Decentralized for Daily Life

White Paper - Version 2.0

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Color Platform Team

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Summary

The Color Project is devoted to bringing the opportunities of a decentralized platform for daily life, and not to be hindered by a bloated blockchain and monstrously high transaction fees. This is why we are building a Crypto Platform that will be equipped to deal with not only the network strain of a high transaction environment, but still maintain decentralization and innovative applications and mechanisms to keep users engaged.

Color Prism: One Second Confirmation

Having to wait for a transaction to confirm (or wondering if it ever will) should be a thing of the past. However, for some blockchains it is still very much an issue. With Color, we want to ensure that not only is that problem solved, but secure and reliable confirmations should happen in fractions of a second, rather than minutes or hours. With our unique consensus algorithm, blocks will be processed with one-block confirmation algorithm, leading to drastically decreased block confirmation times, faster block and transaction propagation times, and an overall smoother user experience.

Color Spectrum: Parallel Processing and the Power of the Cloud

In Color Spectrum, different dApps may have different arguments for how often they sync their results with the blockchain. Some may sync every execution with the blockchain, much like a traditional dApp, or others can process several dozen, hundred, or even thousand executions in the anonymized Color Spectrum, without taxing the blockchain and their application speed. This frees developers to make more complex dApps, as well as allows developers to integrate their skills in more familiar programming languages, like Java or C++. With this in mind, we hope it enables us to attract more developers who otherwise wouldn't bother learning cumbersome blockchain languages like Solidity.

Wondering where to go to create your next decentralized Application or for what Cryptoplatform community to join? **Think Color.**

Challenges and Motivation

1.1. Introduction

The motivation for creating a new Blockchain Platform is simple, we felt that few projects sat back and thought honestly about the real problems facing the blockchain ecosystem today, and what is required to grow it to a scale of relevance. We saw a list of things that blockchain projects needed to do better and often were overlooked to focus on more superfluous minutiae that wouldn't end up being a user draw and rather, were simply novel code changes to an existing change. Aside from the biggest challenges of garnering users, the below are all the factors that lead Color to where it is today, and things we found that needed changing in the blockchain world.

1.2. Social Challenges

Centralized services

Centralized platforms lead to centralized profits. The Apple App Store and Google Play Store collectively take 30% of the profits made from downloaded apps[1] ،not just commissions from paid downloads but in-app purchases as well. With centralized services, high commissions are simply the price you pay for (inefficient) middlemen. Further, this reliance on centralized financial institutions to execute platform transactions isolates a massive unbanked population.

Unbalanced reward models

The centralized exploitation model is simply a retread of existing models. Facebook, Twitter, and Instagram, for instance, are building billion-dollar companies off community labor, a relationship akin to the disproportionate profit of equity holders and base employees. Product profits accrue to administrators, and the actual content creators receive "achievements", "badges", and "honorary titles" only, thus disincentivizing the collective to improve the product.

1.3. Blockchain Challenges

The very first blockchain, Bitcoin, was designed for a specific task of a specific group of people - to do secure transfers of non-government coins among two anonymous parties over the net. Since 2009 the number of usage scenarios of blockchains

[1] "Transaction fees – Play Console Help – Google Support" https://support.google.com/googleplay/android-developer/answer/112622?hl=en. Accessed 18 May 2018.

exploded. Smart contracts, decentralized applications, decentralized autonomous organizations, - activists from all over the world tried hard to push those concepts into very specific framework of blockchain. No wonder that such attempts face significant challenges. Vitalik Buterin, a co-founder of Ethereum, summarized them in a blogpost[2], which basically boil down to a few main points: Governance, Speed, Waste, and dApp usability and adoption. The question is how can we architect a Blockchain that addresses these four main points in a decentralized and secure way?

1.4. Network Challenges

Efficiency

Vitalik Buterin: "PoW is burning billions of dollars per year, even more than all scams and thefts combined. Isn't this a big tragedy?"

Modern blockchains, even the most advanced ones are plagued by the same original sin: all transactions are being executed one by one. It is true not only for Proof-of-Work blockchains, but for Proof-of-Stake as well: transactions are saved into blocks one by one, and only one node at a time can construct blocks. All this results in sequential execution of transactions and smart contracts. This turns the network behind a blockchain into a mega-supercomputer that just throws away 99% of its computing power.

1.5. Governance Challenges

Centralization of infrastructure

As Vitalik Buterin stated recently "Bitmain and affiliated pools now have ~53% of all bitcoin hashpower. Isn't this a really big problem?" Centralization of network resources imposes risks of attacks on the network, making it so that only a few main actors need to be coerced, infiltrated, or shut down to bring about serious pain to PoW networks.

Governance

Vitalik Buterin: "Given how EOS governance has turned into an epic fail, doesn't this mean that all on-chain governance including DAOs is fundamentally flawed? How can any DAO deal with bribe attacks, plutocrats and other risks?"

[2] Vitalik Buterin. Hard questions to crypto people. https://bcfocus.com/news/ethereum-co-founder-vitalik-buterin-comes-up-with-seven-difficult-questions-for-the-cryptoverse/18297/

On governance we have a lot to learn from existing methods, frameworks and attempts. There are some things in governance in which we need to get right from the start, and some things we have to assess the reality of being able to change those later on. Computer Scientists are looking for some perfect solution to blockchain governance that is secure and safe from a myriad of bad decisions and takeover. Like the U.S. constitution, a strong framework will be the foundation of changes that need to happen later. We've devoted a large part of our design with this sole question in mind, "What is fair governance in a cryptocurrency?".

1.6. Software Challenges

Usability

Vitalik Buterin: "Why aren't there any useful large-scale applications yet?"

Most blockchains introduce some kind of executable entities - smart contracts, chaincode, etc. Using newly invented or lightweight languages reduces reliability of the code and its expressiveness. Smart contracts are short and simple. The languages and technologies used in blockchains do not allow development of feature-rich and powerful systems. Only a few smart contracts exceed a thousand lines of code.

Can we create a dApp with complex business logic, rich content manipulation, connecting multiple parties? Color Platform's answer - yes!

Security

Vitalik Buterin:"Why are there not yet good solutions to account security? When will the problem of account hacks and thefts be solved?"

Most blockchains come with just a compiler to build executable code. No tools for unit testing, continuous integration, code analysis. As a result only simplicity saves smart contracts from security breaches. Complicated smart contracts contain defects and vulnerabilities, and many security reports were already filed for security incidents, as well as high dollar breaches that could have been avoided had the developers had access to better tooling.

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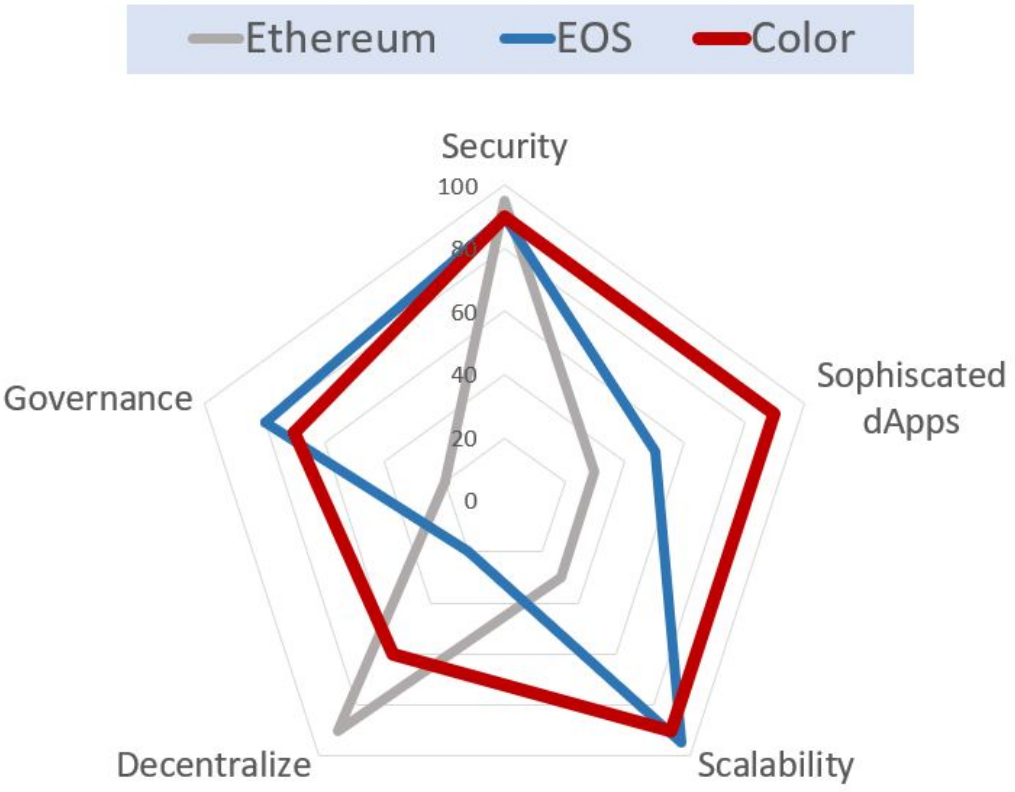
2. Color Platform

2.1. Introducing Color Platform

Color Platform is a feature-rich, efficient and productive environment for Decentralized Applications. We found answers to most of blockchain challenges that will strike the balance necessary for most use cases.

Color is a platform of decentralized app's and contents for the people. The Color Platform is redesigning decentralized governance to enrich those who use the platform. Color endeavors to revolutionize the dApp ecosystem by developing enterprise-level dApps. At Color, we're building a platform to host sophisticated dApps to attract users and build a community. These dApps employ human-centered design so non-technical users may adopt the platform. By removing the technical barriers to entry and making dApps easy, anyone should be able to use them.

In Summary, Color Platform can be compared with other prevailing blockchain platforms as follows.



[Figure 1 - Blockchain challenges Diagram]

Color Platform is a powerful new platform for the ecosystem of decentralized application of tomorrow. The cornerstones of Cloud Platform are Color Spectrum technology and Color Prism consensus algorithm.

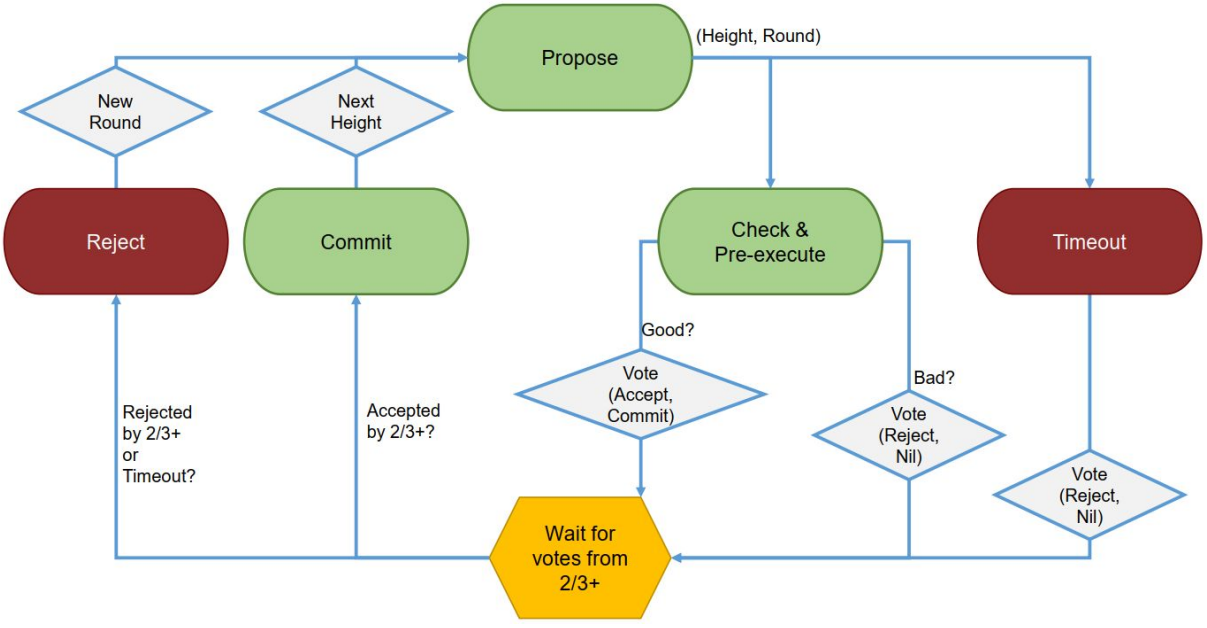
2.2. Color Prism Consensus Algorithm

Color Prism Overview

The Color Prism Consensus algorithm will be the backbone of the Color Platform, ensuring dApp and Core transaction flows happen accordingly. Using Color Prism Consensus, we believe it will achieve two main things:

- ð Achieve Transaction Confirmation Speeds at twice the rate of Practical BFT through concurrent transaction confirmation.

- ð More Decentralized than EOS, thus being more Robust and harder to bribe the mining consensus participants.



[Figure 2 - Color Platform Consensus Algorithm - Pre-Ordered BFT]

Technical Details

Color Prism is a three phase DPoS consensus algorithm.

It includes 49 validating nodes, called **Block Builders**. Only these nodes are eligible to build blocks.

For each block, the algorithm selects a Primary Block Builder for the round. They are selected using pseudorandom deterministic algorithm and change for each next block.

1. The first phase of block production is constructing a block. The primary Block Builder, selected out of 49 nodes to construct a new block, creates the block from transactions in shared mempool. Then the primary Block Builder transfers the block for validation.

2. After the first phase concludes, every 49 Block Builders have a copy of the newly constructed block. Then, within each League, the nodes vote for block approval. Color Prism Consensus utilizes PBFT algorithm for establishing consensus.

Through this process we have devised that our theoretical 'top speed' for Consensus is roughly 2.5 times higher than that of Practical BFT with 49 nodes.

Color Prism Participants

Color Prism Consensus includes 49 nodes to build and validate blocks. How they are elected is based on the amount of coin holder votes they amass, as well as how many coins they are personally putting at stake for the network.

It is assumed that the more coins a user has at stake, means the less likely they are to do "bad things" in fear of getting their coins confiscated.

All Block Builders should prepare servers and run real-time with enough bandwidth in their league. Block Builders are expected to provide adequate low latency confirmations.

All Block Builders must prepare a "campaign" and run to be elected to provide consensus. A Block Builder must first be a regular Council Node and will then stake their coins while providing consensus.

Once the Block Builders are selected, they will remain in that spot as long as they can keep their stake high enough and are not missing above a certain threshold of blocks, provided a Backup Block Builder does not surpass their rating and “dethrone” them from the active Block Builder’s league.

Conclusion

The Color consensus algorithm is essentially a hybrid PBFT algorithm that uses a unique Consensus algorithm. Color Prism prevents cartels, improves security, and lowers the amount of unnecessary chatter. Due to its unique network structure, Color Prism has potential to be one of the fastest consensus algorithms, beating plain PBFT by nearly 2.5x the speed.

2.3. Color Spectrum Technology

Color Spectrum is a powerful new technology that leverages the blockchain in a robust cloud environment for an optimal balance of performance and security.

All modern blockchain technologies face several major issues:

- ð Simplicity of smart contracts. Blockchains have inherent limitations on duration of code execution.
- ð Sequential execution of transactions in sequential blocks downgrade the whole network to the power of a single computer, that produces the blocks.

Color Spectrum is devoted to overcome these limitations to equip developers with powerful coding tools and provide them with an efficient execution environment.

Decentralized Applications, dApp - is the new buzzword, that was coined along with blockchain and distributed ledger. “Decentralized” means that neither the user ordeveloper know where exactly in the infrastructure an application runs. This execution model was originally called “fog computation”, similar to cloud computing.

Many blockchain projects deemed to overcome the shortcomings of the dApp approach, first introduced in Ethereum. Generate blocks faster to increase performance (e.g. EOS), introduce block DAG instead of chain to make concurrent execution (e.g. RChain). But they all keep the original feature of “fog computing” - calls to dApps are mixed with data, and the code is executed by miners (or block producers) in sequence while building a block.

But running the code while building blocks is the root of all limitations on smart contract execution. The time duration of code execution is limited, otherwise block build time becomes prohibitively long. Execution is sequential and is performed by a

single computer - the one that builds the block at the moment. The limitations are inherent in the blockchain design, especially in code execution.

To overcome these limitations Color Spectrum took a completely different approach. In Color Spectrum, we decoupled code execution from storing data in the irreversible and non-modifiable history (i.e. the blockchain). The key point of Color Spectrum is the following: the code of dApps is executed before transactions are written to the blockchain.

To preserve the benefits of decentralization, Color Spectrum uses technologies of cloud computing to conceal details of dApp deployment from the outer world. Furthermore, cloud computing infrastructure gives the value of concurrent execution and efficient utilization of computing resources.

Color Spectrum Overview

The key difference between Color Spectrum and many other blockchain platforms that support smart contracts execution (e.g. Ethereum, NEO, EOS, and others) is the way transactions are processed. In other platforms, the typical lifecycle of a transaction includes the following stages:

> ***Build Block**: Clients propose their transactions to a miner / block builder and the network disseminates it among all nodes, where one of the nodes builds a block using the transactions.*
>
> ***Execute**: Transactions are sequentially executed one by one during construction of a block by a miner / block builder and re-executed by other nodes to verify state update that the block builder saved as a result of the block.*

In order for all peers to synchronize the state, transactions must always execute deterministically: the same transaction must always create the same result on each node, no matter whether the block is being constructed or validated.

Furthermore, transaction execution time should be as short as possible. Sophisticated code, with rich business logic takes longer time to execute, thus introducing latencies and delays into block construction. This is the reason why many blockchain platforms put limitations on smart contract execution - either by higher fees for CPU time (like gas in Ethereum) or by limiting CPU time (like 30ms in EOS).

Color Platform introduces a new paradigm of smart contracts **Execute-Validate-Build** block:

> **Execute**: Transactions are executed in parallel. Developers use well-known and powerful languages to code their dApps - Python, Javascript, Java.

Validate: Block Builders check the results of transaction execution during block construction and consensus.

Build Block: validated transactions are saved in blocks one by one.

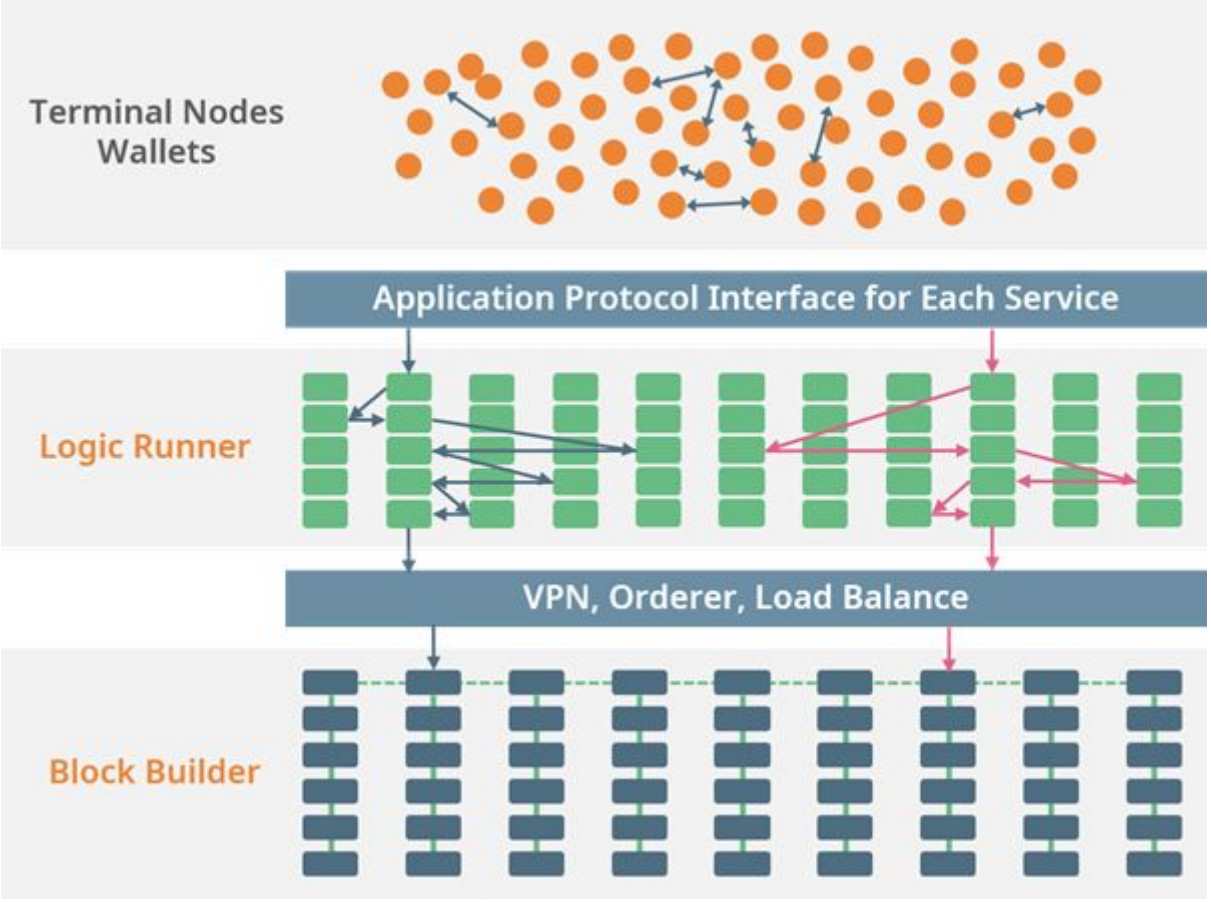
Transactions in Color Spectrum are executed before they are put in a block. This allows nodes to execute transactions in parallel, greatly improving throughput.

In the Color Spectrum execution model, the results of executing dApp code for a transaction are explicitly agreed upon before the transaction is added to the ledger.

Color Spectrum focuses on providing developers with advanced coding practices. They can develop dApps in almost any language they like, such as Python, Javascript, Java or even C.

Two-tier Architecture of Color Spectrum

Decoupling the transaction execution from blockchain data storage leads to a two-layer architecture. In the first layer consists of Council Nodes that perform the function of “Logic Running”, which execute the business logic of decentralized applications. The second layer implements blockchain operations for dApps.



[Figure 3 - Color Spectrum Technology]

Council Nodes are at the core of the Color Spectrum. They host the business logic of dApps, perform processing of users' operations, and store results to the underlying blockchain. Business Logic of a dApp, hosted by a Council Node, is executed within a devoted environment, provided by the **Color Execution Environment** (CEE).

CEE provides an execution environment for dApp code including language environments, system software, middleware to communicate with the API layer, as well as storage and a blockchain. The first release of Color Platform will include CEE capable running applications in modern programming languages. A large part of our resources will be devoted to this effort.

The second tier in Color Spectrum is Block Builders, that form a distributed ledger for irreversible storage of computation results. To achieve mass adoption, Color needs to reach transaction speeds that rival or surpass those of traditional payment providers such as Visa and Mastercard. Scalability issues become more prominent with decentralized blockchain platforms.

The architecture of Color Spectrum is designed to provide unpreceded level of performance. To do so we decoupled computation and consensus - computation is performed by the Council Nodes, while consensus is performed by Block Builder layer. The consensus in Block Builder is planned to be from PoS family, where the actual Block Builder nodes are selected and replaced based on Color internal scoring system.

The consensus algorithm in Color Platform is responsible for three objectives:

·ل validating the results of computations in Council Nodes,

- synchronizing the state in heterogeneous and geographically distributed environment,
- keeping irreversible and immutable log of major events of the dApps that run in the platform.

Currently, the Color Consensus algorithm under development has a primary goal of attaining more speed with only making minimal sacrifices to security and decentralization compared to existing models. The Color Consensus architecture being developed already has a theoretical speed of more than two times that of PBFT, while maintaining decentralization and security.

Color Consensus can be described as a PoS hybrid that runs in parallel, where the Block Builders (those that provide consensus) are elected not by member votes, but by their stake to the network. Then a weighted system based on performance and platform participation and reputation (see below the section “Color Prism Consensus Algorithm”).

Clouds in Color Spectrum

Running dApps in Council Nodes implies requirements on the infrastructure that hosts them.

We believe that developers should be able to implement the business logic of their dApps in well-known programming languages, such as Python, Java, PHP, Javascript.

To prevent code injection and data modification, and ensure decentralization, the Infrastructure should be able to launch dApp code at different physical locations, even while handling subsequent requests. The infrastructure should monitor resource consumption and launch Council Nodes on demand from clients.