trading and aiding in the solution of claims.

2.4.2 Major Incidents

In case a major incident occurs, the Photochain Governance Team has the ability to stop all Photochain network activities until a solution is found. The Ethereum wallets of Photochain users will remain unaffected. This means PHT Token can continue to be traded.

3 Photochain DApp

3.1 Photochain DApp Requirements

These are the design requirements for the Photochain DApp. The requirements result from current issues with microstock photography, which we have already presented in the previous sections, as in 2.3.1.

1. **Decentralized governing bodies:** The Photochain DApp network must be decentralized.
2. **Security:** Transactions are intended to be safe and verifiable at all times for both artists and buyers.

3. **Decentralized Storage:** Transaction data, as well as all digital works traded on the Photochain DApp, should be stored decentrally and encrypted. Photochain will use the IPFS protocol and the Photochain DB (see chapter 3.9).
4. **Content:** The network is intended exclusively for the trade of stock photography. In particular, offensive content such as pornography will not be allowed.
5. **License Terms:** Observance of copyrights must be ensured.

3.2 Photochain DApp Architecture

The listed requirements can be realized technically through the DApp on a Blockchain basis. The correct executions of the transactions, as well as the platform's rules, are realized through the use of Smart Contracts. Requirements 4 and 5 will be realized using computer vision and machine learning algorithms.

Here, we will rely on the Ethereum blockchain when it comes to Photochain, as we are impressed by the platform's flexibility, reliability and its long-term success. The global support of Ethereum by the [Ethereum Alliance](#) implies wide, interdisciplinary industrial acceptance and offers the necessary proof for the platform's long-term existence.

3.3 Open Source and Github

We are convinced that open source is the most suitable approach for developing DApps, as it will accelerate their continued development. Each user will be able to evaluate the code on their own and thus be able to provide feedback. It's not without reason that so many global enterprises employ open source software or offer their solutions in the open source format. Projects like Github offer great support in this matter. This is why we plan to make the code available on our Github channel after the second phase of the project. Community contributions will be crucial for the next version of the Photochain DApps.

3.4 DApp Development

We act in accordance with the best quick web development practices. There are three stages our DApp, or DApp updates, go through, in their development cycle. We develop and test our Smart Contracts on the Ethereum Testnet and on the private Ethereum blockchain. Only after a careful evaluation via independent agents do we implement the Smart Contracts on the Ethereum Mainnet:

- Development Environment (Ethereum Testnet for Smart Contracts)
- Test Environment (Ethereum Mainnet, testing is carried out in small amounts)

- Production Environment (Ethereum Mainnet)

3.5 Third-Party Extensions

The Photochain DApp is written in Javascript in order to ensure platform independence. First, we develop a browser-based web client. For interaction with the Ethereum blockchain, we will use the tried and tested Infura API throughout the first phase of the project. As the project continues, we plan to provide an Ethereum Node with an API.

3.6 Photochain Client

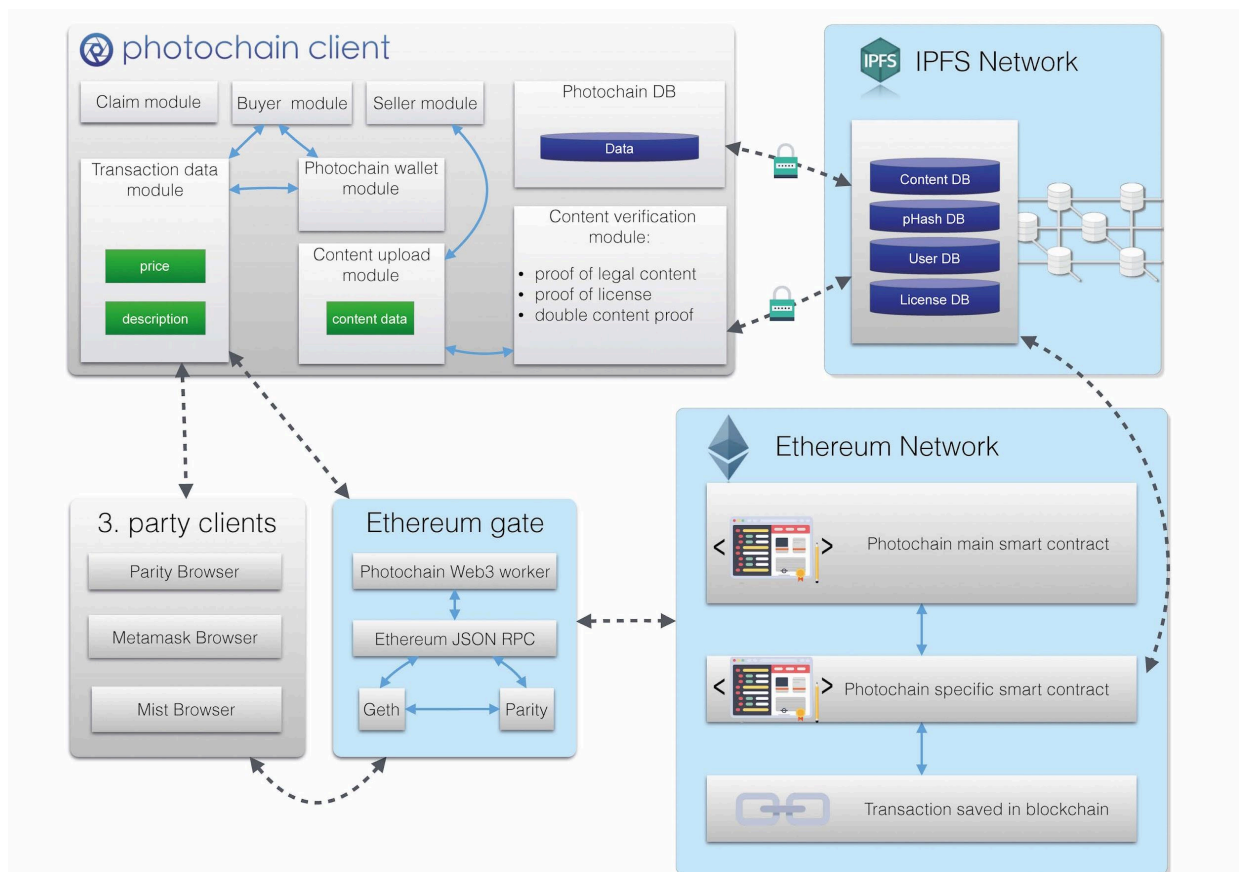


Figure 2 schematically depicts the architecture of the Photochain DApp. The Photochain client is a central component. It will first be available as a web client and will then be developed for current operating systems beginning with phase 2 of the project. The client is used to realize the p2p interaction between transaction partners and consists of several modules:

The **Claim Module** is used by Photochain users in order to act against copyright infringements. If a piece is suspected of infringing upon a copyright, the claim module will be invoked. The workflow of the claim process was already described in chapter 2.3.1. In order to prove copyright infringement for a particular piece, a link to the original source, such as a stock photo, must be provided, from which it can be clearly deduced that:

- The image is the same as on Photochain DApp
- The author's name is visible and it's a different artist than the seller on the Photochain DApp

Our machine learning algorithm analyzes whether these requirements are fulfilled. If they are not fulfilled, the claim is automatically rejected, as it's obviously not copyright infringement. If the requirements are fulfilled, then the moderators will decide over the legitimacy of the claim.

The **Seller Module** offers the seller a simple way to offer his piece for sale on the Photochain DApp. The upload of the piece is realized through the **Content Upload Module**.

The **Content Upload Module** stores the file on the IPFS network.

The **Content Verification Module** verifies whether copyrights are infringed upon, or if the content contains illegal material. To do this, the module uses our **IPFS Photochain node**.

The **Buyer Module** offers a comfortable search mechanism for works within the Photochain DApp. Computer Vision algorithms are used in order to make the images searchable using various criteria:

- Contextual search using tags
- Search of similar images
- Retrievability via image content through computer vision algorithms

The **Payment Wallet Module** has access to the Photochain user's Ethereum address, where the user has exclusive access to his private key, because it is encrypted on the client side. The user can either import his existing address or create a new Ethereum address (see chapter 2.1.2). The user sees their wallet balance in PHT tokens and can view their transaction history. In the future, we will be adding crypto exchange functions to allow for the exchange of PHT and other crypto tokens.

The **Transaction Data Module** is used for the transaction process and is always active in the background. The price, as well as the description of the piece, are forwarded to the **Photochain Main Smart Contract** via this module, which is implemented in the Ethereum network.

3.7 Ethereum Gate

The Ethereum Gate is responsible for the actual interaction with the Ethereum network. This gate is used to transfer the data to the Photochain Smart Contracts. We will use the Infura API in the first phase. As things develop, we plan to create our own Ethereum node API.

3.8 Ethereum Network

Ethereum is a p2p network that provides a platform for implementing Smart Contracts and is based on its own public blockchain. Ethereum uses the cryptocurrency Ether as a means of payment for the computing power that participants provide to the distributed system. The Smart Contracts are written in the programming language Solidity which has been specifically developed for Ethereum [9].

The **Photochain Main Smart Contract** has been developed to ensure everything runs smoothly during the trading process. This Smart Contract is a template. A Smart Contract specific to the transaction is generated from this template when a purchase is made.

The **Photochain Specific Smart Contract** is generated from the Photochain Main Smart Contract. The structure of the Photochain Specific Smart Contract can be clarified by the following description: When purchasing the work, the buyer carries out a commercial transaction with the seller. The important data for the deal, such as the price, the description, and the seller's name, are all stored in this Smart Contract. The seller is then asked to transfer the amount from his wallet in PHT. The Smart Contract will keep the transferred amount until the buyer has received the work they purchased. The work will appear in the Buyer module and is available for download. This ensures both parties have fulfilled their part. The transaction is stored on the Ethereum blockchain.

3.9 PhotochainDB und IPFS Network

The decentralised character of the database plays an important part in the Photochain DApp. The requirements for the Photochain database are as follows:

- High availability
- Decentralized use
- Structured data storage

- Data erasure
- Speed

The InterPlanetary File System (IPFS) is a protocol designed to create a permanent and decentralized method of storing and sharing files. It is a content-addressable, peer-to-peer hypermedia distribution protocol. Nodes in the IPFS network form a distributed file system. IPFS is an open-source project being developed since 2014 by Protocol Labs, with help from the open-source community [10].

The IPFS network complies with some of these criteria and, in addition, is currently the only de-centralised storage solution that works. For the first phase of our project it is sufficient to have a Merkle tree-based algorithm for the structuring of the Photochain data on the IPFS node.

A NoSQL database is particularly advantageous as the Photochain DApp develops, especially with the growth of the data on IPFS through newly-uploaded works. However, a functioning decentralised NoSQL database has not yet been developed. That is why we're working on a database as a top layer of the IPFS node, something that is best suited for the photography microstock Use Case. We are tracking projects such as BigChain DB and Ties, and plan to use their solutions from the decentralised databases, if these are more advantageous than our IPFS-based solution.

Users work's data on the IPFS node is encrypted. The keys are released to the buyer via the smart contract when the purchase is made, so the purchased work can be downloaded in the correct resolution. Since the data addresses in IPFS are generated exclusively for the uploaded file with each upload, only they know who the uploaders are. After the purchase, the file is copied to the IPFS node via the smart contract and therefore from the buyer to the client, meaning only the buyer knows the address. Protecting confidentiality on the network is thus maintained.

pHash DB contains all the pHashes of the works that have been uploaded in the Photochain network. It is used by the content verification module.

User DB contains the Photochain users' ID data. These are used for transaction processing on the smart contract so only the names, not the Ethereum addresses, are visible on the sales invoice.

Lizenz DB contains the link author + content + date of upload, thereby presenting proof of copyright protection.

Content DB contains the content files which were stored after successful uploading. After a successful Photochain deal, the file is copied to the buyer's Photochain client via the smart contract.

4 Photochain DAO

A "decentralized autonomous organization" (DAO) is an organization governed by an initial set of rules and codified into Smart Contracts. This organization's biggest strength is rooted in the decision-making capacity of its community as future developments and changes undergo a democratic voting process [11].

Some of the Photochain DAO's most interesting qualities are the possibility of scaling, lack of a single unit or person for criticism and the instinctive commitment to the rules of the game, thanks to the Smart Contracts.

Photochain Governance and the moderators are responsible for the stability of the platform. Moderators differ slightly in that they are rewarded for their contribution. Studies suggest that creating personal agency amongst users of such platforms, or networks, enhances the long-term development of the platform [12].

4.1 DAO Proposal and Voting

In our role as Photochain Governance, we've made it our goal to guide the Photochain DApp toward DAO. It is especially vital in the beginning phases to bring forth new client versions, strengthen the community and develop new microservices. Still, all decisions regarding platform changes will be made by authorized users according to the democratic voting process.

Should Governance propose modifications to the Photochain DApp Smart Contract, all authorized users will be informed. As a general rule, we believe that the power of each vote should depend on the user's activity within the Photochain community. Regarding voting power:

$$G = \frac{(R - 1)}{R} \quad (\text{Weight of a vote})$$

$$S = \frac{\sum G_p}{\sum G_p + G_n} \quad (\text{vote counting for proposal acceptance})$$

G is the voting power (maximum 1), R is the user's rank and G_p or G_n is the power of the positive or negative vote. When applied, this could mean that a user where $R = 5$ has a voting power of 0.8, and therefore will contribute substantially to the future of the Photochain DAO. Furthermore, a proposal requires a 90% acceptance by the community in order to be adopted.

5 Photochain Token – PHOTON

PHOTON tokens are the means of rewarding users across the Photochain Ecosystem. Any type of transaction on the platform will require the use of PHOTON Tokens.

Use cases for the Photon Token are:

- Access to the services of the Photochain platform
 - Rewarding the resolving of claims
 - Listing on a "featured photographer" section
 - Service delivery from Photochain's partners (like our cooperation partner 1World)
 - Featured in search results

- Other microservices, which will facilitate the Photochain Ecosystem in the future
- Reward system
 - For the photographers and their services

The number of PHOTON tokens will be strictly limited by the declared Hard Cap. After the Crowdsale 21% of the PHOTON Tokens will be reserved for the Team, Advisory board, Photochain partners and legals. After this event, no other PHOTON Tokens will be issued.

Due to the common regulatory situation, it is important to note that PHT is purely a utility token, which does not replace fiat currency and cannot be treated as a currency or an investment asset. In no case can PHOTON Token be regarded as a security token or similar. Rather, they're to be regarded as a means of exchanging services in the Photochain Ecosystem.

5.1 Ethereum ERC20 Token

A crypto token is a digital asset that represents a certain value. From a technical standpoint, tokens are implemented as Smart Contracts in the Ethereum public blockchain. The ERC20 token represents the current standard today [13], and will be used, according to best practices, as the PHOTON Token standard. This standard enables compatibility with other Smart Contracts in the Ethereum ecosystem. This means the token Smart Contracts don't have to be updated when new tokens are issued. This ensures stability and seclusion of the Ethereum ecosystem. All ERC20 tokens have the same set of functions and can be sent to almost all crypto wallets that accept Ethereum.

5.2 Core Properties of the PHOTON Token

We follow Ethereum best practices when designing the PHOTON token smart contracts and attach immense importance to security audits. We subject the token Smart Contract to various security-based audits before we publish the smart contract on the Ethereum mainnet.

The PHT token is based on the following core properties:

- Name: PHOTON Token (PHT)
- Standard: Ethereum ERC20
- Maximum Token Supply: 230,000,000 PHT tokens
- Release Date: Our Token Generation Event will take place right after the end of the Main Sale Event. It may take up to 60 days to distribute the PHOTON tokens to contributors
- Represented value: Tokenization of photography services

We are forming partnerships in the area of token liquidity and we plan to cooperate with projects, such as Monaco, to offer payment options into the Photochain ecosystem using fiat currency. This functionality is

especially intended for users that are not yet fully comfortable with cryptoassets, making it easier for them to get started. The goal is to provide a seamless process also for Fiat-based users using an internal exchange to enable mass adoption.

6 Photochain Roadmap

The Photochain peer-to-peer marketplace and ecosystem development is technologically and organizationally an ambitious project and needs careful planning. We run the project with a mixture of agile methods like Scrum and classic IT project management ITIL. Important milestones of the Photochain roadmap are listed below.

Apr 2017	Idea and business case	• Develop business plan • Market research
Sep 2017	Prototyping	• Development of the DApp prototype • Start to form team
Oct - Dec 2017	Preparation for crowdsale	• Marketing and preparation activities • Get support from blockchain and photography community • Register company in Estonia • Start to form advisory team
Jan 2018	Private ICO pre-sale	• Private Pre-Sale at special discounts for early supporters • New partnerships • Onboarding Beta Customers/Advocates • Prepare ICO platform provided by Swisscom Blockchain AG
Apr 2018	Main ICO sale	• Execute ICO with different stages and discounts • Establishing a connection to the Cryptovalley • Regulatory compliance • New collaboration in the photography industry • Minting of Photon tokens at the end of the ICO
Sep - Dec 2018	Prepare go-to market	• Continue developing Photochain DApp • Mainstream adoption campaigns for Photography industry • Expand development team • Photography influencer support campaign • Trading Smart Contracts on Ethereum Mainnet • Adoption of Photon token/fiat exchange • Implementation of new IP Rights management • Acquisition campaigns (photography stocks) for fast scaling

		• Prepare operational services
Q4 2018	Launch Platform	• Photochain API for better integration with other services • Partnering with a famous brand in the photography industry • Photochain Web - DApp 1.0 with basic functionality on main OS (iOS/Android/MacOS/Linux/Win) • Launch support services
Q1-Q2 2019	Business Development	• Client growth strategy • Accept new forms of payments • 3rd Party Integrations • Integrating with other media blockchain DApps • Simplifying of UI • Paid microservices for strong revenue
Q3-Q4 2019	Market Expansion	• Readiness for the complete mass adoption • Blockchain as protocol in the background • Partnerships with agencies • Stabilizing the vitality of Photochain ecosystem • Concept development of an own Photochain protocol • Supporting hardware gadget for Photochain (camera support for the uploading the photo direct to Photochain)
Q1-Q4 2020	Market Domination	• Implementation of an integrated ecosystem based on an own Photochain protocol • Photochain DApp becomes a standard for the fair photography trading • Photography stock Market Share of 10%

6.1 PHOTON Crowdsale Facts

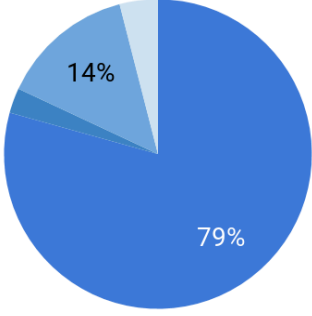
The realization of the Photochain project will be offered through two main crowdfunding stages: the Pre-Sale and the Main Sale. We'll publish weekly reports about the PHOTON crowdfund in our Blog on [Medium](#), and discuss it with the community. We want to maintain maximum transparency in all project phases.

According to best practices of the crowdfunding process, the amount of PHOTON tokens makes for a realistic Hard Cap. The PHOTON token issuance will take place after the crowdfunding phase. It may take up to 60 days to distribute the PHOTON tokens to contributors.

According to the current regulatory situation, we will perform a KYC/AML check of every contributor in the Photochain crowdfunding process. This procedure is needed to guarantee the long-term compliance of the Photochain project.

6.1.1 PHOTON Token Mechanics

Token Mechanics	Metrics
Token Name	PHOTON (PHT)
Price per Token (in USD)	0.12 USD
Pre-Sale Cap (PHT Tokens)	10,000,000
Main Sale Cap (PHT Tokens)	170,000,000
Max. Supply (PHT Tokens)	230,000,000
Token Privileges	platform utility token

Token Allocation	%	 - Token Sale - Bounty - Management & Team & Legal - Advisory
Token Sale	79%	
Management & Team & Legal	14%	
Adviser	4%	
Bounty	3%	

6.1.2 Photochain Pre-Sale

We will finance the development of the Photochain DApp through the use of funds collected in the crowdfunding laps. The funds collected in the Pre-Sale lap will be used especially for marketing campaigns and regulatory compliance.

Pre-Sale PHOTON token Hard Cap: 10,000,000 PHT

Currency accepted: ETH, BTC, LTC

Token exchange rate: 1 PHT = 0.000085 ETH (accordingly in other cryptocurrencies, a discount of 50% of the standard PHT price).

Amount of tokens per one person: unlimited

Minimum transaction amount in Ethereum: 0.1 ETH

Maximum transaction amount in Ethereum: unlimited (within Hard Cap)

Minimum transaction amount in Bitcoin: 0.003 BTC

Maximum transaction amount: unlimited (within Hard Cap)

Start date: January 2017

End date: Now closed

6.1.3 Photochain Main Sale

The Photochain Crowdsale is an important milestone for the future of the project. The financing will mainly be needed to expand the Photochain Governance Team and for delivering the 1.0 version of the Photochain DApp.

ICO Main Sale I “Community ♥ Sale”, for 3 days:

(open sale, non-capped within hard cap but with smaller individual maximum transaction amount)

Start date: 06.04.2018 at 00:00 am CET

End date: 08.04.2018 at 23:59 pm CET

Time based discounts for the PHT tokens price during the Main Sale I Event:

Day 1 to 3: -30% discount => 1 PHT = 0.084 USD

with optional (voluntary) vesting period of 12 months: -40% discount => 1 PHT = 0.072 USD

Maximum transaction amount = 25 ETH

ICO Main Sale II “Braveheart Sale I & II”, for 30 days:

(open sale, non-capped within hard cap limit)

Start date: 09.04.2018 at 00:00 pm CET

End date: 08.05.2018 at 23:59 pm CET

Time based discounts for the PHT tokens price during the Main Sale II Event:

Day 1 to 10: -30% discount => 1 PHT = 0.084 USD

with optional (voluntary) vesting period period of 4 months: -35% discount => 1 PHT = 0.080 USD

Day 11 to 30: -20% discount => 1 PHT = 0.096 USD

with optional (voluntary) vesting period period of 6 months: -25% discount => 1 PHT = 0.090 USD

Maximum transaction amount = 10,000 ETH

ICO Main Sale II “Braveheart Sale III ”:

(open sale, non-capped within hard cap limit)

Start date: 09.05.2018 at 00:00 pm CET

End date: 18.08.2018 at 23:59 pm CET

Time based discounts for the PHT tokens price during the Main Sale III Event:

-15% discount => 1 PHT = 0.102 USD

Maximum transaction amount = 10,000 ETH

ICO Main Sale III “Remnant Sale”, for additional 20 days:

(open sale, non-capped within hard cap limit)

Start date: 19.08.2018 at 00:00 am CET

End date: 28.08.2018 at 23:59 pm CET

Time based discounts for the PHT tokens price during the Main Sale III Event:

Day 01 to 10: -10% discount => 1 PHT = 0.108 USD

Day 11 to 20: -5% discount => 1 PHT = 0.114 USD

Maximum transaction amount = 10,000 ETH

General ICO Sale Information/ Token Economics:

Maximum Amount of PHOTON Token: 230,000,000

PHOTON Token ICO overall Hard Cap (total tokens for sale): 180,000,000

Currency accepted: ETH, BTC (from 17 August 2018 also Fiat, Altcoins)

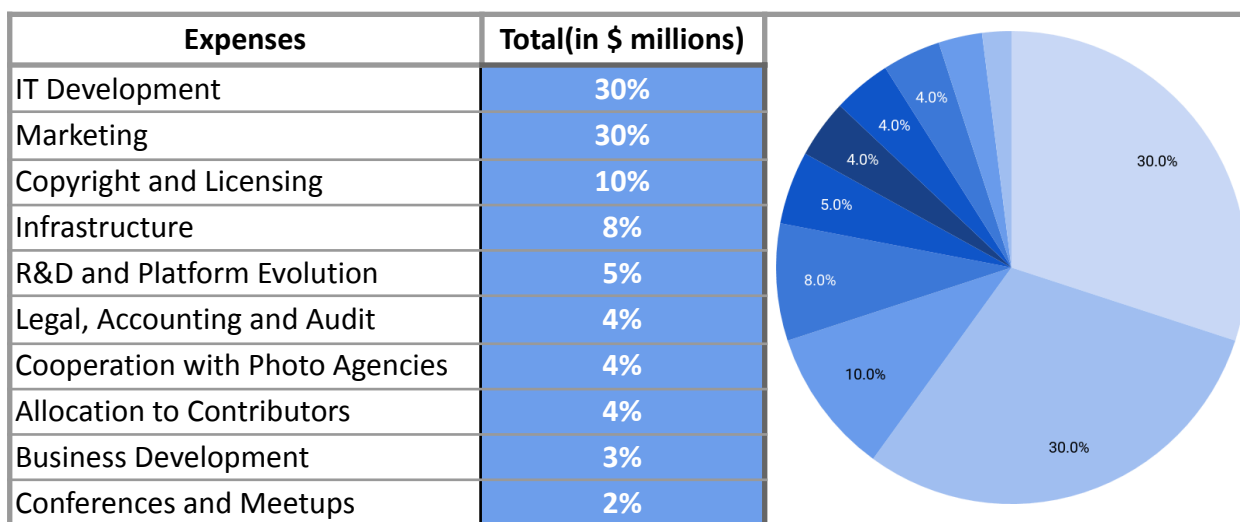
The base exchange rate is 1 PHT = 0.12 USD (cryptocurrency equivalent at real-time exchange rates at time of transfer, time based discounts apply)

Minimum transaction: (0.2 ETH and corresponding value in BTC but depending on the sale phase)

Maximum transaction: (dependent on sale phase. Between 25 ETH and 10,000 ETH - corresponding value in BTC)

Only sold and allocated tokens are minted (no need to burn unsold tokens)

6.2 Financing the Photochain Project



In order to ensure speedy realization of the Photochain project, it's necessary all Photochain Governance members are financed for full-time work. The team will be continually expanding, especially in areas of developing and marketing. Since, in our opinion, in some Blockchain projects, security considerations fade into the background, we will dedicate a lot of attention to this topic. The development of safe Smart Contracts is only possible through well-planned test phases. We are convinced that the long-term success of the platform can be guaranteed, among other things, by ensuring a safe environment.

Additionally, a lot of publicity work will be done. Especially meetups and other events will be used to approach the photographers' community around the world. Since the legal situation of token projects are not completely

cleared up yet, we will dedicate reasonable means to legal overheads.

As a p2p DApp, Photochain is available around the entire world. Although the legal frameworks developed by us use world-wide standards like RM and RF licensing, it's necessary to consider the laws of each country in question.

6.3 Revenue Projections - 10% of market share by 2022

After successful crowdfunding, the development of the Photochain DApp will be provided by an operational company, Photochain OÜ. Different models of transaction fees will be created, mainly depending on the infrastructure usage. The current draft of the fees is following:

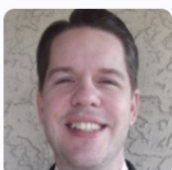
BASIC	SILVER	GOLD
5% fee	10% fee	15% fee
Storage of photos on the client IPFS node	Storage of photos on Photochain IPFS nodes	Storage of photos on Photochain IPFS nodes
3 day support	10 GB monthly	Unlimited storage
	36 H support	Featured in search results
		18 H support

As the platform grows we plan to add a number of additional micro-services such as advisory, preferred listing, preferred photographer, hosting services and others in order to either generate new revenue streams or to increase the platform stickiness.

We can introduce revenue projections by deriving key metrics from the photography stock industry. Our assumptions on these figures are very conservative, based on the financial business case, as well as empirical data from the industry.

Revenue Projections		(# Contributors) x (1000 Photos/Contributor)	# Clients on the Photochain Platform	(# Clients) x (2000 Photo/annum)	(#Transactions) x (2 USD/Transaction)	(#Transactions) x (12.5% fee) x (1,5 USD/Transaction)
Year	# Contributors	photos contributed per year	# Clients	#Transaction	Projected Revenue	Projected Gross Margin
2018	1,000	1,000,000	500	1,000,000	\$2,000,000	\$250,000
2019	50,000	50,000,000	10,000	10,000,000	\$20,000,000	\$2,500,000
2020	100,000	100,000,000	200,000	200,000,000	\$400,000,000	\$50,000,000
2021	500,000	500,000,000	400,000	400,000,000	\$800,000,000	\$100,000,000
2022	750,000	750,000,000	600,000	600,000,000	\$1,200,000,000	\$150,000,000
TOTAL		1,401,000,000		1,211,000,000	\$2,422,000,000	\$302,750,000

7 Team

			
Stanislav Stolberg Co-Founder, CEO InfoSec Consultant Digital Transformation Manager	Arthur Ishmetev Blockchain Developer Software Architect Full-Stack Developer	Haris Rana CMO Marketing Expert Blockchain Enthusiast	Ralf Gerteis Business Development Interim Manager Blockchain Enthusiast
			
Jakub Stefański CTO Software Engineer FinTech Lead Blockchain Developer	Fredri Lienhardt Photographer Relationships Officer Professional Photographer, Entrepreneur InsurTech, Passion for digital & technologies	Dr. Jeannette Heinert Communications Doctor of Medicine Blockchain Enthusiast	Artur Gugelew Financial Strategy Manager Financial Engineer Cash & Derivatives Exchange Specialist
			
Brian Colwell Blockchain Evangelist Marketing and Advertising	Dylan Sharkey Sales and Investment Relations Ex LinkedIn & Enterprise Ireland	Samuel Manzanera Technology and Software Architecture Analyst Full-Stack Developer	Peter Lai Blockchain Developer Full-Stack Developer

See website for continuous updates in team section

			
Lee Willson Blockchain Advisor Blockchain Ambassador	Alexander Sverdlov Security Adviser Cyber Security Strategy CISSP	Audrey Baverel Crypto Tax & Accounting Adviser CFO, Founder, CEO Happen Consult, Ex Big 4 Senior Tax Manager	Marcus Schmitt ICO Advisor CEO bei COPYTRACK Corporate development and Business scaling
			
Paulo Renato Dallagnol Legal Adviser Intellectual Property Lawyer Copyright & Blockchain	Charles Becquet Strategy Marketing Executive Photostock Industry Expert	Chang Liu Assoc. Prof. at Ohio University Decentralized Software Engineering researcher	Jared Polites Strategy and PR Adviser Blockchain Marketing Former FBI Analyst Go-To-Market Strategist
			
Roberto Capodieci Blockchain and Investor Relations Adviser Blockchain Tech Expert - Founder @ BlockchainZoo.com	Ilya Anikin ICO, Investment and Strategy Advisor Managing and Investment director of VC Funds Sferiq Venture Capital Fund and Imperious Group	Alex Fedosseev Adviser CEO & Founder at 1World Online and Mentor at Google LaunchPad	

See website for continuous updates in advisory board section

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