API

CASPER

WHITE PAPER

11.10.2017

Introduction

All of us, irrespective the age, are witnessing information era matured. This is the time of boisterous technological, economical and scientific development that became possible thanks to the most valuable resource of our time i.e. information, and possibility to exchange it promptly.

Amount of data, which we generate ourselves, or those generated by devices we apply is a huge layer of personal, social and commercial info, which can show others where are we going, what are we doing and whom with.

But with the spread of distributed ledger technology (hereinafter "blockchain") and the possibility of decentralized storage and processing of information, you have a choice with whom you want to share information, and with whom not.

Do not trust the information of a single source and rely only on the authority of the company that stores it. Decentralized and secure storages around the world are the new standard where the only data owner is you and no one else, no matter where it is stored at a particular time.

There are many global companies in the world being well proven in offering cloud storage services (Amazon, Google etc.), which are used both by individuals, and companies of various size. They are technological giants; they warrant a safe storage and accessibility everywhere, which ensures their services popularity. Nevertheless, you should always keep in mind that our info is stored on servers of one company, and in case of specific pressure from the third party, information may be exempted from the present location without your allowance.

Besides, recently, young and ambitious competitors appear who take data storage decentralization as the main principle. Projects (Filecoin, Storj, Sia etc.), which use their own solutions for data storage. Their basic problem, from our point of view, is difficulty to implement and popularize own blockchain, or dependency on a single blockchain platform, and desire to compete with classic giants.

As for us, we have chosen an another way.

We want to see boisterous development of decentralized applications (hereinafter DApp) on any existing and developed blockchain platforms, help their clients to keep data safely and reliably, release the commands that change the world or make it more convenient place thereof from the data storage task thanks to our services. This is why we develop Casper

Casper

Casper is a protected and reliable utility for DApp based on Ethereum platform. It is the fastest way to ensure your DApp stores data, i.e., video, photo, audio, text, databases. It is implemented by joint effort of a variety of vendors, which provide their hard drives and

internet-channels for storing and transferring your files. They will rent their facilities in exchange for monthly reward, such as tokens. Vendors may choose to become local data centers, which will ensure a higher access rate and low response time for all users, both individual and companies.

Imagine our nearest future, when information will not only be generated by you, but billions of IT devices, drones, self-driving cars, robots, AR/VR. All of them require an immense storage volume for information, which will cause significant demand for the service in question from both classic-style applications and DApp. This is why we have started Casper API development early on, as it will enable us to resolve the issue of data storage quickly and promptly.

Casper API will allow cloud storage of data with a higher level of confidentiality, reliability, and flexible options for access control.
It removes intermediaries between users and locations where data segments are stored. Only users will have access to their information.
Vendor providing storage is not capable of either viewing or editing such data.
To ensure higher file transfer rates, we use a proven peer-to-peer protocol (hereinafter P2P).

Those principles introduced by decentralized applications will enable future reduction of storage costs with respect to DApp, and hence cut costs for end users. This will further enhance their development and increase the spread of such decentralized applications.

Casper API

Casper is a file system utility for decentralized applications based on Ethereum, and other blockchain platforms supporting smart contracts.

The blockchain platform is based on a P2P network, participants of which provide resources to perform transactions and calculation. Casper complements the P2P blockchain platform with a storage unit network, which provides HDD file storage service to users, while storage units ensure the network is functioning properly. The storage unit network may be connected to several blockchain platforms (now we use Ethereum platform only). A storage unit may be connected to the network by any person with proper equipment at their home, or a regional data center, which is interested in putting its idle facilities in operation. Each network participant will receive payments for rendering storage services. Casper’s vendor regular verification, stimulation, and penalty system is set up to motivate its participants to act in their own interests, independently from each other, thus maintaining the stability of the P2P network. All participants form a decentralized and independent data storage network, which cannot be controlled by any single person or company.
User of a P2P storage unit may upload a file, download the file uploaded, edit or delete the file, grant access rights to other users using various rules. In our case, the target user is DApp, but anyone may also address Casper, if so required. Files are kept encoded in network storage units and replicated to several computers of various storage service vendors. In the case a computer of one vendor becomes unavailable, another vendor is selected immediately to maintain storage of duplicates of those files, which were stored on

the disconnected computer. The new vendor then downloads file duplicates from other vendors that have the exact copies stored.

Any Casper smart contract stores a service vendor register that is used to connect vendors to customers and perform billing. The smart contract also adjusts storage unit network operation by monitoring adherence to the storage service vendor operating terms.

Casper provides API for storage network users. The smart contract provides API for selecting and paying for the storage service, and discloses vendors' Internet addresses. A vendor provides P2P API for file operations. In order to perform the most of file operations (but file download), the user may connect to the vendor by using a DHT system, which does not require use of a smart contract. Such storage unit network arrangement helps make it more independent from smart contracts, and reduces the blockchain transactions number, and thus ensures a more appropriate maintenance cost. User client applications and vendors send minimum sized messages to the Casper smart contract regarding a fraction of operations, thus enabling the latter to conduct billing. Data is transferred encoded using zk-SNARK technique, which was first used in ZCash. Such level of privacy makes the Casper API suitable for use in corporate DApp.

The provided API may be used by any DApp, if it has a client application written in a common programming language, for instance, a JavaScript web client. This client may address both the smart contract and P2P API. Use of the Casper storage unit network enables DApp multimedia possibilities while preserving independence and self-control features inherent to the blockchain technology. DApp is typically represented exclusively by its smart contract, and any request to it goes via the official Ethereum interface or a console interface. A rare DApp features an extremely limited web interface. Such DApps are but a hobby for geeks. With the emergence of Casper, DApp functionality and design may reach the mass-market application and services level. DApp developers can develop a viable graphical interface, and store static content or executable files in Casper. Development of new DApps will become possible, i.e., mail services, blog platforms, digital content shops independent of governments or corporations, development of which would be controlled and monitored by the community of users.

The Casper P2P network allows flexible scaling and customizing of the storage service for a specific user. Supplementary storage units may be connected to increase the static content output rate. Any supplementary storage unit connected in a region selected will be activated as a CDN increasing the Casper-powered DApp rate of operation in the region. Casper may be used by services that are more generic as well. At this level, Casper will begin posing a competition for major cloud services, such as Amazon.

Blockchain Platform Selection

The blockchain technology is currently developed enough to allow creation on its basis of a technology service, competitive with classic services. Compared to the classics, such service offered by one vendor will be considerably more resistant to malfunctions and less exposed to attacks by third parties, because it would be impossible to control the significant

numbers of distributed service participants. In our case blockchain will allow to connect various independent providers for DApps data storage.

For a blockchain platform to enable creation of a mass service, it shall comply with the following requirements:

1. Availability of smart contracts

Smart contracts enable programming complex work of Casper service on a block chain.

2. Quick execution of transactions

Transaction execution time is determined by time period necessary to generate block containing the transaction, as well as by peer synchronization algorithms.

3. Execution of substantial amount of transactions per second

To compete with classic services the blockchain should be able to comparable number of transactions, that is millions transactions per second and more. Many popular blockchain platforms allow dozens of transactions per second to be executed only.

4. Reliability of implementation

Blockchain implementation should pass an audit and be multiply checked for absence of vulnerabilities.

5. Public credibility

Blockchain users should be sure in stability of blockchain miner community – number of community members and community independence.

We have chosen blockchain platforms that are sufficiently well known and trusted by users and listed them in the table below.

Name	Ethereum	Graphene	Waves	EOS
Number of transactions	> 20 *PoW	> 100 000	> 1000	> 100 000
Reliability	Released	Released	Released	Under development
Smart contracts	Turing-complete	Non Turing-complete	Under development	Under development, non Turing-complete
Proof algorithm	POW, under development PoS	PoS	PoS	PoS

*PoW –based on Proof-of-Work algorithm before switching to a Proof-of-Stake one

Ethereum Blockchain Selection

On the strength of all characteristics, Ethereum platform has been selected to create Casper service prototype. At present, Ethereum platform does not completely meet requirements for a blockchain for Casper. Graphene platform fully meets requirements for Casper creation. If the Ethereum is not be developed on sufficient level to fit by all parameters by the time of prototype readiness the user version will be written for Graphene.

Platform Compliance Criteria

1. Availability of smart contracts

The Ethereum platform supports smart contracts in Turing-complete language. The Graphene platform supports smart contracts, however, not-Turing-complete language of smart contracts requires more detailed work during programming. Turing-complete language of Ethereum smart contracts simplify development.

2. Quick execution of transactions

Both Graphene and Ethereum execute transactions within fractions of seconds which is satisfactory for Casper service.

3. Execution of substantial amount of transactions per second

Today, the Ethereum platform does not match by platform performance but Ethereum team develops transition from PoW algorithm to PoS algorithm, and seriousness of team approach to development and testing allows us to trust implementation being prepared. The PoW algorithm used to compose digital signature of blockchain log is such that it makes hard to rewrite the log. Barrier for rewriting consists in time-consuming calculations on computer which consume processor time. Due to more complex cryptography the PoS algorithm protects a log against rewriting without time-consuming calculations. Transition to PoS must increase Ethereum performance to suitable level.

4. Reliability of implementation

Graphene and Ethereum have multiply proven implementations.

5. Public credibility

Both Graphene and Ethereum have stable and independent miner community.

Simplicity of development under Ethereum and planned transition to PoS determined the selection of this platform for Casper prototype development. 722 projects already emerged within the last 2 years allow us to make conclusion that their rapid development will continue in future, and demand for them in API for decentralized data storage will only grow further.

In case of Ethereum transition to PoS confirmation, the prototype will be developed to fully-functional version. Otherwise, after prototype creation, user version will be written for Graphene.

But the charm of Casper API consists in that you can use it for any DApp, on any existent or being developed platform. All you need is connection of smart contract of your DApp with Casper API smart contract

Ethereum Platform Description

Ethereum was the first platform ever to introduce smart contracts. It is written by a talented team, which rapidly develops its platform and the blockchain community in general. The Ethereum currency is ETH. The platform is widely used for writing DApps based on smart contracts. The DApp code is executed in an Ethereum virtual machine, the smart contract programming language is called Solidity. Robustness of the coding language and use of virtual machines provides a Turing-complete computational environment. The cryptographic command execution protocol of the virtual machine ensures protection against possible tampering with smart contract code executed on a miner’s machine. Execution of a single

command of the virtual machine yields a payment of Gwei = 10^-9 ETH. The total payment for implementing a typical smart contract is low.

Casper use prospects

Casper is a data storage network, which may prove interesting for users of typical cloud services. One Casper's distinguishing trait is absence of a common fault point, such as a DNS service. However, Casper is built to comply with blockchain principles, i.e., automated implementation of user requests, regulation by network participants, absence of a common point of decision-making, independence from individuals and organizations. This enables sustainable use of Casper DApps without degradation of their characteristics.

Casper is currently expanding its DApp audience, starting a new phase of decentralized application development. Decentralized storage will enable DApps to create full-fledged GUIs with sophisticated graphics, while the content will be stored in Casper. A good UI will help ensure DApp user-friendliness to most of us, thus securing the service popularity with mass audience.

New independent platforms will emerge, disrupting entire industrial monopolies. The ease of technological development of global systems with complex self-regulation mechanisms will allow diversity and competition in places, where cost barriers traditionally hindered such processes. Music shops, photo and video stores, news and mail services will become comparably much easier to access using Casper. Sophisticated services incorporating their own blockchains may use Casper for UIs files and unstructured data storing. Such services may include network games, cloud democracy platforms, and other social media.

Governments may begin migrating their services to blockchain platforms in order to reduce costs while ensuring full transparency of their operations and eliminating corruption. According to analytics, businesses may choose to migrate to blockchain with the purpose of increasing transparency and public credibility of their services in 18-24 months.

Casper API description

Casper enables users to upload random files to a cloud service, and access them later from any device.

Casper's basic features:

- Encoding of stored files
- High file upload/download rate thanks to peer-to-peer technology
- Shared file access
- Feasible data storage pricing

File encoding ensures data is stored confidentially. Each file is encoded at the user's side before transfer, and only the user keeps encryption keys. Only the user may transfer encryption keys to someone else to share access to the file.

Reliable file storage in data centers is typically ensured by creating three exact copies of the file and storing them on different servers. Casper implements a similar principle by storing the file in 4 or more copies at different service vendor computers, which may be located anywhere in the world. A service vendor shall be imposed with requirements, adherence to which ensures a reliable distributed vendor network. Compliance with requirements shall be validated continuously.

Casper operation is ensured by an Ethereum smart contract. The smart contract charges service users a fee, and pays service vendors whenever file storage and access is performed.

Service vendors will be provided with server-side software, which would allow them to connect to Casper utilities.

Casper API interface

The Casper API comprises of an smart-contract API and a P2P API. Subsets of methods shared by each API may be conventionally referred to as user methods, and service vendor methods.

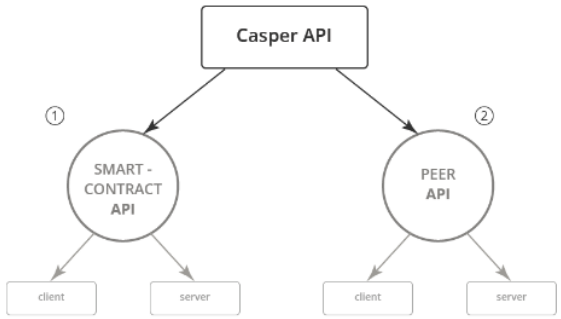
Smart contract interface:

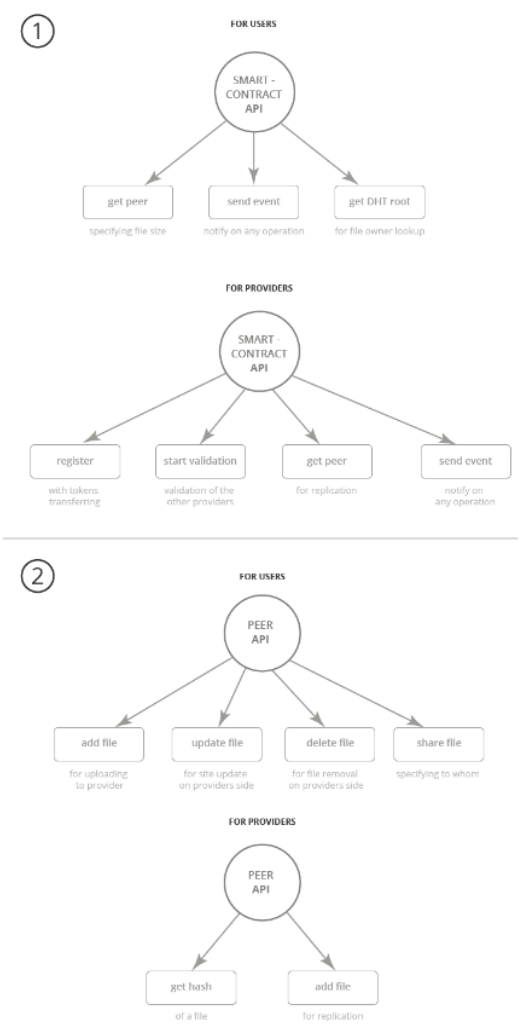
1. Common methods
    1. getPeers (sizeToStore) – obtaining vendor IP addresses for storing file with size of sizeToStore
    2. sendEvent (eventInfo) - smart-contract's notification on operation performed or event
2. User methods
    1. getDHTRoots() – obtaining bootstrap IP addresses of DHT vendor network
    2. registerFreeSpace(tokenCount) – user registration with an indication of quantity of CST for recieving free storage space
3. Vendor methods
    1. register(tokenCount) – registration of vendor and its number of Casper tokens to allocate sufficient memory volume.
    2. startValidation() - initiate validation, receive vendor's IP-address for validation

Peer-to-peer interface:

1. Common methods
    1. addFile(file) – download new file to vendor's computer
2. User methods
    1. updateFile(UUID, file) – update file via UUID
    2. loadFile(UUID) – download file via UUID
    3. deleteFile(UUID) - delete file via UUID
    4. shareFile(UUID, shareSettings) - update file access rights via UUID
3. Vendor methods
    1. getHash(UUID, position, length, nonce) – calculate file fragment hash with nonce additional number.

9. File fragmentation scheme





Casper execution protocol

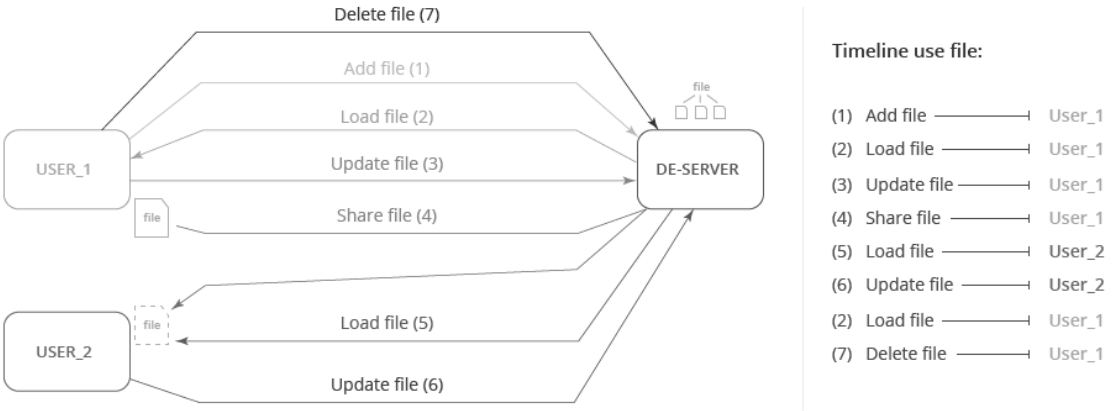
Usage scenarios

The Casper infrastructure features the following types of participants:

1. user – stores files in the system, pays for storage and access;
2. service vendor – provides space on their hard drive for storage at a charge;
3. Ethereum miner – ensures transactions are performed

The smart contract ensures interaction between users and vendors. The Ethereum miner ensures that the smart contracts being executed properly.

11. Variants and scenario of file usage



Vendor registration

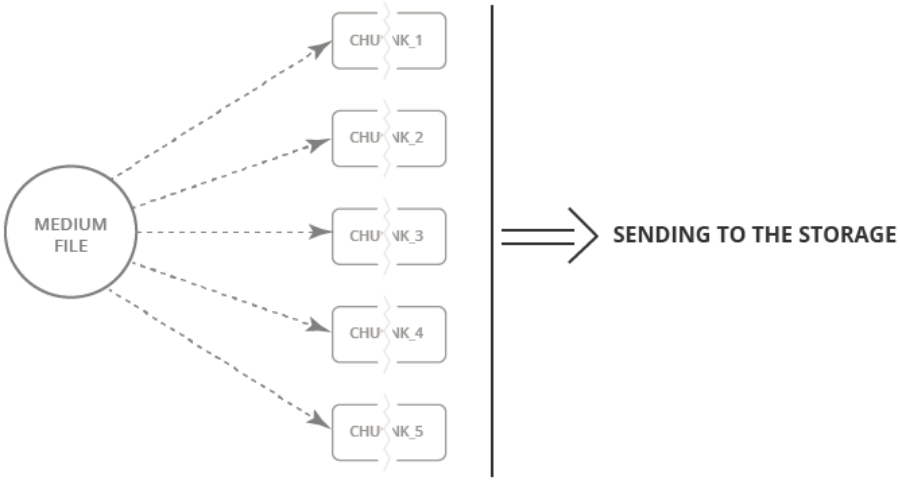
A service vendor shall register with the service by submitting a registration request to the smart contract. In the course of registration, the vendor shall specify hard drive volume, which they provide for storage, and their Rx and Tx values.

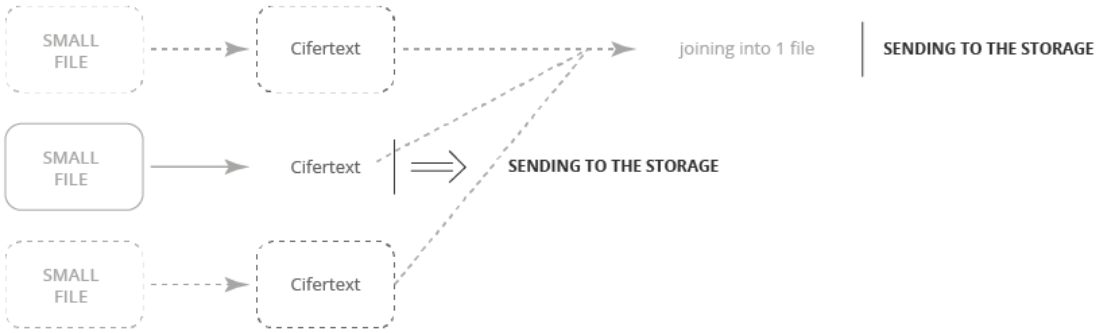
After several vendors have been registered with Casper, the service is ready to provide storage services at a sufficient reliability level. A user may now place their file for storage.

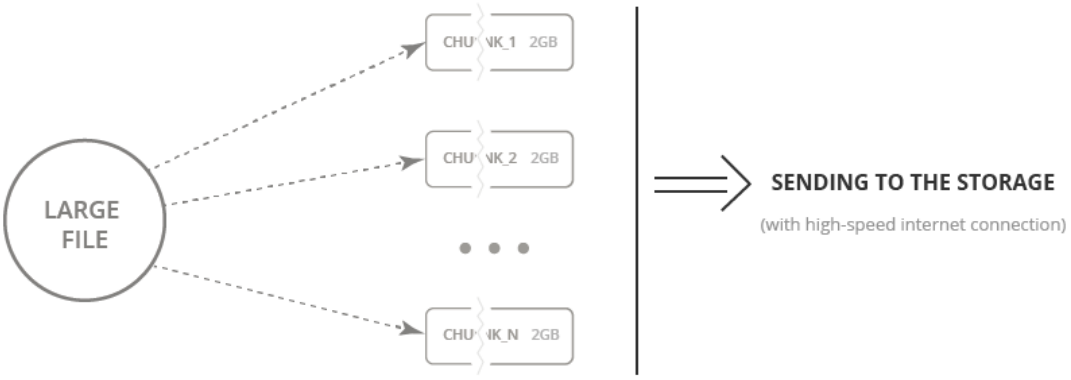
File Allocation by User

1. The user encodes the file, if the file is larger than 10 Mb, it is divided into chunks which cannot exceed 2 Gb. If the user submits several files smaller than 1 Mb at once, the files may be combined into one batch, then sent and stored together with one vendor.
2. User, via getPeers(sizeToStore) method, requests smart contract for addresses of vendors which can allocate file chunks.
3. User establishes direct connections with vendors and sends them the file by parts. According to P2P technology, the file is replicated involving additional quantity of vendors to provide reliability of file storage.
4. User and vendors notify smart contract about successful file allocation which initiates start of action of file storage at vendors service

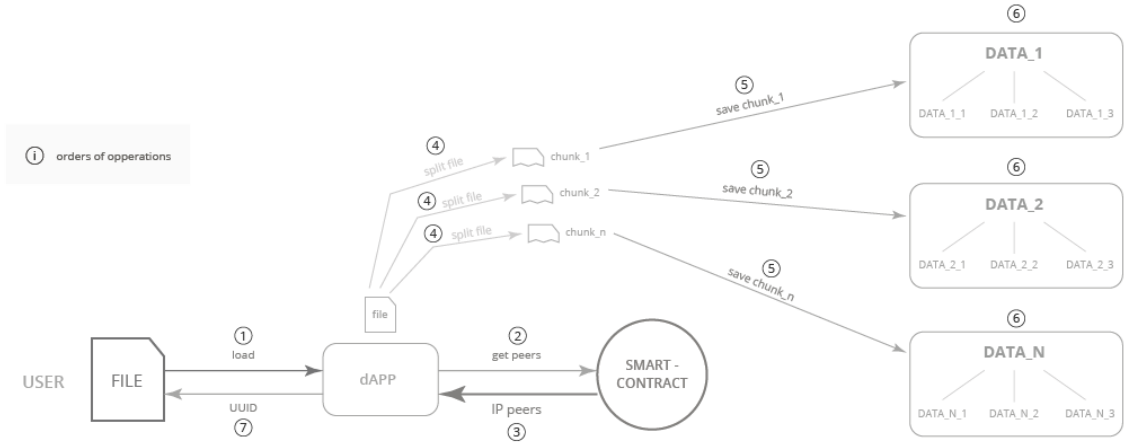
8. API functional definition







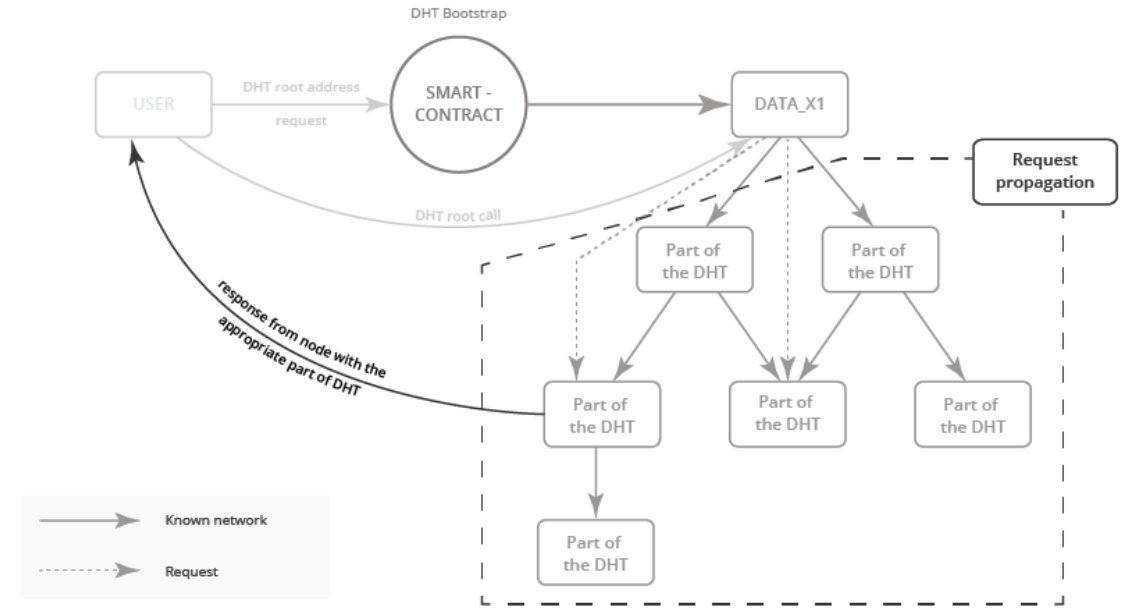
12. File uploading by user



File Downloading by User

1. User, by DHT technology, finds vendors storing the file and reads information about chunks.
2. User, by DHT technology, finds vendors storing chunks.
3. User establishes connection with vendors and downloads all chunks.
4. The user and vendors notify smart contract about successful completion of file transfer which allows smart contract to record the service rendered.

7. DHT organisation

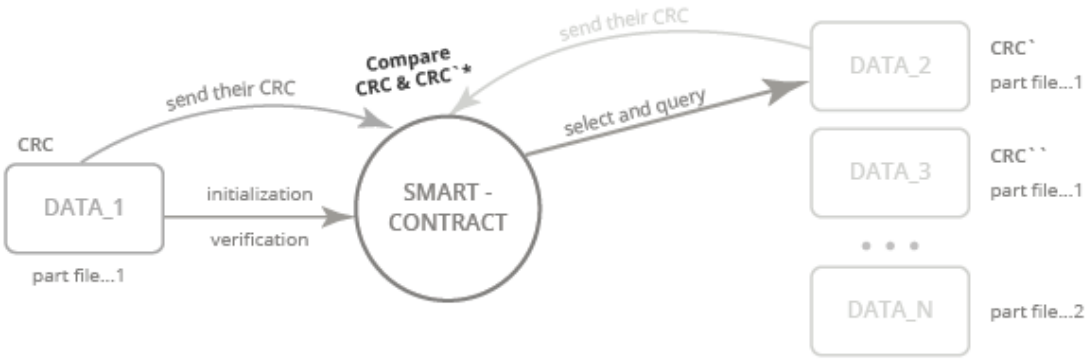


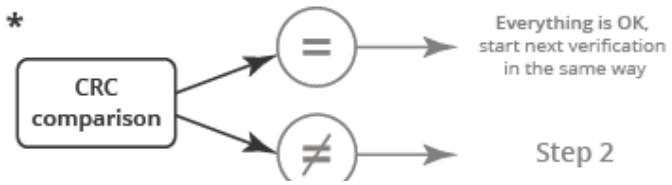
Validation of Service Vendor

1. Each file replicated into 4 parts. Each part is stored at independent vendor. Arbitrary vendor from this group initiates file validation process by addressing smart contract, which determines vendors being checked out of remaining three vendors.
2. The vendor initiating validation sends request to vendors for calculation of hash function for selected part of file in which request additional number for calculation is specified.
3. Vendors send their answer to smart contract.
4. The smart contract compares answers of vendors and version of initiating vendor. If the answers are correct then the vendors have passed the check. Otherwise, one or more vendors store incorrect file part or have violated storage rule. File can be damaged at bona fide vendor or be absent at unfair vendor.
5. The smart contract uses a majority vote to choose honest vendors. Other vendors restore the file by downloading it from the honest vendors.

3.1 Storage integrity verification scheme

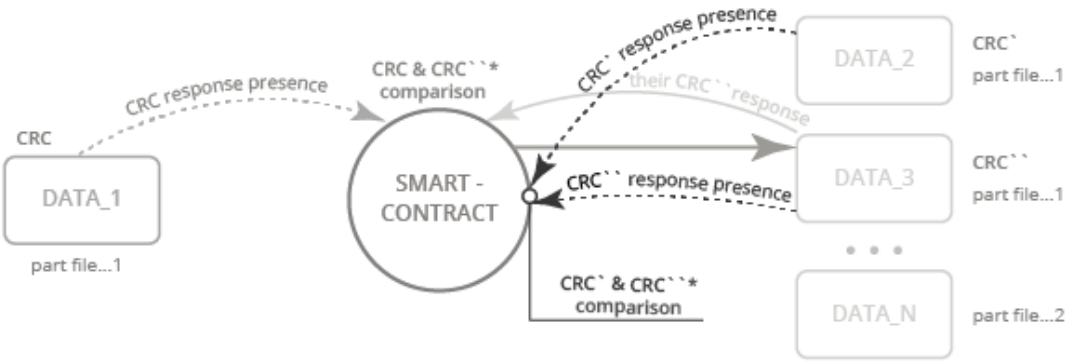
Step 1

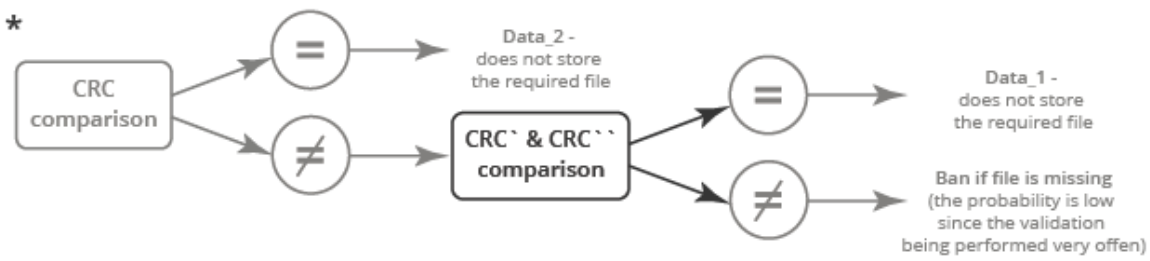




3.2 Validation of storage integrity scheme

Step 2

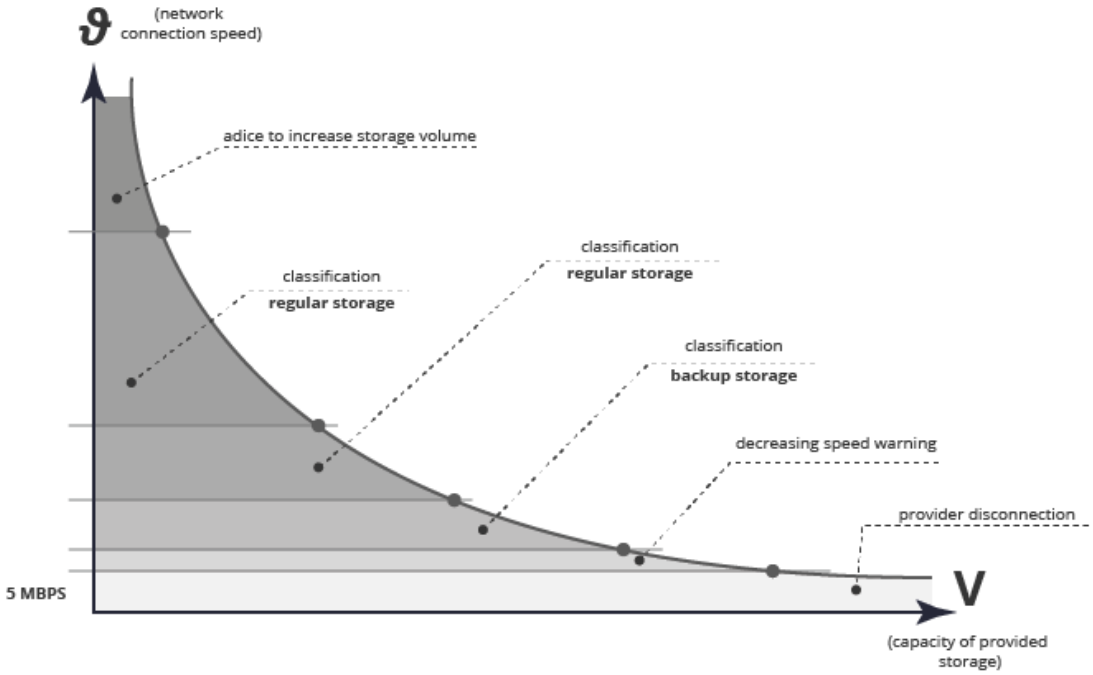




Classification of users and vendors

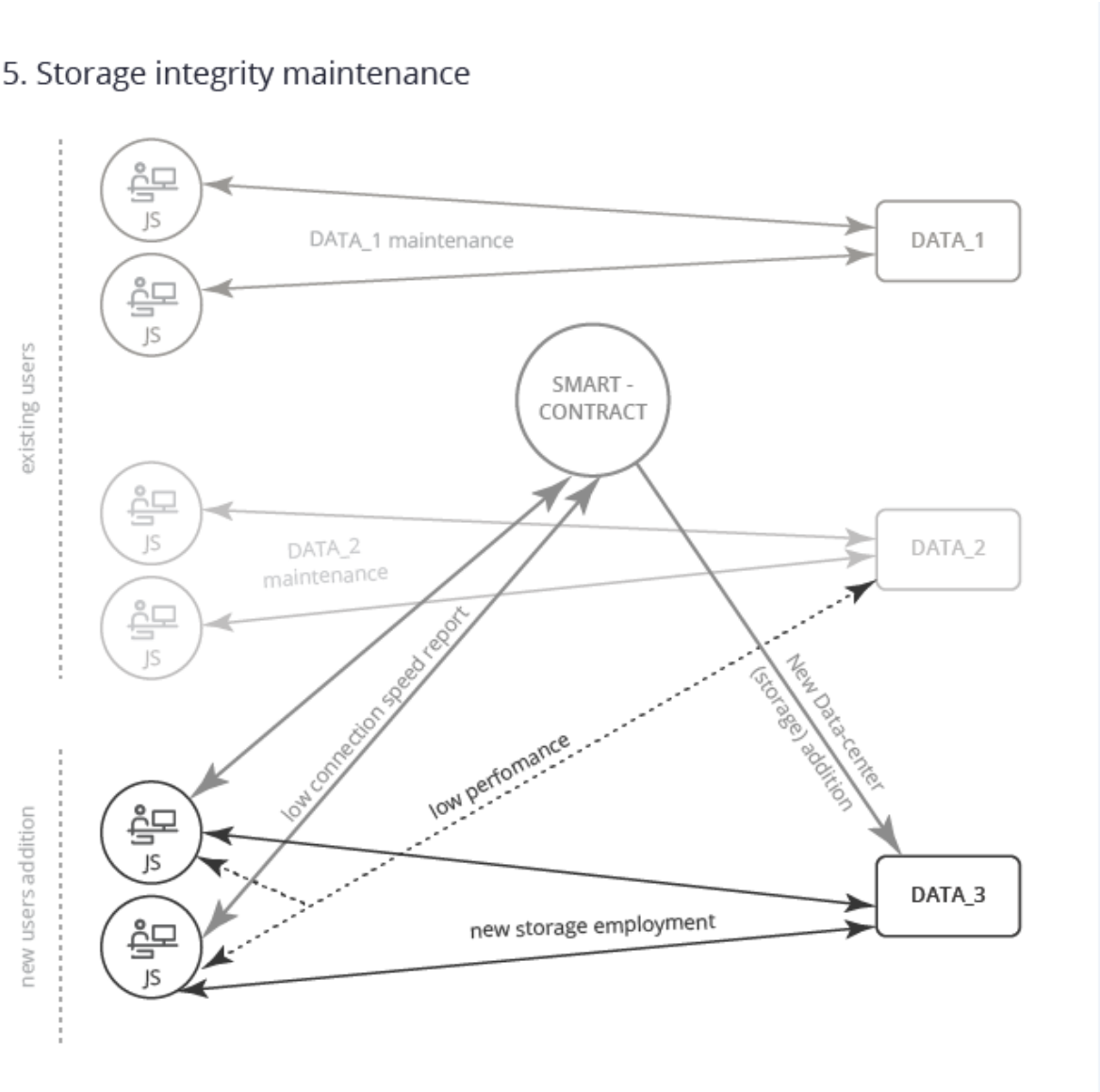
File storage utilities may be used for various scenarios. Casper distinguishes a separate platform use scenario for static content hosting and backups. Casper defines additional requirements for vendors in these scenarios, ranks vendors according to requirements, and chooses the best ones to render the service.

4. Provider classification (specialization)



Hosting

Placing static content in Casper utilities supposes that content is accessible to each site visitor at a higher speed rate and at a low response time. Volume of static content may be small but at a great attendance, required traffic volume to load site quickly may exceed capabilities of 4 peers, as it supposed for typical file storage. Moreover, load to hosting may change as site's popularity grows. For hosting Casper stipulates for enable connecting additional number of vendors to store and seed file, while connection may run automatically in real time as the load grows.
Vendors having high rate of internet-channel and low response time are selected for hosting service having greater preference.



Backup

Backup is saving file redundant copies, which may be required in rare case when system fails that uses these files. Files may be great size, but they will be addressed rarely. When backup file is required by user, he wishes to get it shortly. Vendor having a great storage volume and internet-channel that enables only several major files at a convenient rate may provide backup service. Since backup download is requested rarely, the vendor that stores backups of many users will have few download requests simultaneously.

P2P approach

Modified version of IPFS is used as P2P protocol for communication between customer and vendor/vendors between each other when replicating files.

IPFS modification

IPFS distributed file system enables storing permanent and public static content free from possibility to delete thereof, modify or restrict access rights. Each IPFS user, which downloaded such public file will cache it and seed automatically to other participants.

Control over number of copies

In Casper each service vendor should be paid for file storage and outgoing traffic, since the number of file copies shall be controlled and limited by the smart-contract to ensure service operates efficiently from commercial point. Smart-contract shall determine the number of vendors that keep one or another file by directive. In case when any vendor becomes unavailable, smart-contract shall determine a new vendor, which receives file for storage from other vendors via P2P. Based on reliability requirements, file storage in 4 replicates is selected.

Basic permission system

Casper access right system enables user to determine which other users may have access to file. In IPFS each file is addressed by hash value calculated by file content. Hash value is constant, and file is accessible at address to arbitrary number of users. For Casper addressing shall be de-linked from file content, and generated as UUID. Service vendor shall act as provider, which offers file list at his hard drive via IPNS protocol. User to grant access to file shall send its UUID to another user. To cease access, user shall modify file's UUID via smart-contract. Vendor shall update file's UUID in the list, which is issued via IPNS. The file at the old UUID shall cease being accessible.
Basic system of rights shall enable the user sharing file with others by informing about UUID, and file encoding key. Thereupon, file shall be accessible for non-owner user for reading. Recording/deletion operations for non-owner shall not be passed by smart-contract. Such user's right system is good that it does not require any action from smart-contract or service vendors, and may be implemented by file owners even when internet access is not available. UUID and file encoding key may be transferred using a sheet of paper.

Flexible permission system

Basic system of rights makes access cancel operation labor-intensive, especially when file is opened by manifold users, and one of them shall be excluded. Owner shall issue new UUID for the file, and it shall be disclosed to all users, which will continue to have access.
Flexible system of rights is connected to the fact that info about the users, which have access to the file is transferred and kept at vendor's for every chunk. Capability to chunk of size to 2Gb determines that info about the system of rights will take comparably small space. In user's right info vendor shall keep entities that have access to file, and exact rights i.e. reading, modification, deletion, granting rights to other users. When a request delivered by another user, vendor shall verify whether the rights related to such a request exist, and

implement it only in case sufficient rights are available. Owner may send requests to alter access specific rights via DHT system without touching resources of smart-contract. Said requests will be implemented comparably quick.

File modification

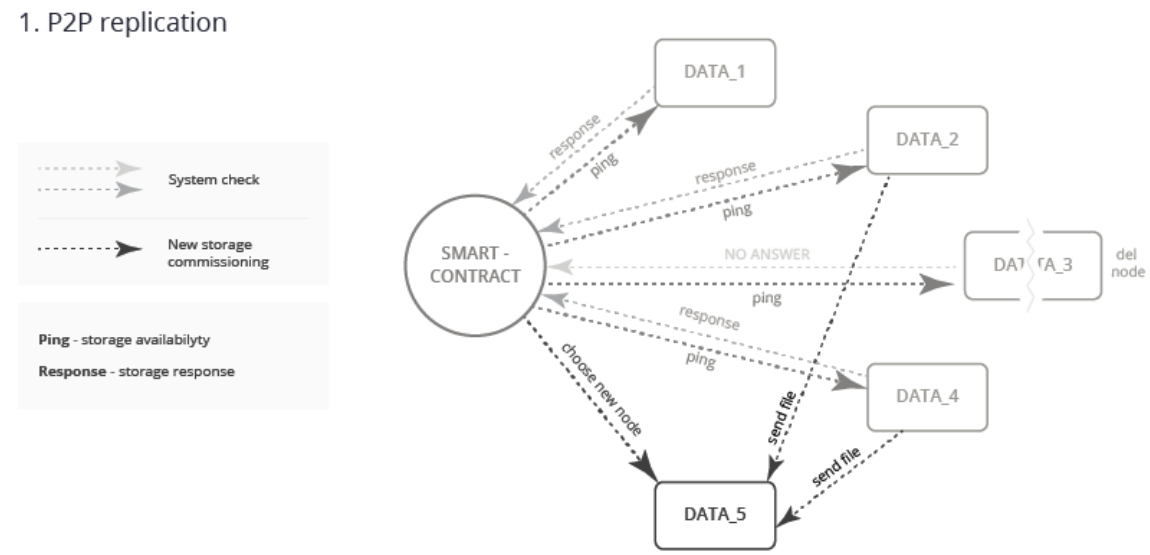
User can modify a file on his computer. File modifications via smart contract are synchronized with file copies at vendors. File UUID is not changed in this process. In case of insignificant file changes, file part that has been changed is determined, and this part only is sent to vendors.

File parts storage

When user's file is of major size, it will be split to several parts, while each one will be kept by Casper service independently. Minimum indivisible storage item in Casper is file part i.e. chunk, which will be represented in IPFS as a file. User's file as a group of chunks technically for IPFS is a directory.

File replication

Vendor shall be required to stay online 95% of time per week providing bitrate 5 Mbit/s minimum. Implementing said requirement by vendors shall enable estimating required number of exact copies at a foreseeable reliability of service. Vendor staying online is verified by regular requests, which are performed by service vendors during validation. When vendor fails to comply with the requirement, it shall be excluded by smart-contract. New vendor shall be selected for the exact copies of files he keeps, which will receive the exact copies from other participants of P2P system.



Estimating number of exact copies to reach high reliability level

Formalizing reliability requirement for vendor. Vendor during 1 hour shall stay continuously online at $p_p \geq 0.95$ probability having average data transfer/receive bitrate 5 Mbit/s minimum. Being online continuously means that vendor during an hour may transfer or receive data flow so that data protocol will fail to record connection disruption event because vendor is unavailable.

A reliable service from customer's point means that his request to upload or download file will be completed successfully at $p_c \geq 0.99999$ probability. Since the file for storage is split by portions having size 2Gb maximum, then each portion may be transferred to vendor or received from vendor at 5Mbit/s rate less than an hour. Any vendor may stay online during an hour at $p_p < p_c$. It means that, when a portion of file will be kept by a single vendor only, user will have success when addressing to this vendor at $p_p < p_c$. When we keep a portion of file in several exact copies, then in case a single vendor is unavailable online, user may send a request to another one. Probability of the case when n vendors are unavailable simultaneously shall be estimated as $q(n) = (1 - p_p)^n$. Probability that of n vendors even one is available shall be estimated as $p(n) = 1 - q(n) = 1 - (1 - p_p)^n$. We have only to estimate n, at which $p(n) \geq p_c$.

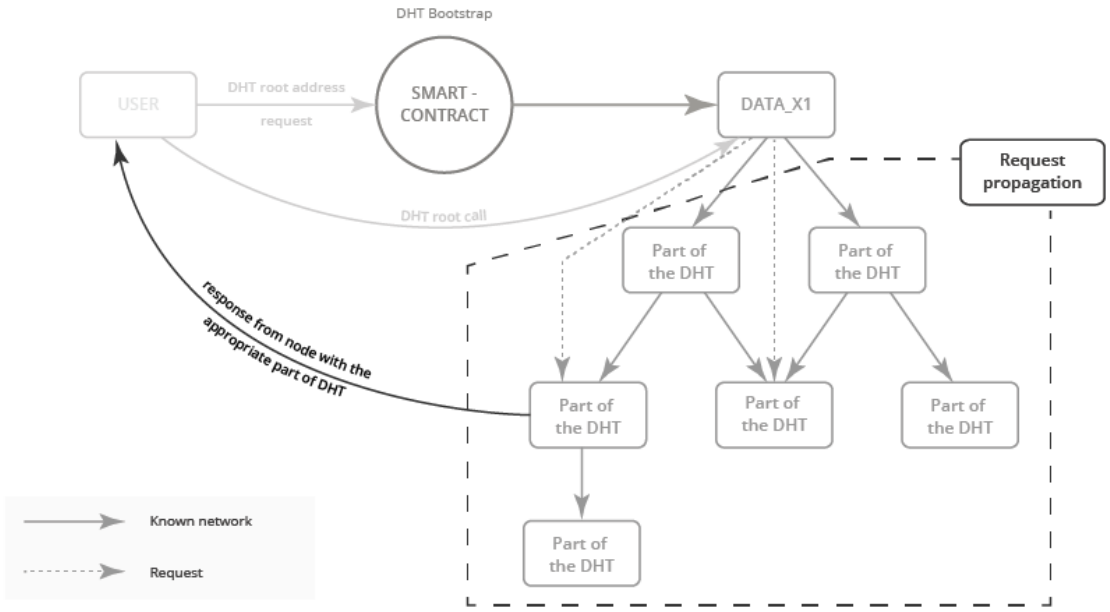
$p(3) = 0.999875 > p_c$
$p(4) = 0.99999375 > p_c$

At file availability reliability requirement 99.999% three vendors are sufficient that comply with service requirements. At file availability reliability requirement 99.99999% four vendors are sufficient. Casper will always send file for storage to four vendors minimum. Casper reserves the right to involve more vendors to file storage.

DHT

To connect Casper users with vendors, smart-contract in it's trivial implementation shall keep addresses of all vendors in its status. At hundreds of thousands of users this volume may raise up to megabytes, and appear significant for storage. Although Ethereum enables keeping such an amount, it is desirable to reduce it for optimization and to ensure that the service is able to scale even more. To reach this goal, it was decided to join vendors into a DHT network, which would allow for keeping vendors' addresses, and find address of vendor required using file's UUID. Vendors' addresses will be kept in the DHT in a distributed manner and separately from Ethereum blockchain. It shall be sufficient to keep DHT bootstrap lists with a portion of vendors' addresses in Casper smart-contract.

7. DHT organisation



P2P log

Resource-intensive for Ethereum users' hard drive is not only keeping smart-contract status, but keeping blockchain log that consists of smart-contract messages. Casper protocol assigns as great portion of messages as possible to communication via the network beyond blockchain and smart-contract. Messages for file modification operations, granting access to files may be performed free from smart-contract participation. Synchronization operation for a new peer and other vendors requires partial smart-contract participation. Smart-contract shall be warned on the fact that new peer commences keeping file chunk. Messages related to other operations may be divided in a similar manner. A reliable cloud service shall log all the operations performed. Messages transferred via P2P system are not recorder to blockchain, and logged in P2P system. Log for such messages shall be recorded and kept on vendors' machines being distributed using DHT. None of the vendors shall keep the entire log, DHT lookup mechanism shall always make possible to find and download required log part from one of the computers participating in the P2P network.

File storage confidentiality

Operation confidentiality in blockchain is of twofold nature. On the one hand, user in Ethereum is represented by identifier, which fails to be referred to user's personality anyway. On the other hand, operation history in blockchain log is public for all Ethereum users. Subject to any person publishes his/her Ethereum identifier somewhere, and any his/her operations in Ethereum, both already performed, and those to be performed in the future will become readable. Using two approaches for log storage i.e. Ethereum and P2P bypassing Ethereum separates info transferred via the network. Summarized info about user's payments is kept by smart-contract in the blockchain. Confidential info about UUIDs of files

stored by user shall be transferred by P2P via encoded channel between the user and vendor, and recorded to log in an encoded form. Log encoding keys shall be kept by user and vendor, so they always may view statistics for operations performed thereby. Once the user and vendor performed a single or several operations via the private channel, which were saved in the encoded log, both participants of communication shall warn smart-contract on operations without disclosing operation content, but providing certificate on their performance and correctness. Said certificate shall be a record comprising hash values in the log, and evidence the hash values are valid being calculated based on zero-knowledge of zk-SNARK algorithm.

Service provider validation

The service provider must meet a number of requirements to be a participant. The provider must be on-line 95% of the time during the week. The provider's average Internet connection speed must be at least 5 Mbit/s for easy downloading of files by the user.

The service provider is paid for storing file chunks for every Gb per month and for sending chunks by client request. A dishonest provider may claim a greater hard disk volume than physically present in order to obtain more orders for placing user chunks from the smart-contract. In this case, the provider will not be able to store all the chunks received from the user, i.e., proves to be dishonest.

A dishonest provider or one who does not meet the requirements is disconnected from the service.

Provider validation procedure

When a provider registers, his speed is checked to meet the minimum requirements. Then a check that the provider is online is made several times a day. File storage and connection speed are validated routinely.

Validation is by the P2P principle. Network participants, i.e., the providers, initiate a check by sending a request to the smart-contract to start it. The smart-contract designates to the initiator the provider to be checked. During interaction with the provider, the client can also take metrics that are used for validation and send them to the smart-contract.

After completion of validation, the provider's evaluation is calculated.

Provider disconnection from the service

A provider may be disconnected temporarily from the service or blacklisted for violating the service operating rules or in a number of other cases. A blacklisted provider cannot be registered in the service.

If a provider is blocked for an intentional attempt to deceive the validation algorithm, he is fined for the amount of his registered tokens.

The validation algorithm operates effectively when the providers report accurate information about themselves. If a provider provides false information about himself, this will be determined during the validation, and the provider will be disconnected from the service and the provider's Ethereum e-wallet will be blacklisted.

If the provider ceases to meet the minimum requirements to be online and connection speed, he is disconnected from the service and may re-register only an hour later. If during the validation time of registration, the speed requirement is not met, then the time for the next possible registration will be doubled.

The provider may decide to disconnect independently from the service. In this case, one hour before disconnection he must inform the smart-contract. Then the service will prepare backup copies on a new peer before disconnection of the provider, and the system reliability level will not be diminished after disconnection. If the provider is disconnected repeatedly from the service without warning, then he may re-register only within a month

Measurement of the provider's connection speed

In order to measure the provider's connection speed, he is sent a 20 Mb file and is immediately asked for the hash value for the file. While downloading the file, the provider calculates the hash value and at the end of the download almost immediately has the fully calculated hash value. The provider returns the hash value in the request response. The validating party compares the hash value with the previously calculated value. If the values match, the file is considered successfully downloaded by the provider. The average loading time is calculated based on the downloading time.

File storage validation

A file to be stored by the provider is validated by the user when loaded and then routinely during its storage. In both cases, the same algorithm is used to validate the proof of storage of the chunk with several participants.

Proof of chunk storage algorithm

One of the network participants, called "validation initiator", who desire to obtain a proof of the fact that all of the other participants are storing the given chunk, should provide the UUID of that chunk to the smart contract, together with a randomly selected number, called "nonce".
Smart contract will save it, adding the current time at the moment of transaction obtainment. All the other participants must continuously check the blockchain, and if they see that the new validation is initialized given the chunk that belongs to them, they must choose a random $nonce_i$ and calculate the value of hash(hash(chunk, nonce), $nonce_i$), that must be then sent to the smart contract.
SC should save all of the received hashes with their senders' ids, rejecting all attempts to add already existing hashes, and should also check if all of the responses are received within the fixed time limit, starting from the moment of validation initialization.

Then the next stage of validation (that is also time-limited) should begin. During that stage, every of the participants must send the following to the smart contract:

- their formely secret $nonce_i$
- value of hash(chunk, nonce) that was calculated earlier

When all of the participants have send their responses, it's trivial to check that their hash(chunk, nonce) are all equal to each other's and that for each participant, their hash(hash(chunk, nonce), $nonce_i$) matches the value published during the first validation phase.
Since nonce value was not set by any of them, but by validation initiator, equality of hash(chunk, nonce) values proves that each of them store the original chunk.
If some of the participants haven't supplied their responses in time, the initiator should call the SC to charge them a penalty.
By the match of the resulting values one can decide if validation is ended with success or failure.

Proof of chunk upload

The algorithm described above is used, where initiator's role is assigned to the uploader of the chunk given (before he actually delete it).
The value of hash(chunk, nonce) sent by him should be considered absolutely reliable.
If the validation was not passed, the chunk upload should also be considered unsuccessful.
The owner of the chunk should then start the upload procedure again.

Proof of chunk storage

The algorithm described above is used, where initiator's role can be taken by any of the chunk providers. In case of a chunk hash mismatch, smart contract should charge the participants who had send the hashes not matching the majority's one or should charge all of them and treat the chunk as missing.

Validation initiator receive a reward paid by other participants who was charged.

Proof of file upload

To check providers' reliability, Casper SC periodically requests a proof of chunk storage from each provider. That provider must prove that he owns the given chunk, but without sending it to the SC or to the client due to high traffic and transaction costs. Provider should compute a string based on the chunk contents using a special algorithm. That string is an evidence of chunk availability by itself. It should be sent to the SC and then checked for correctness. Cryptographically secure algorithm of the string computation guarantees that unreliable provider, if he does not own the full chunk, can compute a correct string with very low probability. In practice, that algorithm can be implemented by applying a hash function to the chunk.

Hash function recalculation

In case smart-contract at each vendor verification would wait from it the same string calculated for chunk, then after the very first calculation unfair vendor may remember the string, and delete chunk. To avoid such vulnerability, calculation needs to be done variable by smart-contract. To do this, in validation request smart-contract will send an additional number which shall be included in the string calculation process. At each request smart-contract shall choose new number randomly.

Hash function choice

Currently, SHA256 is commonly used among many cryptographic protocols, and thus it is selected as a hash function to use.

Calculation of hash function with additional number

In order to balance computational load on vendors' computers during validation process, hash function may be calculated not on the entire chunk but on a portion thereof. In this case errors during file storage validation may be detected at a less probability than for the entire chunk. Regular verifications of various chunk portions reduce possibility to skip error to acceptable values.

Smart-contract shall transfer triple number (position, value, data_length). When calculating chunk hash function, value amount will be added to the chunk at position % length, where length is a chunk's length. Hash function shall be calculated based on a unit of data_length % length + 1 byte length that begins from position % length, at which value is present. Unit in a chunk is read by loop during calculation.

File storage evidence

Above described is chunk storage validation algorithm for user's machine. User is highly interested in entire file integrity. Thus, initiating validation algorithm, smart-contract shall select a file for verification and validate all its chunks.

DApp with Casper API interaction

Customer's DApp may interact with DApp's smart-contract, with Casper smart-contract or with peer-to-peer Casper API. In addition, DApp's smart-contract may interact with Casper's smart-contract. Web application will be the most general-purpose application for DApp.

Web-client

Web-client for today's DApp operates being coupled to geth - Ethereum console client, which must be installed and launched correctly by user on his computer. This solution is complicated from process point for a typical user. Casper implements a module deployed on

javascript with a portion of geth functionality to operate with Ethereum network from browser. Also a module will be created to operate with Casper peer-to-peer network. Developers of customer's application will obtain a complete functionality to work with Casper API.

Operation with Ethereum

Generating transactions for Ethereum using official client requires downloading of the entire blockchain, which occupies over 200Gb. Web services that enable to operate with Ethereum web wallets maintain a common log copy, and update it constantly for all wallets. Casper when launching service will download Ethereum blockchain log to the service on first vendors' machines. Self-regulation logic of peer-to-peer network will be written with permanent updating of blockchain. Ethereum blockchain log will be stored according to hosting regulations in Casper, and number of it exact copies will change dynamically depending on number of requests.
Casper's module on JavaSctipt for operation with Ethereum will operate with blockchain log in Casper's service. Thus, the first decentralized service launched in Casper will the service for operation with web wallet.

Peer-to-peer

There are many peer-to-peer technologies and data transfer protocols. Support of some thereof is embedded into current browsers.
Peer-to-peer technologies:

- BitTorrent
- IPFS

Data transmission technologies

- WebRTC - embedded into current browsers
- SIP

Open libraries exist to operate with technologies from the list above:

- js-ipfs-api;
- webtorrent.io
- p2p
- peerjs;
- SimpleWebRTC.

Existing libraries will enable reducing the time for developing client's JavaScript for Casper's peer-to-peer network.

Issue of Casper Tokens (CST)

Casper issues its own monetary unit – Casper token or CST, which is used for payment settlements within the service on all blockchain platforms and to purchase franchise by service vendors. After being issued at ICO the tokens will be freely traded at exchange.

Storage Volume Registration – Franchise Analogue

CST owner who has decided to render vendor services purchases a quote for memory volume which quote can be registered by him in smart contract for storing. The quote is granted at the rate of 256 GB for 1 CST. To purchase quote future vendor calls register (tokenCount) Casper smart contract method and specifies in the argument desired number of tokens for getting quote. Specified number of tokens is blocked and can't be used by owner for other purposes: sale, lease and other purposes described in the document. Token owner can at any time change the number of blocked tokens and quote, respectively by calling register(tokenCount) method and specifying new number of tokens, including 0.

When user places order for storage calling getPeers(sizeToStore) method of Casper smart contract the selection of vendors is made taking in consideration free space that they have under purchased quote. Quote size of 256 GB for 1 CST is selected so that storage system payback time is N months and therefore could attract long-term collaboration-oriented vendors.

Mechanism of hard drive volume registration linked to CST is similar to franchise purchase mechanism.

Floating Asset Independent from Cryptocurrencies of Various Blockchain Platforms Connected to Casper

Within Casper service, users are charged for storage services, and vendors get payment for rendering storage services. The Casper service technically implements operations based on blockchain which has its own monetary unit. Casper will be launched on several blockchain platforms with smart contracts, and vendor will receive orders for storages from users from several blockchain platforms simultaneously. To simplify and clear payment settlements between vendor and users of various blockchain platforms the payment to vendor will be charged in single monetary unit - CST tokens. CST token will be emitted on Ethereum platform, but will be able to be transferred to other platforms with keeping total number of tokens on all platforms.

Obtaining storage space free of charge – analogue of bonus on Kickstarter

The users which have purchased CST tokens can obtain storage space in the service free of charge at the rate of 1 GB for 1 CST. To obtain free space the user calls registerFreeSpace(tokenCount) method of Casper smart contract where he specifies desired number of tokens to get free volume. Specified number of tokens is blocked and can't be used by owner for other purposes: Token owner can at any time change the number of blocked tokens and free volume size, respectively, by calling registerFreeSpace(tokenCount) method and specifying new number of tokens, including 0.

When files are allocated in Casper service by user, first of all, free storage volume not chargeable for user is occupied.

Mechanism of free of charge storage volume rendering is similar to bonus on Kickstarter, which is received by backers sponsoring new product launch. In our case, storing service is the product, and possibility to use service is the bonus.

Provision of real token value

CST value shall be provisioned by profitability of service provided by vendor per 1 CST registered to memory space, and CST turnover amount to pay for service. During ICO, an issuance of fixed CST number will be determined. Having quota at 256Gb per 1 CTS, Casper service shall allow registering the final memory amount in the storage network for all tokens. At the moment when memory volume is registered in network that exceeds a specific share from the total maximum volume, and specific minimum share from the registered memory volume will be occupied by user for storage, quota amount per 1 CST will begin to grow. Growth criterion will be maintaining a specific share from the common volume of memory free from loading new data from users. Thus, as actual use of Casper network grows, real provision of CST token will begin to grow too.

Token Sale at Exchange and Renting

Casper's smart-contract will be written according to ERC20 standard. It will be possible to put CST tokens for sale at exchanges. Exchanges enable smart contract token free trading according to ERC20 standard. Many exchanges offer additional possibility to rent tokens under flexible conditions. So CST token will be traded and rented at many exchanges.

For Casper economics, CST renting service is important possibility. Free CST circulation at exchange can make its value too high for rapid payback of registered for 1 CST memory volume. It can become barrier for service development. Leasing keeps financial attractiveness for purchasing tokens even at a high market price. Lease of CST tokens will allow a person who invested in CST to begin return of investments earlier while providing providing clear economics to the service vendor, who rented the tokens.

Token Issuing

Token purchasing in the process of preICO

CST token will be issued within the limits of preICO as separate smart contract, not according to ERC20 standard. Issued tokens will not be traded at exchange. After completion, ICO tokens purchased on preICO will be converted in CST tokens of working smart contracts.

Token purchasing in the process of ICO

CST token will be issued within the limits of ICO as separate smart contract according to ERC20 standard. Tokens issued at ICO will be traded at exchange. It will be possible to convert tokens purchased in the process of preICO in tokens of smart contract for ICO using exchange() method of smart contract. After completion of ICO it will be possible to covert tokens purchased in ICO process in CST tokens of working smart contract.

Token inventory in working Casper smart contract on Ethereum platform

In working Casper smart contract, exchange() method will be written which method will permit to exchange tokens purchased in process of preICO and ICO for tokens of working smart contract.

Tariff policy

Basic tariff policy stipulates user's payment for used vendor's resources i.e. for keeping Gb of data per month, and for data download per Gb.

Vendor for keeping Gb of data and data download per Gb will receive payment in CST according to the tariff defined in smart-contract considering vendor's scoring.

User, when adding a file, shall make downpayment estimated for the file storage time required thereby according to the tariffs in smart-contract; smart-contract will select vendors for file storage automatically. Once the file is saved at vendors', smart-contract shall commence sign-off payment for storage from downpayment made by user on a monthly basis. Should user delete file from the service, user will be returned with not-used part of downpayment.

User's downpayment using client's application shal be done in Ethereum or in USD accompanied by conversion to Ethereum.

Vendor's commerce

Service vendor shall use equipment, which enables calculating depreciation expense, power supply, internet-channel and premise rent for equipment. The items listed shall form vendor's expense makeup.

The following resources shall be supplied to the network: hard drive volume for storage, incoming and outgoing internet-channels. The most internet provides make channels asymmetric, incoming channel rate is higher than outgoing.

Vendor shall spend incoming channel for downloading customers' files. Thereby, customer shall use outgoing channel for transferring to vendor, which, as a rule, will feature lower rate than incoming one at vendor's. This means that vendor's incoming channel will usually fail to be loaded fully. For this reason file download is not rated by the customer.

Example of payback period calculation for vendor

Calculations were executed at prices actual for Saint-Petersburg, Russia.
For example let's consider 50 terabyte of storage.
Initial investments of vendor:

Description	Link	Q-ty of TB	Price (rub)	Cost per unit (rub)	Cost per unit ($)

Hard drive	https://market.yandex.ru/product/1728057314?show-uid=10908121026343034401600 5&nid=55316&glfilter=5127044%3A12107443&glfilter=5127047%3A4000~&context=search	4	7000	87500	1458,333333
Network repository (NAS)	https://technopoint.ru/product/2d5900ebecb33330/setevoe-hranilise-thecus-n2310-sale/?utm_source=yandex_market&utm_medium=cpc&utm_campaign=price_new_spb&utm_term=1048403	8	8700	54375	906,25

Periodic payments:

Description	Link	Q-ty of TB	Price (rub)	Cost per unit (rub)	Cost per unit ($)
Internet	http://nevalink.net/family/hs_internet/	100	600	600	10
Electricity				715	12

To become Casper vendor according to example script it is necessary to purchase HDD for 50TB, racks for their accommodation (NAS), and to pay for broadband Internet and electricity required for system operation.
Thus, to enter the system user has to spend $2386 in total for the first month.
Comparison with competitors
We take into account one of the major market players - Amazon with EFS tariff. Main criterias of choosing this tariff are unlimited request number and possibility to store files in organized folders as our service do. Let’s take their cost as a basis for our calculations.

Amazon Tariff				
Description	Link	Volume (Gb)	Price ($)	Cost for 50TB ($)
EFS	https://aws.amazon.com/ru/efs/pricing/	1	0,33	16500

Our offer will cost by 66% less, then we can make following calculations:

Casper offer			

Cost for user for 50Tb ($)	Casper commission	Number of replicates	Vendor income ($)
5445	0,3	4	952,875

(* - the income implies that all 50 TB will be filled throughout a month)

As we charge a commission at the rate of 30 percents, and each file is duplicated in 4 parts then income of one vendor for storage rendering will be 930 dollars (taking into account deduction of expenditures for electricity and Internet). Thus, payback of initial investments will occur within 2.5 months.

Tariff scale

Basic tariff is customized flexibly according to customer's needs. Should a customer use the service for static site content hosting, then he may store not very big files being downloaded frequently. In this case he will pay for more traffic. Should a customer use the service for backup storage, then the payment for storage will be higher.

Basic tariff is intended for corporate customers, which may use the service intensively, and under various scenarios. Meanwhile, a corporate customer may take more convenient a tariff with fixed payment that provide him the required amount of service. Casper's smart-contract may provide for such a tariff policy.

Casper deStorage

In addition to releasing Casper API, we will launch the first commercial service based on it. Casper deStorage is a cloud storage file service. The service will allow uploading files, downloading them later from any computer and sharing the files with other people.
The release of deStorage demonstrates the technical efficiency of Casper, the efficiency of the commercial model and will attract the first storage service providers. The infrastructure is being formed for possible future use of outside DApps.
A web client and clients for mobile devices will be written for deStorage. The applications code will be laid out in open-source and serve as an example for building the Casper API-based service.

The acquired CST will allow the owner to obtain the free, open-ended storage in Casper deStorage. The CST owner can activate the free, open-ended storage, after reserving the chunk of the available CST for this purpose. The size of the storage is given based on a calculation of 1 GB for 1 CST. Only inactive CSTs can be backed up. The portion of CST backed up for storage can be modified at any time by decreasing or increasing its size.

The target audience for Casper deStorage will be both ordinary users who want to store their photos and music, for example, and corporate users who will be able to store confidential documents.

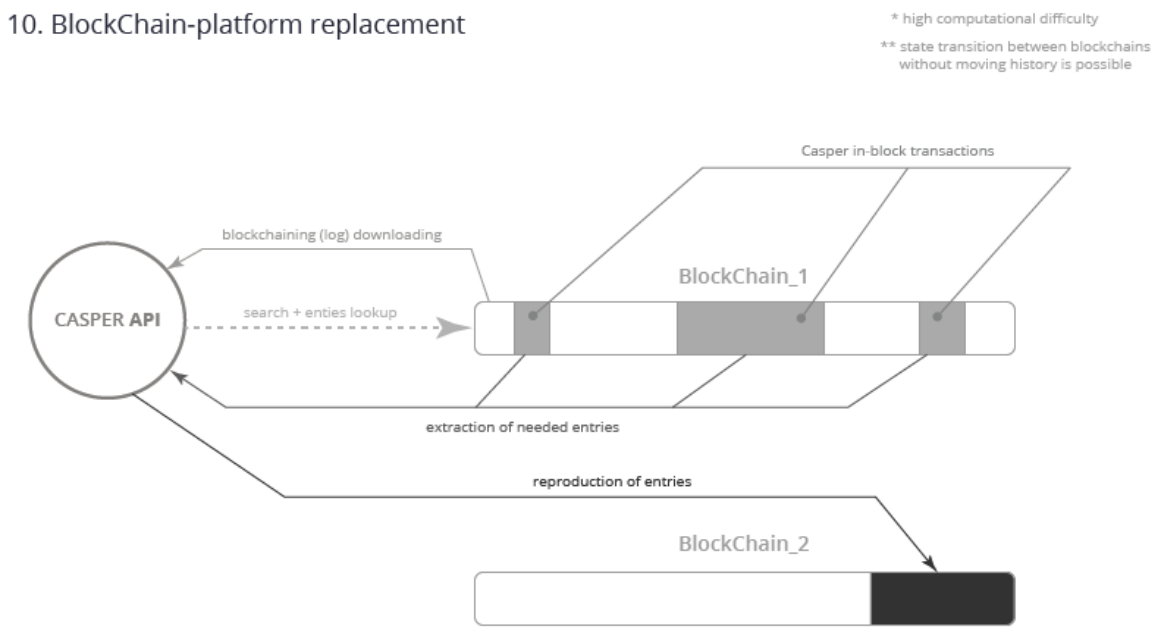
The service is provided for a charge with fixed monthly storage payment of 1 Tb of data. This charging option is convenient for the customers. They can easily predict their expenses. The charge will be unlimited for traffic, however if a certain volume of downloaded data is exceeded per month, the speed will be limited until the end of the month.

Corporate users who may use the service extensively and under different scenarios, will be able to use a base charge. The Casper ecosystem will use encoding of zCash transactions that permits concealing the conducted transactions with the files, to load, store, edit and download them in secret, i.e., corporate users receive a service that reliably protects corporate confidentiality.

Blockchain platform change

Casper peer-to-peer network is built as self-regulated one, and it is sufficiently independent on smart-contract. Network participants shall validate operation of each other, users of storage service may contact to vendors free from smart-contract participation to perform the most operations. Smart-contract code shall coordinate operation of any network participant, and receive notices on any operation significant for billing.

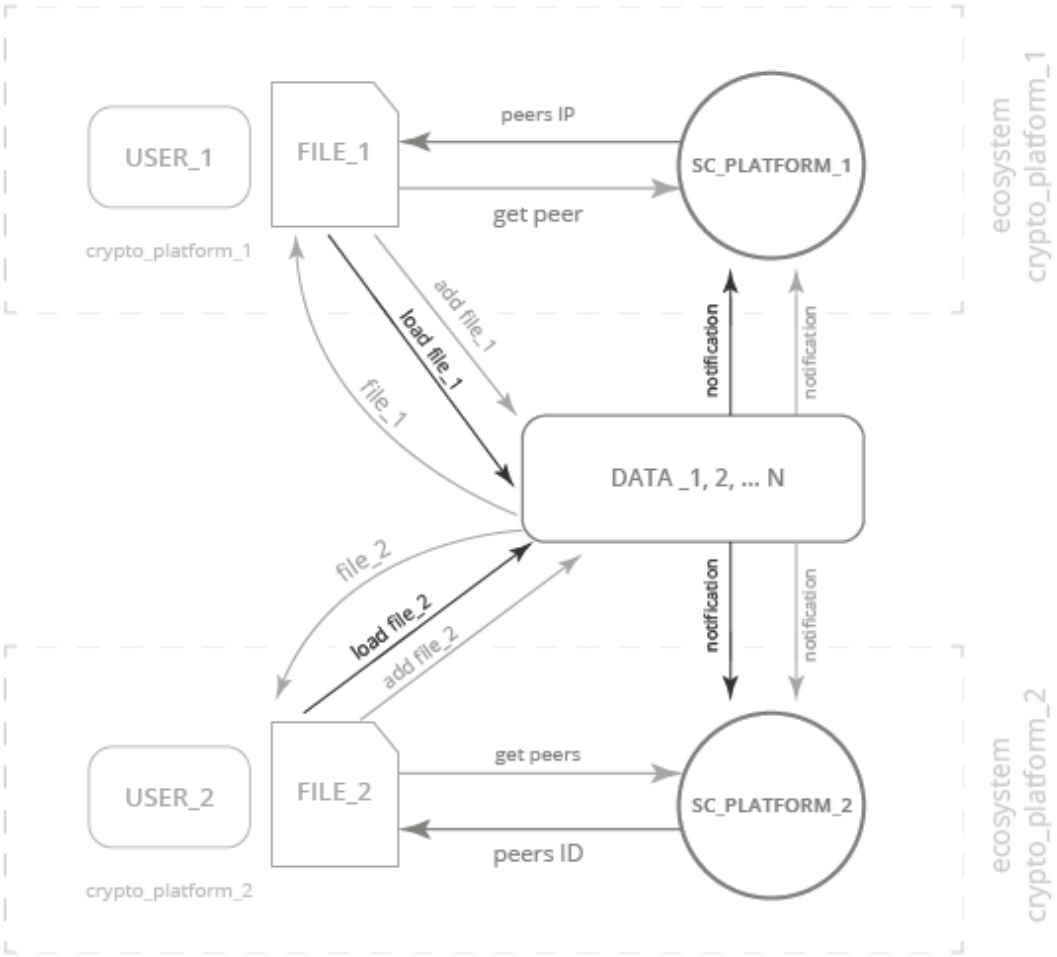
Blockchain technology develops headily and enhances continuously. New platforms will possibly appear over time, which having initially better design would supersede Ethereum, which will fail to evolve at required rate. Evolution of other existing platforms is also possible. To guarantee the users and vendors receive the best service, Casper reserves an engineering possibility to change blockchain platform in future. Logic of smart-contracts may be rewritten to language of a new platform adapting it to specific features. Participants of peer-to-peer network may switch between smart-contracts. This requires them notifying new smart-contract on operations instead of the old one, involve new smart-contract when coordinating operation instead of the old one. When switching to a new blockchain, it shall be imported with operation log from the previous blockchain. Operation log of any blockchain is public one, and may be stored on machines of many participants, and converted and imported to log of new platform. Casper will be able to continue calculation and service operation with status transferred correctly in a transparent for users manner. Service operation logic would not change, and no data will be lost.



Operation with several blockchain platforms

Casper’s network arrangement allows several smart-contracts operate simultaneously. In this case API Casper user when addressing from wallet of definite blockchain will determine that operations related to himself and validation of his files will be processed by smart-contract of its blockchain. Service vendors shall track from which blockchain platform wallet they addressed by user, and select smart-contract of the same blockchain platform when processing requests from user. Thus, Casper service shall combine audiences and DApps of several blockchain platforms, and service vendor shall obtain access to the entire combined audience.

13. Working with multiple Blockchains



Future development: decentralized calculations

Casper storage unit network enables generating first DApps for mass user. Services having arbitrary complexity based on DApp due to engineering restrictions are still impossible to be developed. Messenger, social media, any processing of a great volume of dataflow will be too expensive for use.

Casper developed platform’s functionality subsequent extension following its launch on the route to completely decentralized calculations of any complexity.

Remote database service addition

Typical cloud service keeps binary data and structured data on server for it's own operation. SQL or NoSQL database is used for structured data, which maintains specialized requests considering data framework. Smart-contracts enable keeping structured data in blockchain, which is an expensive solution, and also fails to allow keeping private data.
The next step after storage service for Casper is launched is adding NoSQL database service thereto. Database service will allow for store therein open data at a lower cost, than in blockchain, and private data provided sufficient trust to network vendors. It brings DApp to a new level with respect to performance, and complexity of possible services.
The main difference in storing binary and structured data is that the former are kept by vendor in an encoded form, whilst to perform requests to the database, it shall be kept in non-encoded form. Introducing new service will become possible at the moment when users get accustomed to Casper service, and form a pool of Casper service major vendors, which shall gain goodwill, which shall be appreciated. Developing laws in the field of blockchain, and introducing additional legal liability will enable increasing additionally cultural level within the service.
Existing NoSQL bases support dividing data stored by parts on servers, and synchronizing exact copies automatically, thus meeting the requirements for functionality and reliability to be included in Casper's decentralized system.
New database service will be rated in CST, and add a new quota, which will be appointed per 1 CST. Real provision of CST will increase when databases are introduced, and result in CST value increases at stock exchange.

Vendor clusters for assigned user group addition

Governments study blockchain technology, and prepare to use it in governmental services. Requirements related to reliability, adhering jurisdiction and sovereignty impose restrictions on use of network services. Most probably, requirement of any government for using any blockchain will be possibility control physically and determine servers, on which one or another blockchain will operate with governmental data. Thereby, blockchain service shall be opened for the rest users to integrate governmental services into economy.
Casper will enable generating assigned vendor pools, in which government or another entity will be able explicitly and controllably specify servers used for data storage. Said servers will participate in common environmental system of Casper service, but pool's owner will control additionally vendors selected thereby, and be sure they are reliable.

Remote virtual machine service addition

As vendor storage network, the level of responsibility to customer, server maintenance level grow, the following step in Casper development is possible i.e. connecting vendors' computer calculation capacities to network together with storage devices. It will allow vendors providing new service type i.e. distributed calculations or remote machines. Calculation capacities may be CPU, RAM, GPU. Distributed calculation service means that user is enabled placing a code at vendor's, which will be recalled by external requests (for

instance, by http-requests), and executed to process said requests. Remote machine service means that user on vendor's machine will be provided with a virtual machine, which will be assigned with a dedicated computer's capacity: specific HDD volume, RAM, defined number of CPU and GPU cores.

Calculations run in operative memory, occur using non-encoded data, as well as in the data base kept by vendor. There are homomorphous encoding algorithms, which enable performing operations with encoded data. Meanwhile, said operations are performed by an order of magnitude slower, than their similarities for non-coded data. From a practical point, such operations may be represented in service optionally, but fail to be the basic offering of the service.

Calculations using non-coded data pose a risk that data will be read by service vendor. One can try to struggle with this using tracking tools for suspicious scanning activity from the vendor's like anti-viruses do this. Said tools may be efficient, but from the universal Turing machine theorem it comes that sufficiently sophisticated service vendor may bypass them. Therefore, data safety solution lies both in engineering scope, and administrative one, as well as developing goodwill institution among vendors. Computers being located by vendor shall be protected physically and by legal procedures against vendor's arbitrary intervention. One option is that the vendors shall use computers with seals that protect them against inbreak.

Business and finance

Casper token (CST)

Casper token (CST) is system basic component that ensures inner mutual settlement. Casper-token function systems is designed so as to ensure the system is flexible at the current moment, and ensure it is possible to extend and develop thereof further. The entire CST volume will be issued (emitted) when introducing ICO. CST may divided to 0.00000001 CST.

Your possibilities with CST

Casper API

CST may be purchased, exchanged, sold, leased or rented freely.

Token holder may login in the system as a vendor. Vendor shall be enabled to become a system participant by placing its own capacities in Casper network. In this case each 1 CST will enable vendor placing storage device capacities in the network to 265 Gb. Vendor shall be accrued by a reward in CST for placing storage capacities in Casper network, and meeting engineer requirements related to availability time and connection rate (estimation formula will be presented later). Vendor, as any other CST owner, may dispose freely tokens received.

Any user of Casper network may offer his tokens for rent to other network participants, or lease tokens. When in rent, the right for use token shall be transferred to renter by user or provider for remuneration. Rent system shall be ensured by smart-contracts. Rent value shall be shaped by the market.

Service users will be decentralized applications i.e. DApp. They will be ensured with fixed tariffs in USD for data storage and transfer (Gb/month).

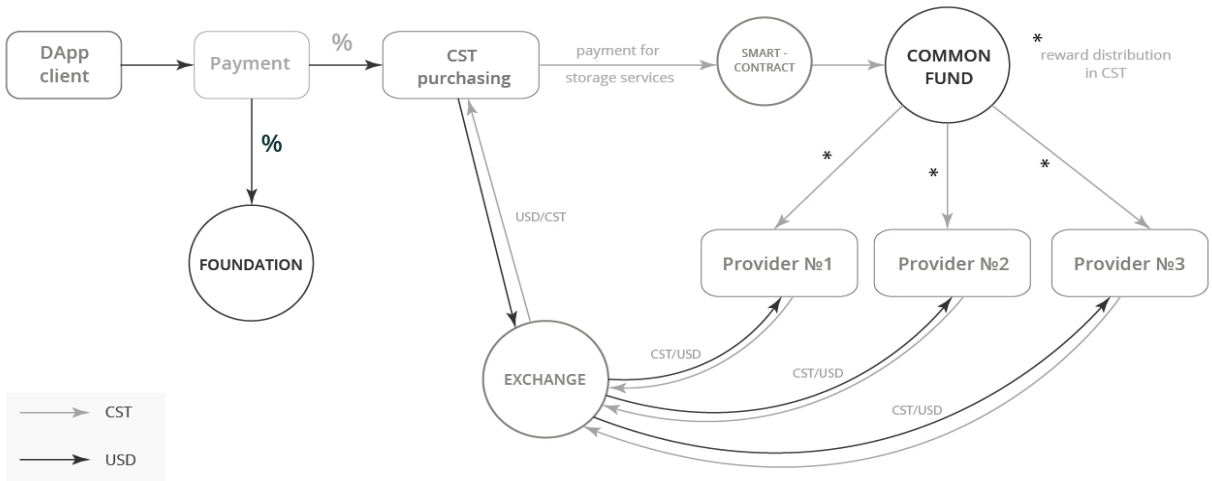
Casper software developer will ensure payments are processed, and appropriate clients are granted with access to network.

Since smart-contract will operate with CST only, Casper will withhold a portion of incoming payments to maintain network and software operation, and the rest portion will be converted into CST by market rate, and sent to smart-contract. Tokens arrived in such a manner will generate network vendor reward fund, and distributed among thereof according to rating regulations, proportionally to the useful contribution into the system. Such a system will enable vendor receiving reward in fiat currency returning tokens into circulation. A growing flow of paying customers will stimulate Casper Company purchasing tokens, which will in turn shape the growth of token value rate.

To ensure inner financial system is stable, Casper will reserve a portion of tokens (25%), and a portion of funds received from ICO (about 1% of the system market volume). Said funds will enable the Company ensuring service operation when its existence starts (in case external vendors are active insufficiently), and ensure CST/USD exchange rate is stable.

Token and fiat money traffic layout inside Casper system:

14. Business model



Casper deStorage

CST owner may activate an own account in the decentralized cloud storage system by booking CSTs he possesses for this. Storage capacity shall be provided cased on 1GB per 1 CST. CST share booked for storage may be changed at any moment thus reducing or increasing its amount. Volume of storage available will depend on tokens booked currently, and provided during the entire time of booking thereof.
Minimum volume for storage space being provided shall be 1GB.

Casper tokens issuing

Pre-ICO Conducting

At Pre-ICO phase it is planned to sell tokens at a discount. 1CST = $0.8. Total amount of funds: $1 040 000. Sales will be implemented via Ethereum smart-contract as per USD/ETH updated rate as of the day Pre-ICO is launched.

ICO Conducting

The sum planned to be raised via token sales is: $31 800 000.
Fund raising minimum threshold is: $4 800 000.
Token sales will be implemented via Ethereum smart-contract as per USD/ETH updated rate as of the day Pre-ICO is launched.

ICO ending conditions: tokens are sold out or 2 month passed.

Token distribution table

	Price	Tokens (CST)	USD
Total		44 000 000	
Pre-ICO	1CST = $0.8	1 300 000	1 040 000
ICO	1CST = $1.2	6 500 000	7 800 000
	1CST = $1.6	6 500 000	10 400 000
	1CST = $2	6 100 000	12 800 000
Bonus for funds		6 000 000	
Casper Team’s tokens		6 600 000	
Casper-system fund		11 000 000	

Basic conditions for conducting ICO

- ICO will be conducted based on Ethereum using smart-contact.
- CST token issue or mining once ICO is over will be impossible.
- In case during ICO the minimum threshold for raised finance wont be overcome, then any funds raised will be returned to the senders. Thereby the funds raised within Pre-ICO shall not be subject to refund.

Vendor's operation profitability estimation formula*:

([tariff for 1Gb storage per month] x [actually occupied space volume] + [tariff for 1Gb data transmission] x [actually transmitted data volume]) x 0.7/4

*provided that engineer requirements for equipment and network availability time.

Forecast of CST rate, $ and CST ownership advantages

Future token cost is determined by two key factors:

1. Speculative demand from investors;
2. Increasing number of system users i.e. DApps, growing DApps' users, growth in data being stored and transferred, increase in payments into the system, and as a consequence growing need for CST;
3. Increasing income being received by vendor when providing the system with resources due to increase in percentage of capacities used actually;
4. Increase in CST owners' income due to token rental;
5. Increasing income obtained by vendor when providing the system with resources due to increasing quota for providing resources for 1 CST;
6. Increasing vendor's revenue due to general cost decrease related to disc array, and internet traffic.

Taking into consideration that the Company is planning to render services to token owners starting from the second year of Project implementation only, we suppose that token cost growth from the first to the second year will be determined just by speculative demand from investors. It is hard enough to quantify the influence of this factor, however taking into consideration the experience of ICO carried out in 2017 it can be supposed that interest of investors to "good idea" can result in token price multiplication as early as in the first days of ICO (e.g., tokens of Voise musical platform have got up by 453 times from June to August, 2017, and coins of Etheroll company have grown from $0.06 to $165, and then went down to $4.15). In our forecast we adhere to more conservative prediction and suppose that token annual average price will be doubled over the first year due to speculative factor only.

Further forecast for token cost will also depend on speculative factor, but we in our prediction in a greater degree rely on fundamental factor, namely on token capacity growth – data volume which can be stored or offered by token owner.

From the first to the second year, token cost is doubled as a result of influence of speculative factors. Further forecast for token cost corresponds to token capacity growth rates (both for

users and Data centers). In its turn, token capacity is determined by quantity of tokens on the market and by data storage volume which is offered to users of Casper platform. Quantity of tokens in the ownership of users and Data centers should comply with the following rule: quantity of tokens, multiplied by token capacity for user should be equal to similar indicator for data centers and should correspond to total Casper Platform storage volume.

Token cost forecast for positive scenario

Metrics	Units	FY1	FY2	FY3	FY4	FY5
DAPPs (IAAS) storage volume	mln Tb	2	6	12	29	49
Casper Platform market share - positive scenario	%	0%	20%	30%	40%	40%
Casper Platform storage volume	mln Tb	-	1	4	11	20
Total tokens amount on the market	mln CST	33	34	35	36	37
User CST storage volume (DAPP)	Gb	1	39	118	367	615
Data-center CST storage volume	Gb	256	256	769	2 394	4 020
The rate of increase of user CST storage volume	%			200%	211%	68%
The rate of increase of data-center CST storage volume	%			200%	211%	68%
Quantity of tokens hold by users	mln CST	33	29	30	31	32
Quantity of tokens hold by data-centers	mln CST	0	5	5	5	5

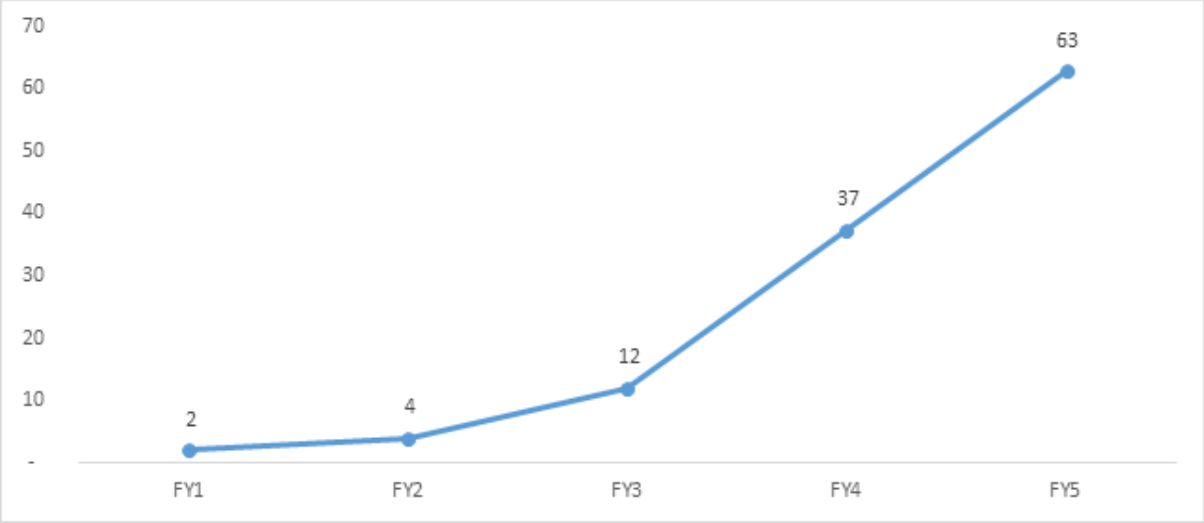
CST cost forecast (by volume for the user)	$	**2**	**4**	**12**	**37**	**63**
CST cost forecast (by volume for the data-center)	$	**2**	**4**	**12**	**37**	**63**
CST rates of cost increase	%		100%	200%	211%	68%

Token cost forecast for negative scenario

Metrics	Units	FY1	FY2	FY3	FY4	FY5
DAPPs (IAAS) storage volume	mln Tb	1,2	4,6	9,5	22,9	39,5
Casper Platform market share - positive scenario	%	0%	16%	24%	32%	32%
Casper Platform storage volume	mln Tb	-	0,7	2,3	7,3	12,6
Total tokens amount on the market	mln CST	33,0	34,0	35,0	36,0	37,0
User CST storage volume (DAPP)	Gb	1	24	72	222	373
Data-center CST storage volume	Gb	256	256	769	2 394	4 020
The rate of increase of user CST storage volume	%			200%	211%	68%
The rate of increase of data-center CST storage volume	%			200%	211%	68%

Quantity of tokens hold by users	mln CST	32,9	31,1	32,0	32,9	33,9
Quantity of tokens hold by data-centers	mln CST	0,1	2,9	3,0	3,1	3,1
CST cost forecast (by volume for the user)	$	**2**	**4**	**12**	**37**	**63**
CST cost forecast (by volume for the data-center)	$	**2**	**4**	**12**	**37**	**63**
CST rates of cost increase	%		100%	200%	211%	68%

Token cost growth forecast, $



Cloud data storage market for decentralized applications

According to GARTNER's forecast, market size for services based on cloud technologies will reach 383.4 billion USD by 2020.

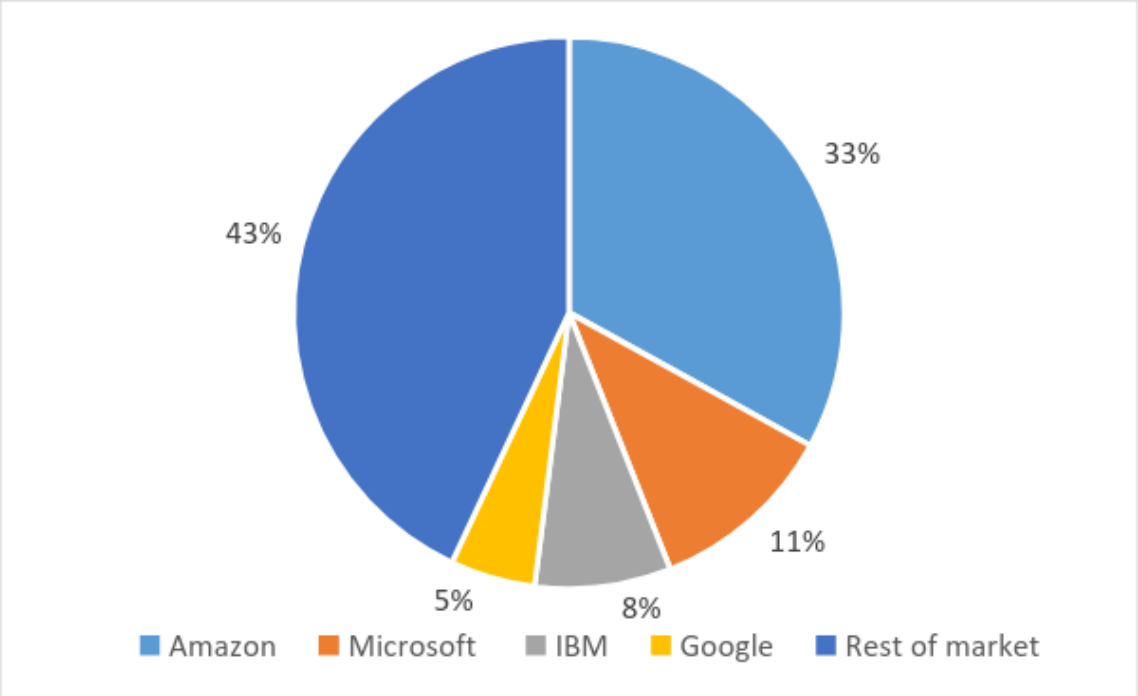
Cloud technology based service global market, GARTNER, billion USD

	2016	2017	2018	2019	2020
Cloud Business Process Services (BPaaS)	40,8	43,8	47,6	51,7	56,2
Cloud Application Infrastructure Services (PaaS)	7,2	8,9	10,6	12,6	14,8

Cloud Application Services (SaaS)	38,6	46,3	55,1	64,9	75,7
Cloud Management and Security Services	7,2	8,8	10,4	12,2	14,0
Cloud System Infrastructure Services (IaaS)	25,3	34,6	45,6	57,9	71,6
Cloud Advertising	90,3	104,5	118,5	133,6	151,1
Total Market	209,2	246,8	287,8	332,7	383,4

Cloud System Infrastructure Services (IaaS) is the fastest growing market segment for cloud based services having yearly average growth rate at 30%. By 2020 IaaS segment will reach 71.6 BLN USD. Market growth basic factor is companies striving to optimize expense, and growing use of IT solutions based on cloud approach by medium and small-sized business. Top 4 players at IaaS market occupy about 50% of the market. Amazon Web Services is the leader at IaaS market having share of 43%.

Market shares of IaaS main players



As blockchain know-how appeared and being popularized, software developers are interested more and more in DApps. Currently, about 722 DApps function on Ethereum platform. Services that offer decentralized cloud data storage are more and more popular. Similar to Casper platform, a number of player position themselves as platforms for distributed applications, among which MaidSafe, Swarm, Crypti, Nxt shall be distinguished.

	Project	Year	Specificity
1	Sia	2014	Decentralized encoded platform for data storage. Focus on enterprise

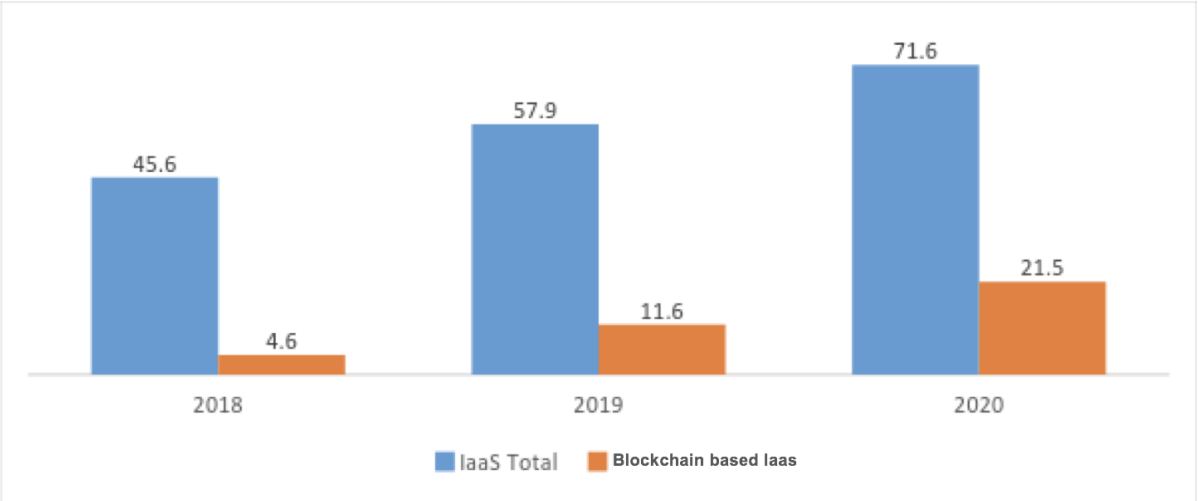
2	Filecoin	2014	Decentralized network on blockchain basis for data storage. No focus.
3	Storj	2014	Distributed encoded platform for data storage. Focus on developers and companies
4	Cryptyk	2015	Decentralized environmental system for safe data storage, file exchange. Focus on enterprises
5	MaidSafe	2006	Not only a platform for data storage but for decentralized calculations as well
6	Swarm	2016	Platform for decentralized data storage and decentralized applications
7	Crypti	2017	Decentralized payment system that enables placing and commercializing applications on Crypti platform
8	Nxt	2017	Platform for generating distributed applications

Nevertheless, none of listed above offers a service, which would ensure a convenient environment for developing DApps.

We suppose that IaaS market considering platforms of any type both classic ones, and based on blockchain know-how will come to 71.6 BLN USD. According to our assessment, IaaS segment based on blockchain will come to 30% of market, or 21.5 BLN USD in 2020.

Current classic cloud storage market top 4 players are Amazon, Microsoft, IBM, Google with total market share about 60%. Considering that we are developing platform for decentralized cloud storage and strive for leadership we can suggest Casper API share as 15%.

Blockchain based IaaS market forecast 2018-2020, BLN USD



Casper platform strategy is aimed to reach the leading positions in own segment, similarly to the current positions of leading services, therefore, in our forecast we are guided by 30% market share in blockchain based IaaS segment. At 30% commission for Casper platform service, revenue in 2020 will be 1.9 BLN USD.

Financial model

Basic provisions and assumptions when shaping Casper project financial model

- Operating expenditure shall be covered from profit, and Casper original capital.
- Company's profit is generated by payments delivered by clients (DApps) that pay for data storage, except a portion of funds delivered to the pool of vendor reward system, and funds from CST sales delivered as commission for operations in CST circulation inside the system (token rent).
- Company's original capital is cryptocurrency assets obtained as a result of ICO.
- Company's basic expense items are:
    - Product team maintenance cost (salaries), and accompanying expenses (office, machinery rent, taxes);
    - Marketing specific expense (attracting clients);
    - Shaping project fallback fund.
- Basic factors that affect Company's financial standing will be as follows:
    - Number of DApps attracted, their need for the service;
    - Cost for user attraction;
    - Number of vendors attracted (storage space placed in network).
- A fallback fund will be established when starting the

Use of project's fallback fund to implement marketmaking and investment fund for development of DApp startups

Within the framework of the Campaign, two funds will be formed of issued CST:

1. Fallback fund to provide stability of CST course and high rates of token mass movement (for these purposes we reserve tokens (up to 25%) and monetary funds ($1.7 to $2.6 million). The fund formed of CST fiat money will allow Casper Project to be a market maker on the CST market, to perform retirement of excess CST as necessary, or vice versa – to feed out additional CST to satisfy demand of customers wishing to become power suppliers to Casper network, if such need raises. Later, mechanisms of key parameters determination will be elaborated. Key parameters are such parameters the achievement of which will take effect on the fact and level of influence of Casper Company on the CST market.
2. Investment fund from the assets of which tokens in the form of grants for selected startup projects in the area of DAPP will be given. Invested in such a manner projects later can become users of Casper platform and will strengthen company positions on the market.

CST distribution between these funds will be determined by, among other factors, amount of CST sold in the process of ICO. Below, two possible variants of ICO realization and their corresponding CST distribution between funds are presented:

Variant of ICO realization	100% CST sold	50% CST sold
Quantity of CST sold on ICO and pre-ICO	26 400 000	13 200 000
Quantity of CST which team has	6 600 000	6 600 000
Quantity of CST on the market	33 000 000	19 800 000
Quantity of CST in fallback fund	7 000 000	11 000 000
Quantity of CST in investment fund	4 000 000	13 200 000

Project development positive scenario

Assumptions:

- All providers use CST, project team fails to interact with data centers directly. Therefore, the Company has no expense for hosting.
- As a result, the sole source of income for project is commission from clients, commission rate shall be 30%.
- DApps share within IAAS market will grow from 1% in 2018 to 15% in 2022.
- Casper Platform's share at DApp market will grow from 10% to 40%.
- Summary expense over 5 years for development will be 1.9 million USD
- Advertising costs in 2018 - 700 000 USD.
- Advertising costs is 2019 will be 5% lower than 2019 year revenue.
- Tariff for clients shall be fixed at $0,025 per Gb/month for Storing and $0,15 per Gb traffic.

CASPER PROFIT & LOSS STATEMENT, POSITIVE SCENARIO, $

	2018	2019	2020	2021	2022
Company turnover	**0**	**347 381 965**	**1 073 280 000**	**3 434 496 000**	**5 924 505 600**
Revenue	**0**	**104 214 590**	**321 984 000**	**1 030 348 800**	**1 777 351 680**

Hosting costs	0	0	0	0	0
Advertising Costs	-700 000	-99 003 860	-257 587 200	-515 174 400	-533 205 504
Development team salaries	-290 000	-723 330	-741 413	-1 033 814	-1 162 249
Staff salaries	-607 000	-1 471 284	-1 621 118	-2 321 774	-2 994 857
Payroll taxes	-167 633	-239 660	-246 314	-292 667	-324 750
Rental Costs	-57 000	-135 432	-145 128	-213 224	-267 703
EBIT	**-1 821 633**	**2 641 024**	**61 642 827**	**511 312 921**	**1 239 396 617**
EBITDA	**-1 821 633**	**2 641 024**	**61 642 827**	**511 312 921**	**1 239 396 617**
Income before taxes	-1 821 633	2 641 024	61 642 827	511 312 921	1 239 396 617
Corporate Income Taxes	0	528 205	12 328 565	102 262 584	247 879 323
Net income	**-1 821 633**	**2 112 819**	**49 314 262**	**409 050 337**	**991 517 293**

Project development negative scenario

- Providers fail to use Casper-tokens, the team interacts with data centers directly and independently. Thereby, hosting cost increase by 4% with respect to positive scenario.
- As a result, the source of income for project will be not commission but the entire payment amount of users.
- DApps share within IAAS market will grow from 0,8% in 2018 to 12% in 2022.
- Casper Platform's share at DApp market will grow from 8% to 32%.
- Summary expense over 5 years for development will be 4 million USD.
- Advertising costs in 2018 - one million USD.
- Advertising costs is 2019 will be 5% lower than 2019 year revenue.
- Tariff or clients shall be fixed at $0,025 per Gb/month for Storing and $0,15 per Gb traffic.

CASPER PROFIT & LOSS STATEMENT, NEGATIVE SCENARIO, $

	2018	2019	2020	2021	2022
Company turnover	**0**	**222 324 458**	**686 899 200**	**2 198 077 440**	**3 791 683 584**
Revenue	**0**	**222 324 458**	**686 899 200**	**2 198 077 440**	**3 791 683 584**
Hosting costs	0	-161 852 205	-500 062 618	-1 600 200 376	-2 760 345 649

Advertising Costs	-1 000 000	-73 367 071	-164 855 808	-329 711 616	-341 251 523
Development team salaries	-580 000	-1 446 660	-1 482 827	-2 067 628	-2 324 499
Staff salaries	-607 000	-1 471 284	-1 621 118	-2 321 774	-2 994 857
Payroll taxes	-184 673	-285 100	-291 754	-355 147	-392 910
Rental Costs	-75 000	-184 680	-195 607	-284 299	-347 022
EBIT	**-2 446 673**	**-16 282 542**	**18 389 469**	**263 136 600**	**684 027 124**
EBITDA	**-2 446 673**	**-16 282 542**	**18 389 469**	**263 136 600**	**684 027 124**
Income before taxes	-2 446 673	-16 282 542	18 389 469	263 136 600	684 027 124
Corporate Income Taxes	0	0	3 677 894	52 627 320	136 805 425
Net income	**-2 446 673**	**-16 282 542**	**14 711 575**	**210 509 280**	**547 221 699**

Pre-ICO financial plan

Overview

Pre-ICO Goal	$1 040 000
Costs (up to 4 months)	
Global marketing & PR campaign	$400 000
Legal	$80 000
Business expenses (regular)	$60 000
Development	$160 000

Roadshow	$80 000
Hackatons&Tech Expert rewards	$140 000
Team	$120000

Staff

Top-management	RUB	USD
Chief executive officer (co-founder)	50 000	862
Chief operating officer (co-founder)	50 000	862
Chief technical officer	250 000	4310

Marketing	RUB	USD
Head of Marketing Communications	100 000	1724
Traffic manager	70 000	1207
SMM-traffic manager	70 000	1207
Community manager (Russian speaking community)	50 000	862
Community manager (English speaking community)	50 000	862

Development	RUB	USD
System architect	200 000	3448
Lead Java Developer	160 000	2759

Lead Frontend Developer	160 000	2759
Lead C++ Developer	160 000	2759
QA lead engineer	100 000	1724
Java Developer	100 000	1724
Java Developer	100 000	1724
Java Developer	100 000	1724
Project lead	120 000	2069
Data Analytic	80 000	1379
Product manager	120 000	2069
Designer UI/UX	130 000	2241
Markup development (outsource)	100 000	1724

Total (per Month):	2 320 000 ₽	$40 000
For 4 months:	9 280 000 ₽	$160 000

Marketing

Activity	RUB	USD
Publications about the project		
Preparing publications about Casper for mass-media (3 ea.)	19 500	336

Publications in major Russian media dedicated to IT, cryptocurrency and blockchain technology	700 000	12069
Publications and advertisement in major English-speaking media dedicated to IT, cryptocurrency and blockchain technology	2 000 000	34483
Publications and advertisement in major Chinese-speaking media dedicated to IT, cryptocurrency and blockchain technology	2 000 000	34483
Publications and advertisement in major Spanish-speaking media dedicated to IT, cryptocurrency and blockchain technology	2 000 000	34483
Direct advertising		
Target FB	4 000 000	68966
Contextual advertising	2 000 000	34483
ICO rating	8 000 000	137931
Dedicated companies' service		
Open Ledger service	1 200 000	20690
Developing video-explainer about Casper for landing Animation	300 000	5172
Alternative activities		
Hackathon with a prize for talented programmers, prize will be shared by 3 winners	1 500 000	25862
Content language adaptations		
Translating lending to Chinese	10 000	172
Translating lending to Korean	10 000	172
Translating lending to Japanese	10 000	172

Translating lending to Spanish	10 000	172
Translating lending to Portuguese	10 000	172
Translating lending to Hindi	10 000	172
Translating VP to Chinese	40 000	690
Translating VP to Spanish	35 000	603
Translating lending to Portuguese	35 000	603
Translating lending to Hindi	40 000	690
Translating publication about Casper to English (3 ea.)	30 000	517
Translating publication about Casper to Chinese (3 ea.)	30 000	517
Translating publication about Casper to Spanish (3 ea.)	30 000	517
Translating publication about Casper to Hindi (3 ea.)	30 000	517
Total:	24 049 500 ₽	$414 647

Other

Legal support	RUB	USD
Consulting company, full support in foreign jurisdictions	4 656 000 ₽	$80 000
Business (up to 4 months)	**RUB**	**USD**
Rent office space and equipment	2 328 000 ₽	$40 000
Accounting&Taxation	1 164 000 ₽	$20 000

Tech experts reward	RUB	USD
Expert in cloud storage services (consulting)	291 000 ₽	$5 000
Expert of something related	291 000 ₽	$5 000
Expert in P2P networks (consulting)	291 000 ₽	$5 000

Marketing plan

In case you have already considered generating an own DApp, you know good, which opportunities blockchain technology may provide.
We want all your efforts to be focused on the main advantages of your application, but not on developing own storage utility; our Casper API service may help you. Using our utilities ensures your DApp a safe, decentralized and accessible storage with respect to prices, which in our opinion, will decrease each year, and allow reduce your expense making your applications stronger players at the market.

Our basic marketing task is not only bringing info about capabilities of Casper utilities to developers, but also assure common users that using Casper API in DApp is a new standard for data storage that ensures their data are confidential and reliable.
To make out marketing plan understandable for everyone, we have divided thereof by logic units, which demonstrate the way we are going to promote Casper, throw light on team's activities. Said division will help you understand better, which way we spend cash collected during PRE-ICO and ICO from marketing point of view.

Special attention we pay to work with community. We will do everything possible to make our answers maximum clear, prompt, and release you from any doubt, while considering and clearing your comments.

Why is Casper API attractive

We don't build a cloud storage, but we help DApp on any blockchain platform with smart-contract to resolve task of data storage, and quicken development of blockchain project industry.
Our utilities will result in reducing storage prices at vendors'.

Casper SWOT-analysis

Investigating inner and external factors that impact or capable impacting both in favorable, and unfavorable manner

	Strengths	Weaknesses

Inner environment	**1) Using popular blockchain i.e. Ethereum** **2) Experience in developing smart-contracts** **3) Enable working with any blockchain with smart-contract** **4) Transferring files at a higher rate due to P2P** **5) Vendors may be both individual users, and data centers** **6) Storage: no intermediary between user, and data storage utilities** **7) Reliable storage: splitting file, duplicating, and distributed storage all over the world** **8) Focusing on growing DApp market** **9) Attractive branding** **10) Clear product positioning** **11) Advanced token usage system (token enjoys an actual use within the system)** **12) Unavailable direct competitors** **13) Paying data storage companies using fiat money** **14) Broad capabilities to implement API in any DApp, being developed or new ones**	**1) Using bockchain of other company** **2) Proof-of-Concept not ready yet** **3) Global task in changing users' thinking**

External environment	**1) Enthusiastic blockchain community** **2) Increased attention of private users to projects on blockchain** **3) Increased attention of companies to projects on blockchain** **4) Growing cloud storage market (increasing demand for storage)** **5) Growing demand for confidentiality** **6) Transnational market** **7) Ethereum's strong positions** **8) Number of DApp growing actively** **9) Growing cryptocurrency market**	**1) There are services involved directly in storage that have started earlier, and having product that works** **2) Strong business of major corporations that provide cloud storages** **3) Possible issues related to the laws on personal data** **4) Weak demand for confidentiality from private users** **5) Rapid technological development: more effective approaches are possible to appear** **6) Conservative major business** **7) Corporate clients need completely private blockchain** **8) Hype around ICO area** **9) Governmental regulation of the area fails to be formed in the most countries**

Working on weaknesses

Inner

1) Using bockchain of other company
From all blockchains existing currently we have selected the most popular one, DApp with a rich basis, since we are sure that Ethereum is awaited by quality development, and we will see the nearest results already with switching to PoS (Proof-of-Stake). It shall be reminded also that our API may operate with any blockchain based on smart-contracts.

2) Proof-of-Concept not ready yet
Many blockchain projects reach ICO having only one idea; we have already commenced working on preparing Casper concept to demonstrate the job is running. You'll see the job for sure before ICO start.

3) Global task in changing users' thinking
Each member of our team is a evangelist of idea that information is the most valuable resource. We will propagate the idea everywhere and all the time. As with any global idea before, the more we talk and draw people's attention to this idea, the more will be the number of those that share our values, and disseminate thereof further.

External

1) There are services involved directly in storage that have started earlier, and having product that works
We don't strive to compete with decentralized cloud storage services. Our idea is to help developing DApp without focusing on data storage issues, thus, we see here only partial intersection, which may not bear global consequences.
.
2) Strong business of major corporations that provide cloud storages
Disseminating our idea on value of information for everybody will result in failure of major corporations to guarantee for storing entities that information belongs to them only. This will lead them to the idea about decentralized cloud storage.

3) Possible issues related to the laws on personal data
Since the utilities use cryptographic encoding, and splitting files to several minor ones among unknown vendors, it shall neutralize risk they may be reviewed or edited.

4) Weak demand for confidentiality from private users
This problem is impossible to be resolved in a single blow, since the idea requires bringing it to public every day in an understandable manner.

5) Rapid technological development: more effective approaches are possible to appear
We are all livers of quite interesting time, when hovering technological thought changes habitual environment and operating principles every day, thus, it needs to be ready for

sudden breakthrough, which would make the idea on decentralized storage unable to function. But anyway, it will pass pretty much time before it is introduced to life.

6) Conservative major business
Not all corporations have understood capabilities that brings blockchain technology, and which advantages it may provide, but understanding will come as the number of successful DApp grows, which may become capable reject obsolete practices, and develop something own.

7) Corporate clients need completely private blockchain
DApp, which will use Casper API, undoubtedly, shall provide their clients capabilities of private blockchains.

8) Hype around ICO area
Despite ISO is a perfect tool for young teams to implement their ideas, this market has attracted plenty of unfair companies that want cash in on the wave failing to implementing the product claimed. This fact, plus a great number of planned ICO hinders fundraising for really useful and interesting projects.

9) Governmental regulation of the area fails to be formed in the most countries
The most countries failed yet to establish legal grounds for cryptocurrencies, conducting ICO, and relations between blockchain startups and their investors. But all this goes to the area will be over-regulated, and this for sure, will result in an abrupt growth of DApp, and financial influx to the area not only from major corporations, but from private investors of various size.

Making Casper popular

Casper's potential audience makes use of various applications, services and social media both for everyday operation, and communication as well. We also will catch the chance to tell about our project to the maximum broad pool of persons.

Casper-promo

For all users that possess CST in their wallets, and activated thereof we offer a service in free of charge storage of files in terms of 1CST=1GB.
This service will operate on Casper API base, and enable demonstrating how good our utilities are doing.
Please note that when selling or renting CST partially or entirely, storage period will be shortened by the similar value.

Targeted advertising in social media

Just think thoroughly that Facebook audience came to 1.9 billion persons this year, 700 million for Instagram, and 100 million persons for VK. These are the perfect sites that provide a variety of advertising tools to bring the info required. Carousels (video/photo sets), video promotion, promoting advertising posts, and many other else.
These social media is the basic way to tell about ideas embedded into Casper to the global community.

Advertising in popular messengers

Messengers get more and more popular having dozens of author's channels with interesting content that attract mass of attentive and active subscribers.
One of the most popular is Chinese WeChat having vast audience of 900 million users. This is not simply a chat, but an entire environmental system comprising capabilities to pay, book etc.
Kakao is the main beacon for South Korea having audience of 100 million users.
Telegram is a messenger actively used all over the world, audience is 100 million users.
These are modern and updated channels to bring info to users, which prefer author content, deep immersion into content.

Contextual advertising

A portion of our marketing team are persons- descendents from Legion digital-agency having 6 year experience in contextual advertising. We are the certified partners of Google, and we know that contextual advertising is a well-proven way to address once again, and make potential user interested when he/she browses Internet. We understand well that a decision to invest in a blockchain project may not occur at once, thus, the maximum number of touches is the pledge that a user will pay attention to our service among the entire informational noise, which accompanies our life every day.
Google and Chinese Baidu internet search leaders will be perfectly good for this purpose.

ICO listings

These are various internet resources, which provide their users with info about forthcoming ICO projects from the entire world i.e. dates, cost of token (project coin), phases, bonuses etc. There are many listings both having global, and local importance, which help deciding on purchase, weighting any pluses and minuses of the project, learn opinion of other users on it.

Blockchain/cryptocurrencies/ITmedia

Of course we cannot pass attention to detailed and thorough overviews of our product from major internet resources, which cover everyday global events from IT, blockchain and cryptocurrencies point of view. Authoritative opinion of portal's journalists will enable not only shaping an opinion among potential users of Casper, but receiving feedback from persons involved in review of projects on a professional basis.

Roadshow, conferences, exhibitions

Following the ICO we will prepare a list of the most important global conferences and exhibitions dedicated to blockchain technology, data storage and protection, where our team well be ready to answer any question personally.
In addition, this is our perfect opportunity to bring our main ideas to the DApp developer teams. It's not only a chance to find partners, but enforce the teams showing them, how we can partially resolve issues in development of their projects thanks to our Casper utilities.

Community Use

Casper account in social media

For your comfort, we are planning to maintain various Casper's official accounts in different social media, where we will upload any updated info on project progress, and answer your questions.
We are planning in this respect:
- Facebook account in English and Russian. As the social media having the greatest audience in the world.
- Twitter account in English and Russian. As the social media having convenient format for updates on all actual news related to Casper project.

Official Casper chat in Telegram, WeChat, Kakao.

These are our basic communication channels for the community.
Want more details about the project?
Pose engineering or any other question?
Want provide feedback on the project, share an idea?
Or simply talk to the team?
Our official chats in Telegram in English and Russian, WeChat in Chinese, Kakao in Korean are the best sites to do all the above. We'll try to be maximum prompt and available!

Project blog at Medium

Casper official page in English and Russian on Medium platform. Everything that would require a detailed submission and coverage of nuances will be concentrated over here. You are awaited by actual news on project development, upcoming events where you'll be able to communicate with our team personally, reviewing emergent issues, and options to resolve thereof, replenishment in the team, or novel partnership. All of this, and even more is here!

Branch on bitcointalk.org

If we ask any person that monitors the world of cryptocurrencies and blockchain, which forum is the most popular one, 100% will answer bitcointalk.org.
That is why we have planned two individual branches for the project in English and Russian on the most popular resource related to blockchain/cryptocurrencies where you may pose any question you interested and learn more about Casper.

Live broadcasting

See team's reaction to your questions. To pose the most captious questions free from possibility to get prepared for answer. Simply view those that contrived revolution in the area of cloud data storage free from intermediaries.
Everything above will be available for you once in 2 weeks on our live broadcast. Questions will be posed in textual format, and we will answer on the air.
The best your proposals in enhancing the service or other aspects will also be announced on the air.

Working with venture funds

Involving venture funds on ICO phase will enable us raising for sure the sum required for development. Therefore, we pay the closest attention to this aspect, which requires not only an idea during ICO, but an elaborated financial and marketing plan, and working concept related to the product, which shall leave no doubt that the team is able to bring the affair commenced to the completion.

Working with cryptocurrency stock exchanges

We understand how it is important that CST brings benefit not only inside the system, but also to bargain thereof on exchange to enable you at any time receiving profit from investment to our project. Therefore, just when PRE-ICO is over, we will start communications with major cryptocurrency stock exchanges: Poloniex, Kraken, Coinbase, Cex, Bitstamp, Bitsquare, Bittrex, Bitfinex, Coinbase, Shapeshift, Bithumb, Bitso, BitBay, YoBit, Exmo, HitBTC, GDAX etc.
Any update related to concluding partnership with exchanges will be posted on our official resources.

Developer team expansion

Hackathons

These are marathons in programming where loners or teams shall resolve a specific problem or task posed by developers.
Our team is planning to conduct said events on a regular basis before upcoming ICO. Why we do so:

- widening Casper's utility functionality
- receiving feedback from IT community
- software framework test
- testing Ethereum as a blockchain platform, being the base for our service
- involving new talented developers
- project advertising in IT community
- project advertising among DApp developers

We will announce hackathon's subject beforehand, and select participants using preliminary tests. You are awaited both by money reward, and possible offer to join Casper team.

Blockchain projects development

Supporting new blockchain startups

We understand well how many difficulties are awaiting a young startup toward the success. So we want to be useful for the projects, which require service in storing a great amount of data. All of them may get a working utility, and a beneficial tariff for data storage. This will

clear a number of engineering issues, and enable them focusing on basic functions of their applications free from thinking about issues related to storage.
Our team is sure that using joint efforts one can quicken development and propagation of blockchain technology into all areas, where it is called for indeed, and provide benefit.
In addition, our support service is always ready to help your team in developing smart-contract for adaptation with Casper API. We will find an optimum solution for your DApp.

Team

Artem Koltsov
Co-founder
6 years of Legion-digital managing
IT development(mobile APP, web-sites)
Head of Expert Council for blockchain and cryptocurrencies in the Russian State Duma

Vitaly Chermensky
Co-founder
2 years of work as the Sales Dept. Chief in Holiday Club OY (Finland)
A great managerial experience in various business areas (Eurosib, Fogzy)
Owner of Museum, interactive excursions in St. Petersburg
Alumnus of ITMO University, SPbSU

Stanislav Kapulkin
Head of development
A mathematician-programmer, studies mathematics and conducts research in cognitive psychology
Winner and participant of various competitions and start-ups in the field of IT and AR.
In 2016, the co-organizer of the hackathon Hackthebrain
In 2015, the winner of the regional stage of the Imagine Cup, the winner of the Intel Real Sense Challenge 2014
Participant of many IT conferences and regional hackathons
The winner of the hackathon HackCV in 2017th year.
Many times conducted lectures "Theory of categories for agile-development"
Organized a club for applied machine learning
Education: ITMO University graduate with a master's degree

Alyona Kolpashnikova
Project Lead
5 years of working experience as a project and product manager, i.e. Welltory
Building processes in teams from 5 to 120 people. Both in-house and remote

Nurlan Tlegenov
CMO
6 years of working experience in a major corporate business, i.e. KaVo
5 years in event and digital marketing
Member of Expert Council for blockchain and cryptocurrencies in the Russian State Duma
Background: SPbSU, Economics and East Affair department

Anton Cobac
CTO
Since 2009 involved in robotic engineering
Since 2014 established own commercial robotic engineering lab
2015 - second position in the best startup award according to the Business Petersburg, Young Millionaires awards
2014-2017 - involved in working on healthcare innovative devices, as well as movie making technique in 360 format
In 2009, 2011 and 2012 the winner of All-Russian competitions in robotic engineering, repetitive winner and awardee in various competitions in robotic engineering and startups, such as microsoft imagine cup (twofold winner at the regional stage), RoboFinist, participant of many technical and scientific conferences.
Background: Baltic State Technical University "Voenmeh" D.F.Ustinov, Mechatronics and Robotics Engineer, Excellence Diploma.

Vadim Batkin
Financial advisor
Founder of Senior Advisors consulting business.
11 years of experience, financial and strategic consulting, supporting venture, PE and M&A transactions for companies in such industries as IT and Internet, retail, timber industry, power industry, advertisement, freight traffic, food industry, real estate, and many others.
Saint-Petersburg University of Economics (International Finance, master degree)
Universite de Grenoble (Management, bachelor)
Hamburg University (MiBA). Diploma per IFRS DipIFR

Ao Khi
Adviser
CEO Innosilicon
Senior software architect in Micron Technologies
Since 2006 he has been designing integrated circuits
Long-term partner of Huawei Hisilicon, ZTE, Daewoo
Graduate of the Huazhong University of Science and Technology and Stanford University with a degree in Electrical Engineering and Art of Management

Van Jiangan
Adviser
Official representative of IBeLink in Russia
Responsible for working with investment funds in China

David Kang
Adviser
Responsible for working with investment funds in South Korea
Angel Investor, Startup Mentor, Startup Consultant, UX/UI Designer,
Marketer, Investment Advisor