



## Whitepaper:

DApp for fair, p2p 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 Photochain Ecosystem.

**PHT** Trading Token in Photochain Ecosystem.

**RF** Royalty-free license.

**RM** Rights Managed license.

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# 1 Motivation

Nowadays we live in the innovative era of web 3.0 which enables a global network of people, with the aid of high data availability and high data throughput. The use of blockchain technology is required so that the p2p company can operate safely and without the need for a central authority. Blockchain technology enables secure p2p networks. This technology opens up new horizons for software architectures and applications. It provides a safe and verifiable transaction list available to all users at any given time. With so-called Smart Contracts[1], the Ethereum blockchain technology opens up the possibility of checking correct compliance with digital agreements by using a machine. Therefore, the conditions for the conclusion of a smart contract are met only if both parties have fulfilled their part of the digital contract. In doing so, the machine leaves no room for any malicious tampering. The flexibility of the Ethereum language ‘Solidity’ facilitates the implementation of many use cases, which until not too long ago would have been regarded as utopian.

With the p2p platform Photochain, we are releasing a new concept as the next generation of a stock photography platform, as well as enabling fair p2p trading of digital works between artists and buyers.

By doing so, the terms of use for this platform, which are specialised for this use case, ensure a secure, uncomplicated and fair trading process for both parties. Moreover, the artist receives up to 95% of the final selling price.

## 1.1 Complicated Sales Conditions for Artists

There aren’t currently many options available to an artist (e.g. a photographer or designer) who wants to earn money in a fair way by selling their digital work. It particularly concerns 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 platforms such as Shutterstock and Adobe Stock available. These platforms are subject to the microstock category (see [1.5.1](#)).

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, so that the photo stocks receive up to 90% of the profit margin[2]. Also, the platforms are characterised by stringent requirements concerning the conditions of participation for sellers. Due to these challenging conditions, the artist is obliged to publish a substantial number of images in the hope of being able to compete against the immensely high levels of competition.

More problems for the seller include the fact that it’s not possible to set his own pricing, long waiting times for verification of the content, a large number of rejections of the work by the photo stocks platforms, as well as long time intervals between the 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. Photochain is a decentralised platform and uses Smart Contracts based on the Ethereum blockchain. Smart Contracts ensure the security of transactions for p2p trading with stock photography. When a sale is made, the seller is paid, and the buyer receives the purchased picture simultaneously. Thus, Photochain does not require a centralised authority to ensure the correctness of transactions. This reliability is inherently contained in the blockchain technology, and the Photochain platform has been designed from the ground up to solve the problems of traditional stock photography platforms. It does this by using machine learning and the wisdom of the community (see [2.3.1](#)).

## 1.3 Photochain's Mission

Photochain gives clear advantages over conventional photo stocks to both parties: contributors and customers. Contributors at Photochain benefit from an extremely low fee of only 5% of the selling price, while conventional photo stocks take up to 90% of the earnings. This opportunity to keep 95% of the final sale price allows contributors to offer their work cheaper, and, therefore, become more lucrative for the customers.

These profound market changes are 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. We will summarise our vision here, as well as the goals we've set for implementing this project.

- **P2P Marketplace**

It is very important to us that only the artist themselves can determine the value of their work and that they are given the opportunity to offer their work to lots of potential buyers. Our platform provides this opportunity which is realised by using synergies from Blockchain technology and machine learning.

- **Crypto Economy**

The platform Photochain appeals to a broad audience that is currently still far from the Blockchain and cryptocurrency technologies. The use case of "Photochain" will appeal to this audience. The easy-to-use GUI and trading processes facilitate the onboarding process and help the Crypto Economy to become mainstream.

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

Over the course of the project, more and more artists will be able to strengthen their copyright by 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 will analyse the stock photography market on which the Photochain platform is oriented and to which it will appeal.

### 1.4.1 Stock Photography Market

We will first present the characteristics of the photography microstock market since this is 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
- Uncomplicated acceptance of hobby 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 a several other smaller platforms. The estimated annual turnover of this market is currently around two billion dollars. According to the analysis done by the company Technavio, the stock photography market turnover will increase to about four billion dollars by 2020[\[3\]](#).

### 1.4.2 Photography Stock Business Model

Since the prices for digital content on the photography microstocks are kept low, one can only achieve a high turnover if selling a lot. Based on the data of a well-known photography microstock, it is possible to estimate the trading volume at this point. On average, in 2015 an image on this microstock cost \$2.80.

With this, 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 [\[4\]](#).

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

### 1.4.3 License Models

New and diverse license models have also come about with the development of stock photography technology. All of these models have simplicity as their common goal, and serve to provide the opportunity for sellers and buyers to sell/buy their products at low prices without any 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, and 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 it is 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 many 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 uncomplicated way of 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 purchase process. This will enable large purchase volumes and is the reason why we will suggest to use RF as the standard license, although the seller can still 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 independent bloggers to multinational publishing and radio broadcasters.

### 1.4.5 Market Opportunities for Photochain

According to information from a well-known photography stock, its approximate 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 Photochain p2p platform's potential.

## 2 Photochain Platform

With all currently existing stock photography platforms, the only way that security in transactions can be ensured is via a central control. Compared to that, we are creating a platform that works securely and efficiently based on predefined rules set by us.

We are developing the Photochain DApp [\[5\]](#) on the Ethereum blockchain. Moreover, Photochain also uses computer vision to fulfil 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 set themselves, 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 behaviour from the sellers. This means that the artist is responsible for the legality of the works he is selling, and is held fully accountable for any illegal activity.

### 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 Governance is the team that 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 and implements the rules as well as running the initially necessary infrastructure (IPFS Node, Ethereum Node). Furthermore, Photochain Governance offers a team of moderators that will, especially in the initial phase of the DApp, be needed to resolve claims.

For this we determine that 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. The PHOTON tokens are initialized and 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

We place great importance on the onboarding of the Photochain DApp being simple in design. When opening the web client, the user can either generate a new address in the Ethereum Network or import an existing address. This address counts as the wallet address of this user and can be saved in the Photochain 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 the permissions, we distinguish between the seller (artist) and the buyer.

- **Seller:** An artist has to reveal his identity to be able to become a seller on Photochain DApp. This step is necessary for the [DCC](#) to be filled with works while also preserving copyrights, by mapping 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 serve 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 instead used for the invoice. 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 the moderators consists of resolving claims. Thus they act as the keepers of the Photochain ecosystem. This task is rewarded both monetarily and via 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.

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

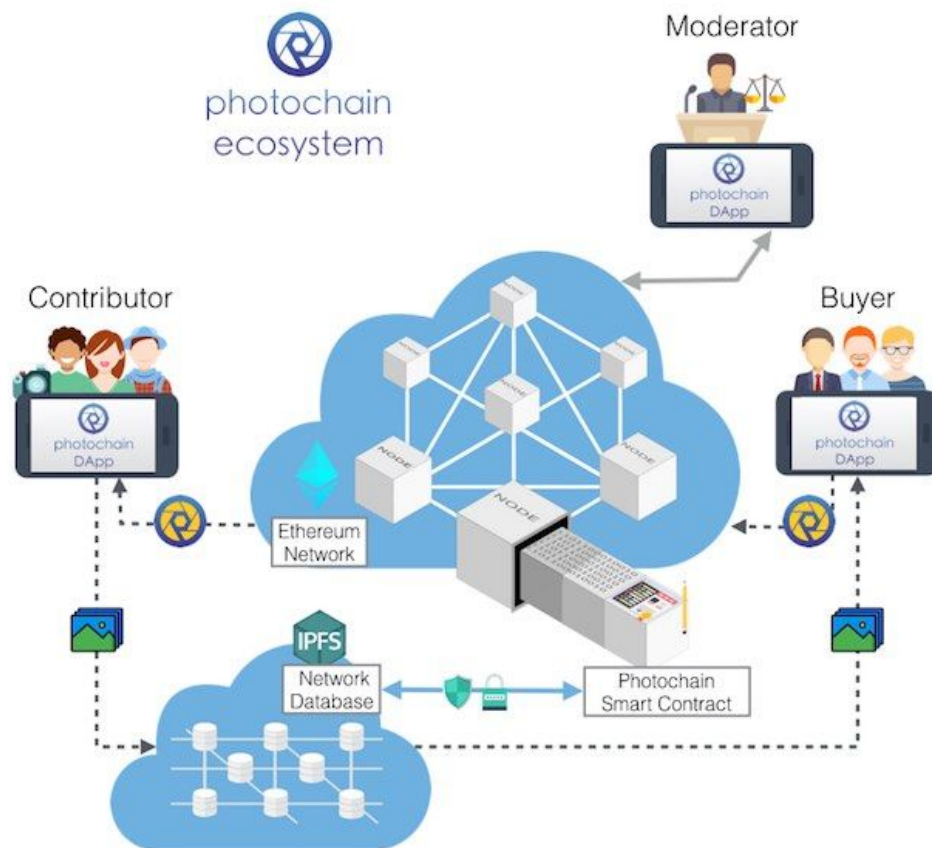
### 2.1.4 Ranking-system and Reward

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 the Photochain DApp. The minimum requirement for joining the ranking is a registration with a name.

- The moderator gets one point (+1) to his current rank for his contribution to solving one claim
- 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 the 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 his 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 transparency and simplicity.



### 2.2.1 Payment (Rewarding) Process

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

Further along the process of 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 services like Monaco. 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 the personal data and the Ethereum address. The mechanism of the anonymization used by Photochain DApp will be described here in a simplified manner.

All transactions run through a trade Smart Contract that ensures that the names of the artists and their Ethereum addresses cannot be connected to each other. The trade 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. Additionally, the more frequently payouts happen, the more likely it is that the trade partners can find out each other's Ethereum address. The 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 cannot map each other's addresses, because they would lack the knowledge about an additional purchase from the buyers.

### 2.2.3 DApp Fees

The Photochain Governance is 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 that is necessary for the Photochain DApp to function, such as an IPFS Node, load balancers etc. That is why Photochain Governance takes a 5% fee that is deducted from successful transactions. It is paid into the Ethereum wallet of the Photochain Governance. Since the prices for the micro stock photography are very low, this means that, for example, with a stock price of 5 EUR per photo, the fee is only 25 cents.

**The 5% fee is divided as follows:**

- 0.2% 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 a lot of 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% 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 will create a Digital Copyright Chain - **DCC**, which contributes to the prevention of many discussions about Copyright as each person can understand the link between a piece of work and the associated author of that particular work.

### 2.3.1 Copyright Infringement & Machine Learning

One of the main issues of stock photography are the various violations of copyright law. For example, a case can emerge when a person other than the author himself unlawfully offers a work for sale. We have developed a four-step concept against this type of infringement while using both technological methods of machine learning and the knowledge of the Photochain community. Generally speaking, the transaction on the Photochain DApp has already served as proof of a proper license acquisition for the buyer. Exceptions are posed by cases where sufficient proof exists that the seller has infringed the copyrights of third parties when setting up work within the Photochain DApp.

It must be taken into account that a unified global digital image database that contains each work and a 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 on the Blockchain technology. The growth of the Photochain DAO complements this decentralized database and focuses on solving issues in relation to copyrights in digital works. Every person can see when and by which artist a work has been uploaded.

#### Stage 1:pHash

It is 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 those 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 artist/author tries to offer an already saved work within the Photochain DApp, the technology will automatically prevent this action.

#### Stage 2: Claim

If a work that is 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 of that stock photography) 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, 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 claim tab of the Photochain Client and will be visible to all community users. To determine the validity of the claim, ten community artists need to view the request manually and decide about its legitimacy. These artists are classified as moderators (see chapter 2.1.3). They will receive a commission from the reserve fund of the Photochain community as compensation for their work. The provider of the copyright infringing image will be blocked, and his Photochain account will be frozen. However, if the claim is found to be illegitimate, the case will be closed.

#### **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 fund, for the amount of three months, will be frozen. 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, 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 upload of illegal content. This applies especially to pornographic content. In order to avoid the uploading of this type of material, 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 has been developed to recognize pornographic content. Every image that is exchanged in the Photochain network will be analyzed on a scale from 0 to 1 on pornographic contents.

After various experiments, we came to the solution of lowering 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 information security standards and is subject to the Continual Improvement Process. The Photochain Governance Team is dealing with a tracking issue and it will use their best practises 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 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 spamming or random voting:

- In general, a user holds one vote
- A ranking of at least five to solve a claim (five sales, one month time, 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 his ranks without being active on the Photochain DApp (trading and solution of claims) and for that reason, he cannot do any harm.

### 2.4.2 Major Incidents

In case a major incident does occur, 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 that PHT Token can be traded further.

## 3 Photochain DApp

### 3.1 Photochain DApp Requirements

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

1. **Decentralized government 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 that are traded on Photochain DApp should be stored decentrally and encrypted. Photochain will use IPFS protocol and 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 DApp on a Blockchain basis. The correct executions of the transactions, as well as the Photochain's rules, are realized through the use of Smart Contracts. Requirements 4 and 5 are to be realized using computer vision.

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 the DApps as it will also accelerate their continued development, since each user will be able to evaluate the code on their own and thus be able to provide feedback. It is 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 via our Github channel to anyone 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 and have three stages through which 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, we implement the Smart Contracts on the Ethereum Mainnet:

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

## 3.5 Third-Party Extensions

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 API.

### 3.6 Photochain Client

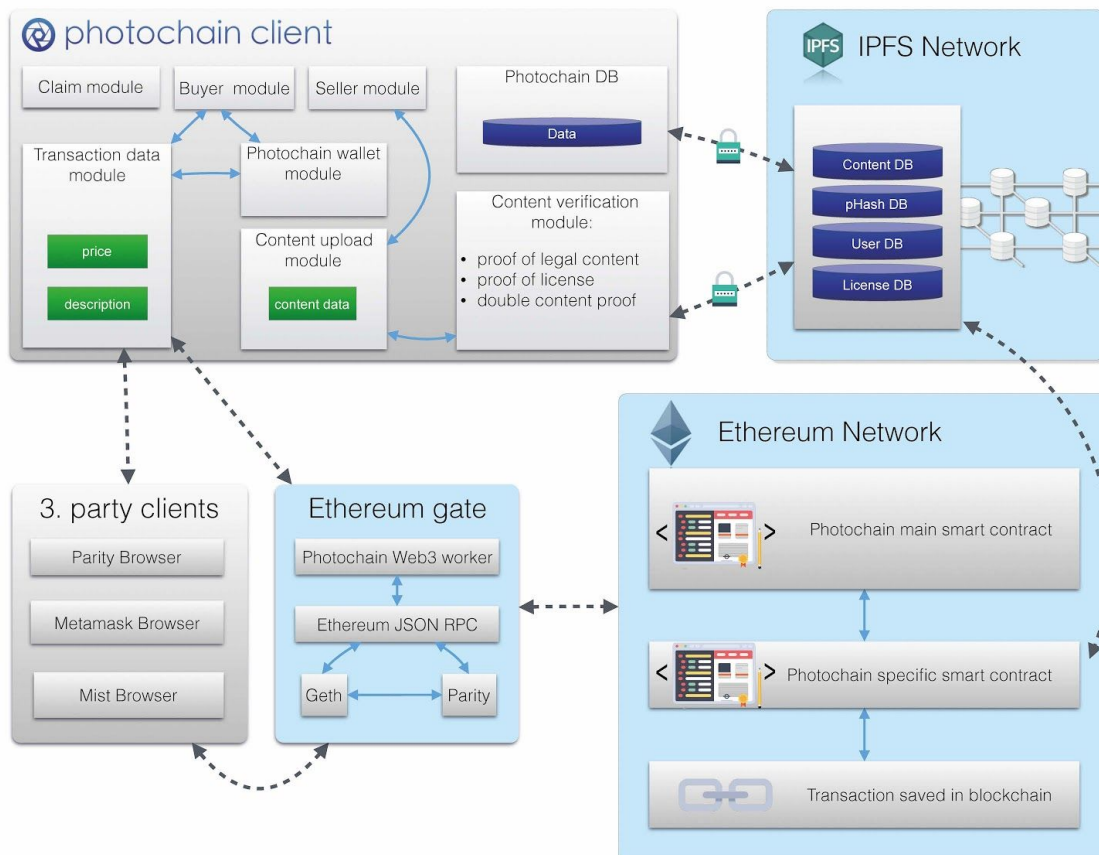


Figure 2 schematically depicts the architecture of the Photochain DApp. The Photochain client is a central component. It will first be available as a web client and will then be developed for current operating systems beginning with phase 2 of the project. The client is used to realize the p2p interaction 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 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 the particular piece, a link to the original source, (such as for example, 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 Photochain DApp

Our machine learning algorithm analyzes whether these requirements are fulfilled. If they are not fulfilled, the claim is automatically rejected as it is 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 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 the form of PHT tokens and can also view their transaction history. In the future, we will also be adding crypto exchange functions in order to allow for the exchange between 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

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 with 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 that 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

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 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 also currently the only decentralized storage solution that works. This is the reason why we will use IPFS as infrastructure for the Photochain databases. For the first phase of the 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 decentralized NoSQL database has not yet been developed. That is why we are working on a database as a top layer on 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 decentralized databases if these are more advantageous than our IPFS-based solution.

The work's data on the IPFS node are encrypted. The keys are released to the seller via the smart contract when the purchase is made, so that 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 also from the buyer to the client, which means that only the buyer knows the address. Protecting confidentiality on the network is thus maintained.

**pHash DB** contains all the pHashs of the works that have been uploaded for sale 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 that only the names, and not the Ethereum addresses, are visible on the sales invoice.

**Lizenz DB** contains the link author + content + date of upload and thereby presents proof of copy-right protection.

**Content DB** contains the content files which were stored here 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 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 with  $R = 5$  has a voting power of 0.8 and therefore will contribute substantially to the future of Photochain DAO. Furthermore, a proposal requires a 90% acceptance by the community in order to be adopted.

## 5 Photochain Token – PHOTON

Trading on Photochain DApp is conducted through PHOTON token (PHT). PHOTON token is the means of rewarding used across the Photochain Ecosystem. Any type of transaction on the platform will require the use of PHOTON Tokens.

Use Cases for Photon Token are:

- Sales commission to the photographers
- Rewarding the resolving on claims
- Listing on „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 future

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

It is important to note that PHT does not replace fiat money and cannot be treated as a currency or an investment asset. In no case PHOTON Token can be regarded as a security. It is to rather be regarded as a

means of reward 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 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 tokens or Smart Contracts in the Ethereum ecosystem. This means that the token Smart Contracts do not 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 therefore 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.

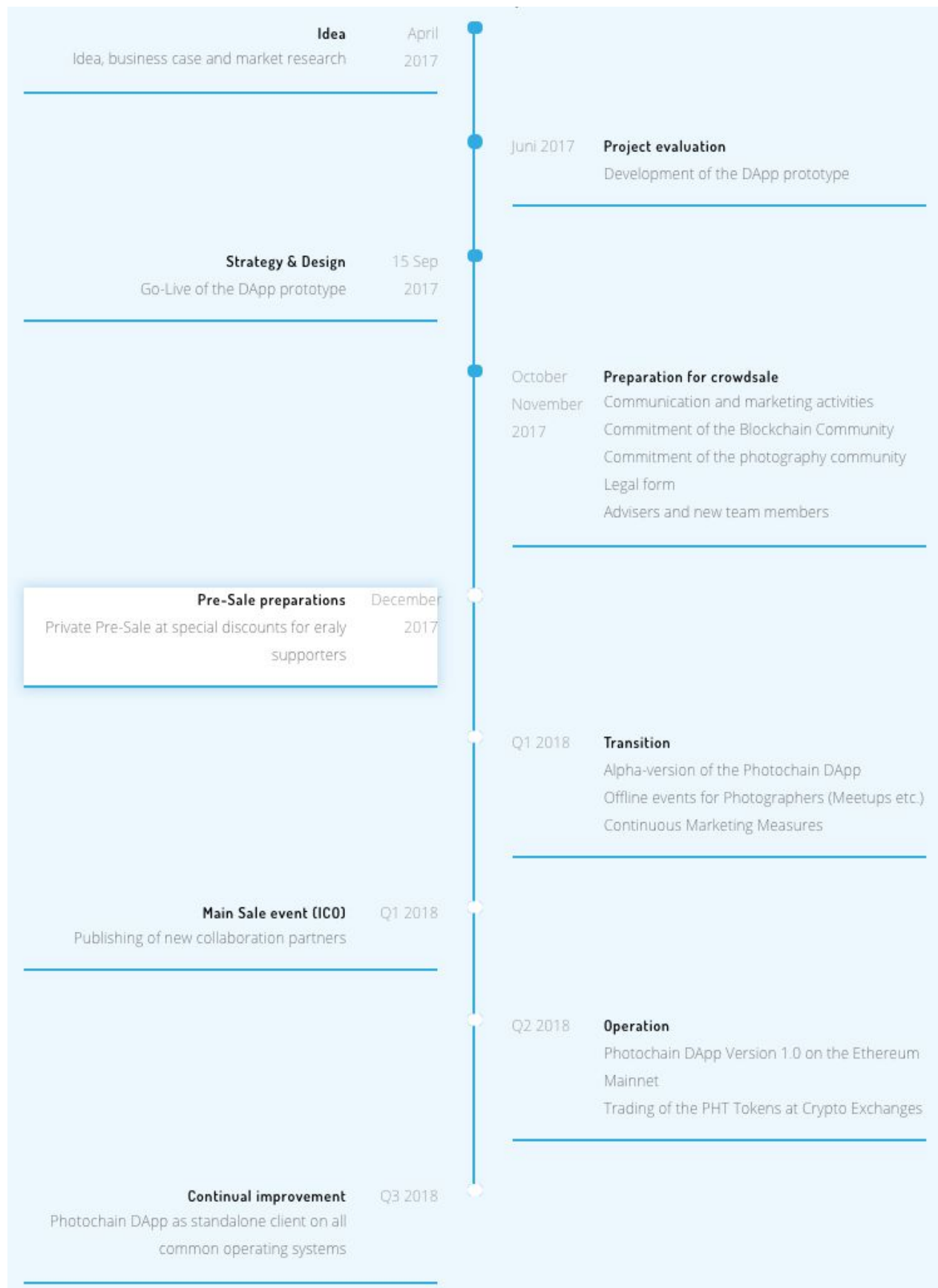
The PHT token is based on the following core properties:

- Name: PHOTON Token (PHT)
- Standard: Ethereum ERC20
- Hard Cap: 230,000,000 PHT token to issue
- Release date: Our Token Generation Event will take place right after the end of the Main Sale Event. It may take up to 30 days to distribute the PHOTON tokens to contributors
- Represented value: tokenization of digital visual works

We are forming partnerships in the area of token liquidity and we plan to cooperate with projects such as Monaco to offer payment options in fiat money. This functionality is especially intended for users that are not yet fully comfortable with cryptocurrencies, making it easier for them to get started

# 6 Photochain Roadmap

Photochain DApp development is a technologically and organizationally 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.





## 6.1 PHOTON Crowdsale Facts

We will offer the realization of the Photochain project through two main crowdfund stages: Pre-Sale and Main Sale. We will 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 the best practises of the crowdfund process, the amount of PHOTON token have a realistic Hard Cap. The PHOTON token issuance will take place after the crowdfund phase. It may take up to 30 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 crowdfund. 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 ETH)	0.00017 ETH
Pre-Fund Cap (PHT Tokens)	10,000,000
Main Fund Cap (PHT Tokens)	167,274,994
Hard Cap (PHT Tokens)	230,000,000
Token Privileges	platform utility token

Token Allocation	%	
Token Sale	77%	<ul style="list-style-type: none"> <li>Token Sale</li> <li>Bounties &amp; Partners &amp; Reserve</li> <li>Management &amp; Team</li> <li>Legal &amp; Advisory</li> </ul>
Bounties, Partners & Reserve	10%	
Management & Team	12%	
Legal & Advisory	2%	

### 6.1.2 Photochain Pre-Sale

We will finance the development of the Photochain DApp through the using 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 = 0.000102 ETH (accordingly in other cryptocurrencies, discount of 40% on 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: coming soon

End date: coming soon

### 6.1.3 Photochain Main Sale

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 the delivering the 1.0 version of the Photochain DApp.

Start date: January 2018

End date: February 2018

PHOTON token Hard Cap : 165,723,285 (minus tokens sold during Pre-Sale)

Currency accepted: ETH, BTC, LTC

The exchange rate is 1 PHT = 0.00017 ETH (accordingly in other cryptocurrency assets, time based discounts should be taken into consideration).

Minimum transaction: (0.1 ETH and corresponding value in BTC/LTC)

Maximum transaction: (100 ETH and corresponding value in BTC/LTC )

Discounts for PHT tokens:

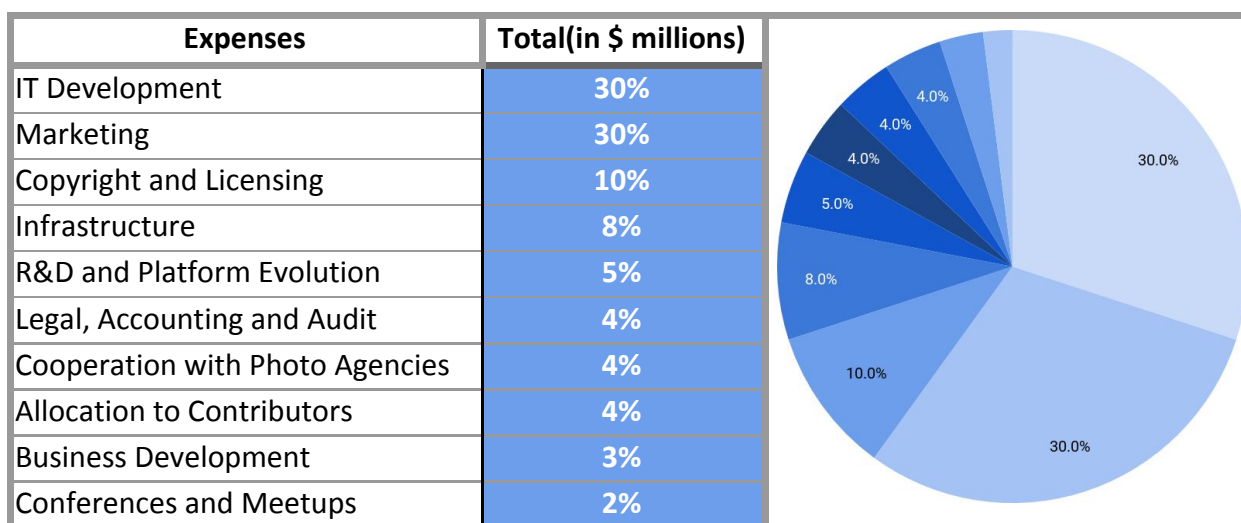
Day 1 to 7: -30% discount

Day 8 to 14: -20% discount

Day 15 to 21: -10% discount

Day 22 to 31: -5% discount

## 6.2 Financing the Photochain Project



In order to ensure a speedy realization of the Photochain project, it is necessary that all Photochain Governance members are financed in their full-time work. The team will be continuously expanding, especially in the 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 a tokenization projects is 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 is necessary to consider the law standards of each country in question.

## 6.3 Revenue Projections

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

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

Year	# Contributors	# Photographs	# Clients	#Transactions	Projected Revenue(in \$ millions)
2018	750	750,000	9,000	1,080,000	\$0.1
2019	7,000	7,000,000	40,500	4,860,000	\$0.5
2020	15,000	15,000,000	162,000	19,440,000	\$2

<b>2021</b>	25,000	25,000,000	567,000	68,040,000	<b>\$7</b>
<b>2022</b>	45,000	45,000,000	1,417,500	170,100,000	<b>\$17</b>
<b>TOTAL</b>					<b>\$26 million</b>

## Projected Revenue und Year



## 7 Team



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Co-Founder, CEO

InfoSec Consultant  
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**Ralf Gerteis**  
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Communications

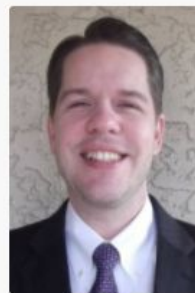
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Help us not to make mistakes

			
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Copyright & Blockchain	Photostock Industry Expert		



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