HPB
High Performance Blockchain

Whitepaper

Version 2.0

Contents

1. About HPB

With blockchain technology growing at an unprecedented pace and the world scrambling to find new and exciting applications for this development, a problem plaguing the industry has hampered progress: **scalability**. High Performance Blockchain (HPB) has solved this issue with its novel approach in combining software and hardware. HPB is a revolutionary permissionless blockchain architecture developed and operated by the HPB Foundation. Committed to becoming the world's highest performing blockchain platform, HPB will pave the way for the blockchain technology revolution for businesses and consumers alike.

With a core team comprised of talents from high-powered multinationals such as Huawei, IBM, Inspur, Alibaba, UnionPay, ICBC, McKinsey and Deloitte, Founder and CEO Wang Xiaoming formally established the team in 2017. CEO Wang Xiaoming gathered a team to build and launch a platform that would win numerous awards in the blockchain industry, and himself was rewarded the title of "Most Innovative CEO" in the 4th Annual Blockchain Finance & Fin-tech China 2018.

Due to the novel approach of combining hardware and software, HPB gained the attention of blockchain enthusiasts, IT professionals, and developers worldwide. Through immense fundraising done by the core team, HPB has grown to more than 50 professionals from top firms and universities with experiences ranging from top IT employees, investment bankers, consultants and marketing specialists. Having weathered the peak and valley of the cryptocurrency market, one of the foundational beliefs of the project is stronger than ever: blockchain technology is not only an advancement of computing technology, but also an economic model wherein all stakeholder interests are aligned.

As blockchain technology grows and becomes a part of everyday life, we hope that you will join us. We hope that you will collaborate with us to build a new world which is more transparent, more accessible, and more agreeable to both ends of a transaction. We believe that with the proliferation of blockchain technology, a new economic model for businesses will develop and flourish into a powerful instrument in security, transparency, and commerce. We look forward to that day, and we hope you will be there with us.

2. Public Blockchain Industry Overview

The blockchain industry has evolved from the simple cryptocurrency application with an immutable, public ledger at blockchain 1.0, to smart contracts with innumerable applications 2.0 with decentralized applications (DApps). In the current landscape, public chains are scrambling to gather as much funding and developers as they can to create their ecosystem and tokenomics to secure their spot in the future of blockchain. With the influx of investments from Initial Coin Offerings (ICOs), to direct private investments and token swaps, the industry itself has moved from the initial boom of publicity to steady development.

With so many public chains and corresponding applications being developed, the industry is a highly fragmented, competitive environment all striving for sustainability. With initial reactions of many key governments harshly regulating blockchains and cryptocurrencies, they are now stabilizing and looking to foster growth of their respective industries. After enjoying a very hectic boom of the industry in late 2017/early 2018, investors and consumers alike have become more stabilized and are awaiting the projects with sustainability. The main traits they look for are, of course, attractive tokenomics, capabilities of the infrastructure, development team and so forth, but also the solution to the big blockchain problem: scalability. Blockchain 1.0 offered a new platform and technology to transact and keep a ledger, and blockchain 2.0 offered smart contracts. As with any future technology, the main differentiator for blockchain 3.0 may be an unknown at the moment, but it is evident that the scalability problem must be solved for the tech to move forward, with the possibility that scalability itself will be the differentiator.

DApp development and their ecosystem have been a point of focus for many public chains, and rightfully so; without a full, thriving ecosystem, the majority of a public chain's value becomes void. As new applications are coming to light, such as social networking, energy and resource management, social networking, big data, financial instruments, advertising, and more, it is apparent that DApp development must be fostered and allowed to explore new avenues of business. With proper tokenomics, all stakeholders' interests may be aligned, creating a new business model where owners/investors, employees, and consumers all benefit together. With a strong and powerful enough infrastructure, developers may create applications to their heart's content, allowing for any number of different capabilities. With user/developer friendly tools, the burden of learning a new technology is taken away and that barrier to adoption is nullified.

Although a fragmented market, the blockchains that offer a competitive advantage, lasting infrastructure, or high utility will undoubtedly survive and move forward exploring this blue ocean.

3. The Problem

The current major iterations of blockchain possess several problems:

TPS performance

As blockchain technology's adoption rate grows, transaction volumes grow at an exponential rate. Current infrastructures cannot handle the volume, causing massive congestion and slow-downs

Bitcoin is a legacy network, confined to about 7 TPS. Visa, running at an average of 2,000 TPS with a maximum of 50,000, far outpaces current networks in comparison

High transaction fees

Congestion in networks leads to higher transaction fees, as the processing entities prioritize the ones who pay the most

High block sizes can lead to increased network latency, in turn increasing confirmation times, congestion, and a general slow-down of the network. This again increases fees even further

Difficulty in developing DApp

Due to the stated issues, developers experience roadblocks and face challenges in DApp development

Poor security

Several public chains have already experienced security breaches

A split in the community can lead to hard forks, leading to splintered blockchain networks and sometimes even abandonment of the infrastructure

A protection against a 51% network attack, where a majority of mining resources are turned against the network, still hasn't been found for most networks

4. Our Solution

With blockchain technology still being in its infancy, the implementations of its offerings differ with each public chain. HPB aims to tackle the most obvious problem, scalability, with a novel architecture in an effort to add value to businesses while solving the challenges for consumers.

With the unique mix of open-source hardware and software, the architecture offers many unique advantages not seen elsewhere. Through this mix, a fusion of high-level technologies come together to create the comprehensive package offered:
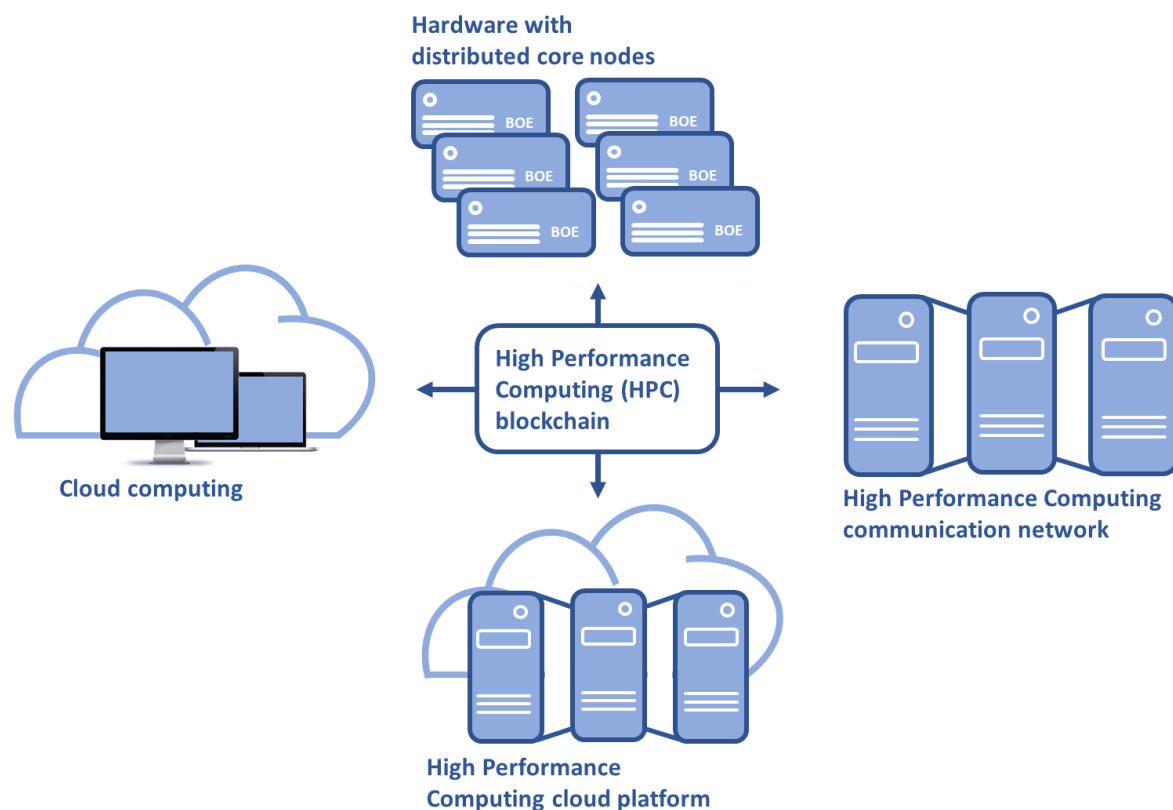
This suite of technologies is served first by the hardware architecture. The BOE hardware unit is comprised of four main components; the MAC module, Hardware Random Number Generator, TCP/IP Offload Engine (TOE), and Elliptic Curve Digital Signature Algorithm Module. These modules come together to present a streamlined approach to security, data integrity, data collection, and the main blockchain processes such as signature verifications and the consensus algorithm, while massively reducing the workload on the parent system. This system is designed to optimize the software as much as possible, leaving the hardware to do what it should do - computation.

The software architecture focuses mainly on being an interface as a customizable tool for the user. It provides accounts, identity, authorization and policy management, along with database and asynchronous communications on a multitude of CPUs, FPGAs or clustered program schedules.

The two architectures are assigned to perform what they are best suited for; hardware for raw computing, software and data management for interacting with the user.

Through lowering parent system requirements, one of the barriers to entry is lowered to join the blockchain as the BOE takes the majority of the work. With the expansion of Software Development Kits (SDKs) that will allow most mainstream programming languages to be implemented with minimal adjustments, developers will enjoy a more flexible development stage as they can utilize the language their applications are best suited for and are comfortable with. Lastly, as scalability is solved through the high performance of the network, the HPB public blockchain will be a great offering to all, from large multinationals to individual developers.
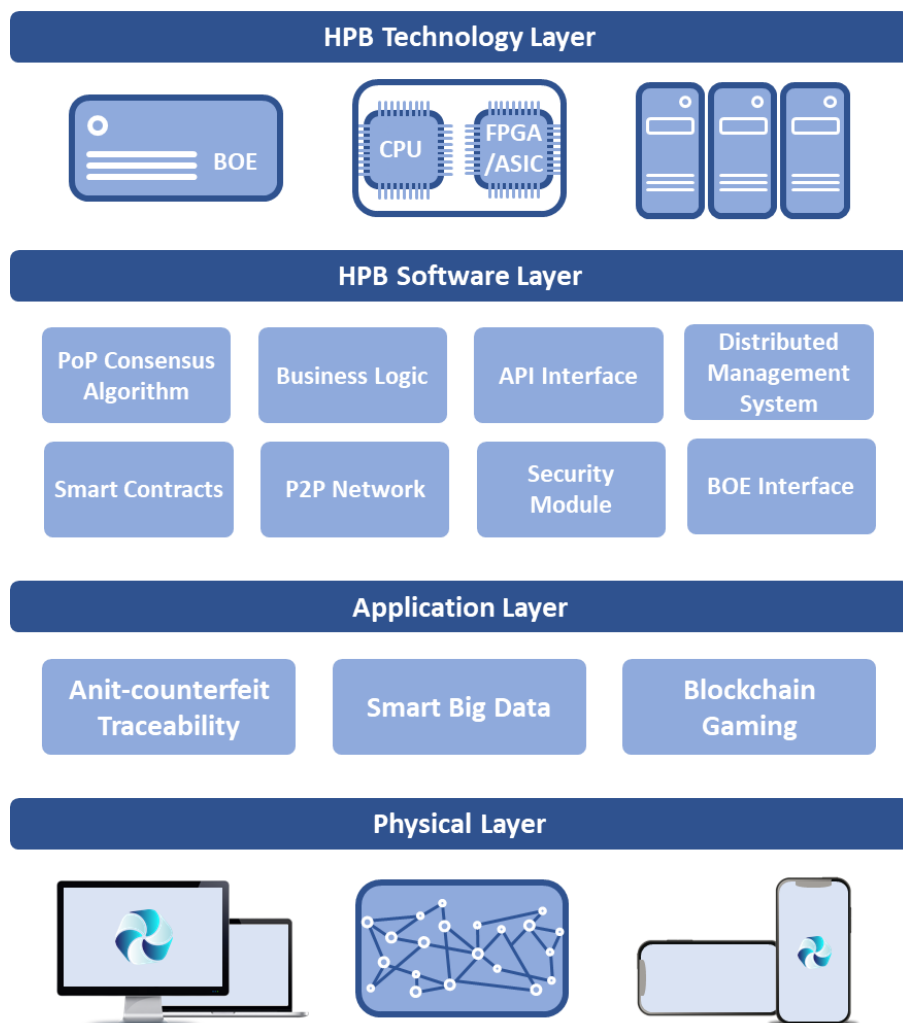
4.1 Our Value Proposition
High Transactions Per Second (TPS)
The Blockchain Offload Engine (BOE) hardware chipset is developed to optimize the blockchain network and alleviate the most common bottlenecks. Different parts of the consensus algorithm process are offloaded onto the chipset to greatly enhance transaction speeds.

Full Customizability & Accessibility

The HPB platform is programming language agnostic using RPC to build new SDKs for most programming languages, making decentralized application (DApp) development highly accessible. At launch of the HPB MainNet JAVA will be the main coding language. After a variety of coding languages will be available, professionals and unaffiliated developers alike can utilize whichever means they deem fit for their purpose and develop their DApps without the hassle of tweaking their projects to a specific language, as any of the added coding languages can be used to deploy smart contracts.

Low Maintenance Costs

Unlike traditional hardware, our BOE hardware chipset is specifically developed to run and maintain a decentralized blockchain network. The chip is fully optimized to complete the consensus algorithm process in a highly efficient and effective manner. Through the unique synergies achieved by the combination of hardware and software, transactions are verified and stored without incurring excessive electricity costs.

Data & System Security

The coupling of hardware and software enables greater system security compared to traditional systems. Blockchain by nature is a distributed ledger, preventing data loss and preserving the integrity of said data. The BOE hardware adds another layer of security by introducing the physical component to the blockchain infrastructure, which is far less susceptible to attacks than software only solutions. In addition, the BOE hardware has an embedded hardware random number generator, which greatly increases security through unpredictability.

5. Our Technology – the Blockchain Offload Engine

For traditional blockchain nodes, functions such as transaction broadcasting, transaction verification, block broadcasting, and block packaging are all implemented on the software level. The data connection between each node is a serial process, resulting in complications such as complex network topology, long delay times and low serial processing performance due to general hardware bottlenecks.

To address such stumbling blocks, the Blockchain Offload Engine (BOE) was created. The BOE is a heterogeneous processing system, harmonizing hardware, firmware, and corresponding matching software that streamlines the whole process. To achieve target performance and high concurrent computing acceleration, the BOE combines CPU serial capabilities and the parallel processing capabilities of Field-Programmable Gate Arrays (FPGA)/ASIC chips.

BOE System
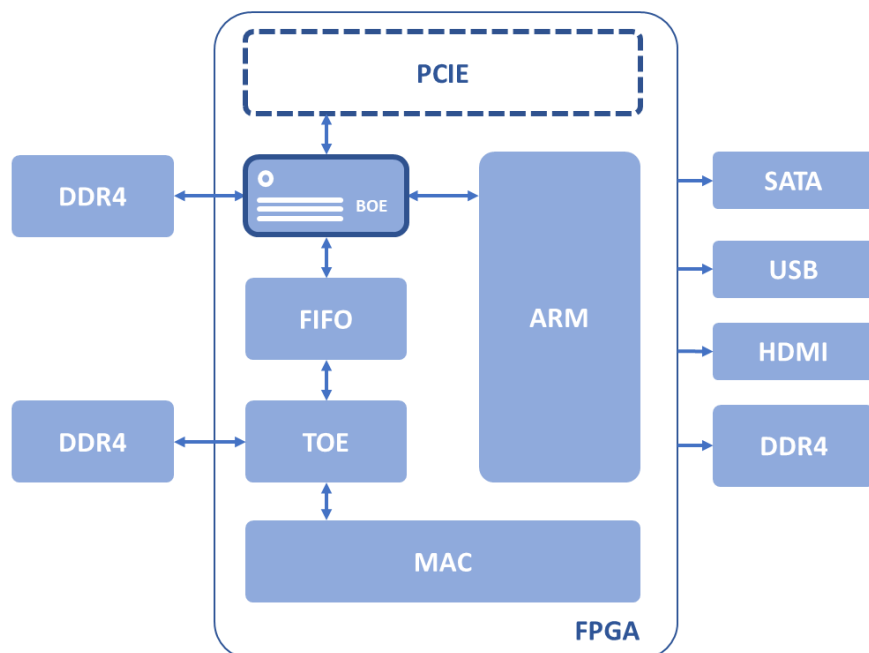
BOE Board Schematic
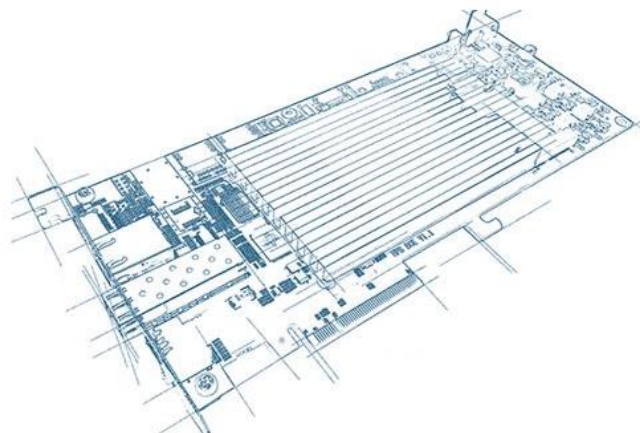
The BOE's first point of interface with the network is the MAC module. Connecting to other devices through a Peer-to-Peer (P2P) network, the MAC module uses a Gigabit/10 Gigabit Ethernet interface. Encrypted communication channels are established via the TCP/IP Offload Engine (TOE) module. The module performs integrity checks and signature verifications, as well as account balance checks on messages, transactions and blocks. TCP and UDP packets are resolved for communication. For excessive block data, it performs fragment processing to be sent and encapsulates each fragment to ensure the integrity of the received data. This offloads a lot of resources from the CPU, as it takes no part in these functions.

The BOE is designed to be able to provide corresponding incentives for the contribution of the system, so as to attract more users to participate in maintaining the network's operation. This is done through collecting statistical information regarding the received traffic of each TCP connection.

ECDSA Acceleration

To reinforce security, every transaction and block broadcast in the network requires a signing and verification process. ECDSA, the Elliptic Curve Digital Signature Algorithm, is currently the most mature and widely used digital signature algorithm in the industry. Due to hardware limitations of traditional blockchain set-ups, software-only implementations are limited to a low number of verifications per second (VPS), falling far short of HPB's desired specifications.

The BOE hardware solves this issue by an ECDSA module embedded in the unit itself, alleviating the burden of having software run the process. This solution allows for signature verification speeds that meet enterprise level requirements.

Hardware Random Number Generator

When data transmission is performed between nodes, an encrypted channel needs to be established through a key exchange. As software random number generators are generally pseudo-random, a hardware solution is needed to guarantee truly random numbers for encryption purposes. This not only ensures the true nature of the random number, but also alleviates a workload from the CPU.

Data Fragmentation

Current network infrastructures are not able to handle the great amount of data transmitted between nodes, leading to slow data synchronization. The BOE adopts block data fragmentation broadcast processing. In this approach, each block fragment contains a complete block header, allowing for newly generated blocks to be broadcast easily to all nodes and realize a quick convergence of the blockchain.

Network Performance

One of the network's requirements to become a High-Performance Node is to provide bandwidth to the system. Collecting network statistics and traffic information through the BOE is the most efficient, as the gateway to the network is through the BOE hardware. This results in an easily and readily available method of data collection provided by the BOE unit.

Concurrency

The BOE is able to achieve a considerable number of concurrent connections, supporting more than 10,000 simultaneous TCP sessions, processing the sessions in parallel. This greatly reduces the number of distributed network layers by dedicating parallel processing hardware in place of traditional serial processing methods. This allows functions such as transaction data broadcasting, transaction confirmation broadcasting and so forth to be done in parallel, greatly reducing response times and bolstering network speeds by a factor of 100.

6. Governance

Despite being heralded as the onset of decentralization, a fully decentralized blockchain faces many infrastructure-breaking problems. Due to their uncontrolled nature, the infrastructure itself may be subject to roadblocks such as hard forks from a divided voter base, or cartels that may form to control the voter base.

The dual-election model of HPB is the solution to balancing the benefits we seek from decentralization, and a stable infrastructure. Although the issue of decentralization is at the very least sensitive, and at most subjective, we believe we have found a good solution. With four core principles, efficiency, transparency, accessibility, and inclusion, we are able to bridge the gap between decentralization, and effectiveness.

6.1 Consensus Algorithm: Introducing Proof of Performance (PoP)

As the consensus algorithm is one of the pillars of blockchain, it is understandable that many different iterations have sprung up from the different public chains. HPB is no different, and faced the core of the problem head-on. The vision of a decentralized future was difficult to balance with performance, and after carefully balancing the pros and cons, a novel approach was chosen. Existing algorithms presented strong drawbacks in one of two categories; decentralization and performance. Striking a balance without much compromise had been the holy grail of upcoming projects, and our core team was able to devise their own design.

HPB's consensus algorithm is based on the performance contribution of each Node and takes into consideration many different factors in its calculation. This sets it very much apart from other consensus algorithms that we have analyzed for the use for our blockchain and because of it we have named it Proof of Performance (PoP).

6.1.1 Node Types

In order to understand the technical details of HPB's Proof of Performance, it is important to understand the type of Nodes that participate in the network. Each Node type has its own purpose participating in the network and execute different processes on the blockchain.

Node type	Description
BOE-Node	Refers to both HP-Nodes and Candidate-Nodes that are maintaining the network (by means of BOE Node Election or HPB Invitation
HP-Node	High Performance-Node responsible for block generation and synchronization
Candidate-Node	Responsible for forwarding transactions. A Candidate-Node can become a HP-Node through the embedded HP-Node generation of the consensus algorithm every 10 minutes

The main drivers of the HPB MainNet are the BOE-Nodes that comprise the entire active network for the duration of the seasonal BOE Node Election & Invitations periods as outlined in Section 6.3. The MainNet is run on 150 active BOE-Nodes, out of which 31 are denoted HP-Nodes based on their performance. HP-Nodes are on constant rotation and generated by the consensus algorithm, choosing from the pool of Candidate-Nodes and re-assessing existing HP-Nodes using an embedded two-tier calculation formula.

6.1.2 Two-Tier Calculation Formula

The PoP consensus algorithm features a two-tier formula that divides and completes the calculations from an outer and inner layer. This division reduces computational resources and increases the speed at which the PoP can complete the necessary calculations to reach consensus.

1) **Outer Layer**

   The outer layer of the consensus algorithm determines which Candidate-Node will become a HP-Node through an embedded HP-Node generation mechanism. All HP-Nodes are chosen from the available pool of BOE-Nodes based on the performance contribution of each Node. The embedded HP-Node generation mechanism utilizes performance indicators that rank the BOE-Nodes to determine which Node will be a HP-Node of the next HP-Node rotation occurring every 10 minutes.

   The HP-Node generation mechanism embedded in the PoP consensus algorithm runs automatically and ensures a steady Node rotation for fairness of the HP-Node selection. Key influencing factors for becoming a HP-Node are:
   - Server performance (high spec. server set up)
   - Network bandwidth (bi-directional upload & download speed)
   - BOE compliance status (BOE-Node network connectivity; BOE-Node transaction analysis)
   - Number of times a BOE-Node has been selected as HP-Node
   - Geographical location
   - Daily continuous votes received
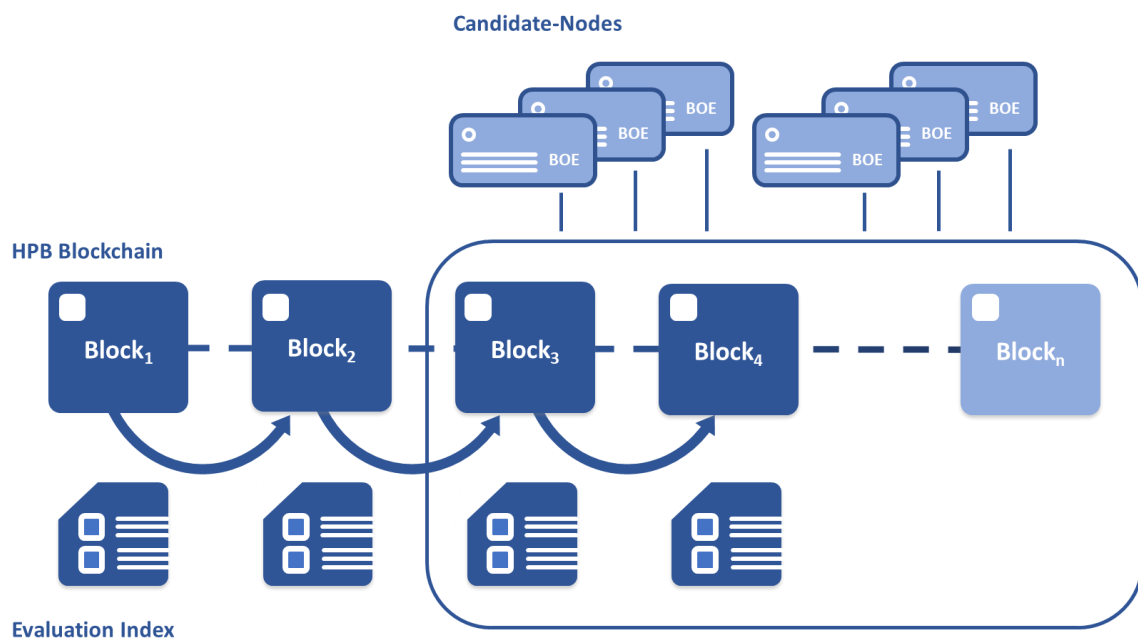
2) **Inner Layer**

   The inner layer of the consensus algorithm determines which HP-Node is prioritized to generate the block, based on an anonymous hash queue mechanism. The inner layer calculation is divided into three components of 1) Nomination, 2) Statistics and, 3) Computation:

Nomination: At the beginning of each HP-Node rotation, the BOE generates random Commits, which are part of the generated blocks. Each HP-Node submits their respective blocks to be synchronized into the chain, including the random Commits.

Statistics: At the end of each HP-Node rotation, the HP-Nodes count the Commits part of the generated block and create a Commit Pool: ($Commit_1$, $Commit_2$, $Commit_3$, $Commit_4$, … $Commit_n$)

Computation: When a new block is generated, each HP-Node calculates the priority of the Node in the block. This priority calculation is done using the Commits fixed weight algorithm choosing from the created Commit Pool. The HP-Node with the highest priority will generate the block, while the other BOE-Nodes perform signature verifications, following the principle of Verifiable Random Functions (VRF) to ensure privacy and security, as the new block is integrated into the blockchain.

As a result of the inner and outer layer design of the PoP consensus algorithm, the HP-Node selection and the block generation process provide enhanced security and privacy for the entire network. In addition, the division of the calculation helps to increase computational speeds and allows for higher performance on the blockchain.

6.2 The BOE Node: Dual-election of Nodes

By ensuring that the spirit of decentralization remains as the foundation of our model, **the dual-election of nodes** was chosen as our method of voting and selecting our BOE-Nodes. This method features an Election, and Invitation track that determines how nodes are allocated, and the amount of block rewards they receive.

Through the **Election track**, any entity, be it person or organization, may **apply and vote** for a BOE hardware unit. If elected, the candidates that successfully pass our community supervision guidelines will be given a BOE hardware unit on a quarterly basis until our BOE hardware unit cap is reached. Anyone may **apply and vote** to become an active BOE-Node running on the MainNet.

The **Invitation track** is different in nature, where HPB invites entities to become nodes. Here is where we not only bridge the gap between effectiveness and decentralization, but also keep alive the spirit of blockchain itself. The main benefits of blockchain were widely acclaimed due to its holistic, non-zero-sum-game nature; it looked to benefit all stakeholders. We uphold these values by inviting institutions that are contributing to the development of society, such as universities and scientific research institutions, NPOs, NGOs, and those having a stake in the network (i.e. HPB DApps). By thoroughly vetting the invitees, we ensure that invitee nodes may bring synergy to the network and create wider decentralization.

6.3 Global BOE Node Allocation

As having an operational BOE hardware unit is a prerequisite to participating in running the HPB blockchain and receiving its block rewards, we have defined the following Node allocation to ensure a smooth and efficient system:

BOE-Node allocation	Composition in %	Composition in #
Election Track (BOE-Nodes elected by voting)	70	105 BOE Nodes
Invitation Track (BOE-Nodes delegated by the HPB Foundation)	24	36 BOE Nodes
Pre-assigned to the HPB Foundation	6	9 BOE Nodes

With the total number of BOE Nodes being less than that of BOE units in circulation, Election and Invitee Nodes are subject to a rotation cycle. BOE Node Elections are held every three months, and Invitee Node delegations every six months.

As demand for the HPB infrastructure grows, the network of active Nodes will grow organically in tandem. The expansion of the Node network is divided into two phases supporting the infrastructure from the time of the MainNet launch.

Phase 1) **MainNet Go-Live**
A total of 150 BOE Nodes maintain the network, with a total of 31 HP-Nodes.

Phase 2) **BOE Node Expansion**
An additional 150 BOE Nodes are added to the network to strengthen the MainNet, resulting in 300 BOE Nodes maintaining the network, 61 will be HP-Nodes.

In regards to our BOE Node holder governance, it is important to highlight that we foster the principle of inclusion and give everyone the opportunity to apply for a BOE hardware unit by means of the Election and Invitation Tracks.

The Election Track allows anyone to apply for a BOE hardware unit, competing with other applicants at every BOE Hardware Election. It is when BOE hardware owners compete again as part of the BOE Node Elections for an active BOE Node that network participation is decided. Invitee Nodes however, face stringent requirements and are vetted harshly as they are delegated directly by the HPB Foundation, and automatically become BOE Nodes participating in the network. In principle, anyone or any institution may apply to join the network as an Invitee Node, but we will only consider the following institutions and partners:
-   **Enterprises**: Enterprises within the HPB ecosystem that deploy DApps and serve their target users.
-   **Academic Research Institutions**: Universities or scientific research institutions that can carry out academic research and develop advanced technology in the blockchain industry.
-   **Developers**: Those who can contribute to the HPB technical ecosystem.
-   **NPOs**: Non-profit organizations that can give back to the society through blockchain technology.

6.4 Voting: Election and Invitation of Nodes
The HPB blockchain infrastructure is open source and allows all participants, both network operators and users holding HPB coin, the opportunity to impact the platform governance. This is an important virtue embedded within HPB's vision regarding community supervision, as the community can come together to build a decentralized future, aligning majority stakeholders interests, where every HPB coin can be used to cast one vote, with the weight of the votes being accumulative.

6.4.1 Election of Nodes: Voting

The BOE Nodes maintaining the network are the backbone of the HPB infrastructure, and facilitate most of the transactional processes occurring on the HPB blockchain. The BOE Hardware Election is divided into two expansion phases. Phase one voting will continue quarterly until BOE hardware owners are elected by the community to fill the hardware unit cap of 200 (at time of writing, Q3 2018, 124 have been distributed). Phase two will increase the cap to 400 as to meet the expected increase in demand.

The voting feature is accessed through the HPB Wallet, where all users can use their HPB coins to cast votes for themselves or other community members. For each BOE Hardware Election, applicants compete with each other for the most votes, with the highest ranking receiving a hardware unit each. As we feel a healthy amount of competition is good for the system, more hardware units will be released than there are available slots for BOE Nodes, implying that there will be applicants who own the BOE hardware units without the status of a BOE-Node. Those who won the BOE Hardware Elections, now compete with each other to run an active BOE-Node. This competition is called BOE Node Elections and follows the same election logic and is based on the same voting rules.

6.4.2 Invitation of Nodes: Voting Exclusion

The Node Invitation is also divided into two expansion phases, where Node holders are invited by the HPB Foundation during a bi-annual Node Application for Invitation cycles. Although there is no hardware unit cap for invitations, a maximum of only 36 active Nodes will be able to participate in the network. For phase two, the number of active Nodes for invitations will double to 72, falling in line with the expansion plan of the network. At the time of writing, 2 out of 36 invitee BOE Nodes have been allocated (Q3 2018). Unlike the Election track, Node invitees are automatically given the status of an active BOE-Node, and as such will be completely segregated from the voting feature, unable to cast or receive votes. This is to balance the economic rewards as part of the Node incentives (i.e. block rewards) outlined in Section 6.5.

6.4.3 Pre-assigned HPB Foundation Nodes: Voting Exclusion

There are pre-assigned Nodes for the HPB Foundation, which will not be rotated. A total of 9 BOE Nodes as part of the network in phase one. Phase two will again double the number, bringing a total of 18 HPB Foundation Nodes active in the network. As they are not elected Nodes, they will follow the logic of Invitation Nodes where they are segregated from the voting feature, being unable to cast or receive votes. This again is to balance the economic rewards as part of the Node incentives (i.e. block rewards) outlined in Section 6.5.

6.5 BOE-Node Incentives

The economic model for BOE-Node holders is driven by an incentive paradigm embedded in the way the supply of HPB coins increase annually. HPB has a total initial supply of 100,000,000 HPB and the annual additional issuance is capped at 6,000,000 HPB. The team has decided that adopting an inflationary model will help to stabilize HPB's market economy, especially because we agree with the theory that coin loss can be modeled as a percentage of the total supply per year and the total HPB supply in circulation will eventually stabilize and reach an equilibrium.

For the first year of the HPB MainNet operations (running on 150 BOE-Nodes) the inflation will not reach the issuance cap, instead is set at 3% of the initial token supply or 3,000,000 HPB. As part of the BOE Node Expansion (running on 300 BOE-Nodes) the issuance is expected to reach the cap of 6% of the initial token supply or 6,000,000 HPB. Fixing the maximum inflation using an issuance cap implies that relative inflation decreases every year.

Furthermore, we have decided that for the first year of inflation an equal amount of HPB coin will be burned from the reserve fund to drive adoption and economic incentives for BOE-Node holders. This means, despite using an inflationary model, the effective inflation for the first year will be 0%.

6.5.1 BOE-Node Block rewards

The additional issuance of HPB coin as part of the inflation is allocated as block rewards to BOE-Node holders and the distribution of the block rewards is divided into two parts:

1) Two-thirds of the block rewards are allocated to HP-Nodes and Candidate-Nodes. For each block generated, the HP-Node responsible for the block generation receives 35% of the block reward, and all other Candidate-Nodes evenly divide the remaining 65% of the block rewards.

2) One-third of the block rewards are allocated according to the proportion of daily votes the elected BOE-Nodes obtained, as part of the BOE Node Continuous Voting process. This allocation model compensates for the block reward allocation model of HP-Nodes and Candidate-Nodes and incentivizes those maintaining nodes.
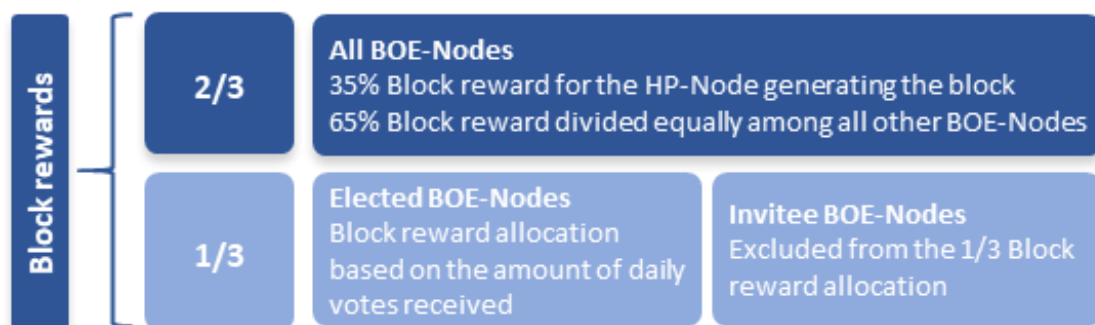
6.6 Voting Rules

In order to facilitate the BOE Hardware Elections, BOE Node Elections and, BOE Node Continuous Voting the voting feature is embedded in the HPB Wallet. The rules for voting consider the stake users have in the network and also allows for community initiatives to thrive.

Voting Period: Each HPB coin can be used to cast one vote every 24 hours, which will be accounted for calculating the node's reward for that day, as part of the BOE Node Continuous Voting process. In order to qualify for the 1/3 block reward allocation for elected BOE Nodes the node must receive at least one vote.

Vote Source: The eligible amount of HPB coin for voting is captured with a random snapshot of the wallet balance of the previous day. The eligible amount for voting stays the same within the same round of voting and will not change if the balance in the wallet changes.

Voting: Voting is done using the HPB Wallet App and features an automatic voting mechanism (AutoVote), votes can be automated based on a percentage allocation. The following scenarios apply:

- Additional funds added to the wallet are not automatically considered for voting, and need to be manually added to the automated voting mechanism
- If funds are less than originally specified, the voting allocation will use the percentage allocation based on the remaining funds (random snapshot)

Vote Count: Votes received are used to calculate the block reward for each round. Any votes received are cleared and reset to zero for the next round of voting on the next day.

Vote Withdrawal: Withdrawing votes already submitted within the same round/ day of voting. Votes withdrawn within the same day/ round can be used to vote for other BOE nodes.

6.7 Running for a BOE Hardware

The BOE hardware is a prerequisite for anyone who wants to participate in the network as a BOE-Node. Given the hardware integration into a server, minimum server requirements apply. The BOE Hardware Election is subject to a performance test of the server which can be completed while the BOE Hardware Elections are open. Interested parties are asked to complete the following steps:

- Register for the BOE Hardware Elections on HPB's website: www.hpb.io
- Download and run the server testing software
- Link and verify the authenticity of the wallet address, by sending 0.1 HPB coin to the address shown on the BOE Hardware Election page

Applicants compete for available BOE hardware units through their wallet holdings. The wallet linked to the application is used to determine a ranking of the majority stakeholders for the current season of BOE Hardware Elections.

The minimum BOE hardware requirements are:

#	Classification	Configuration	Note
1	CPU	16 CORE 2.0GHZ or above	
2	Memory	32G	
3	Hard disk	16TB 7200 SAS Interface Hard disk / 16T SSD	
4	Network	Minimum bi-directional bandwidth 20Mbps (for each direction) Recommended bi-directional bandwidth 100Mbps (for each direction)	Only Candidate-Node with bi-directional bandwidth 100Mbps is eligible to become a HP-Node
5	System	Ubuntu 16.04 64bit Centos 7.0 or above	

7. Token and Distribution

HPB total coin supply is 100,000,000 HPB. In order to incentivize our node holders, the HPB foundation provides an annual proportional reward of 3 to 6% of the total initial coin supply. For the first year (starting September 2018), the reward is set at 3% and is issued through our reserve fund. Starting from year 2 (September 2019), there will be an additional issuance of coins to reward the high-performance nodes and candidate nodes. The number of additional issuances shall not exceed 6% per year.
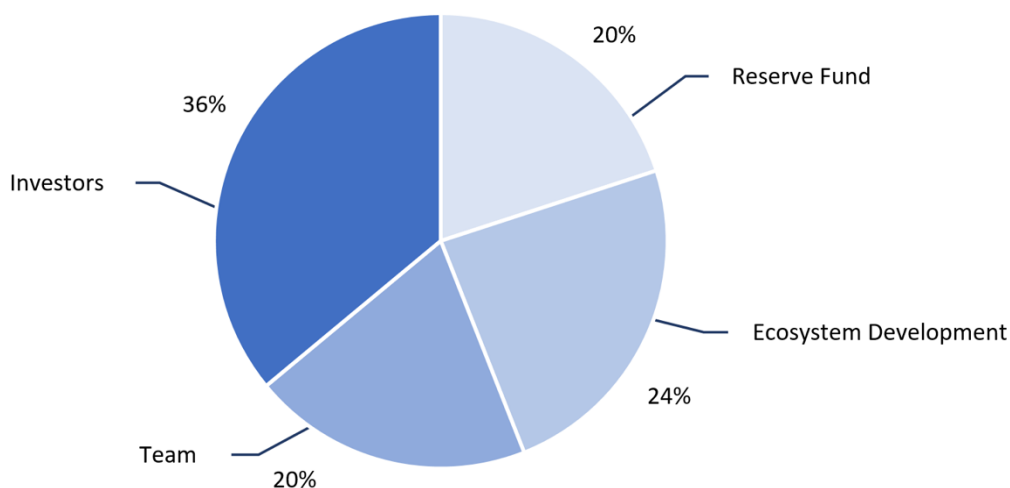
Team: 20%
Incentive for founding team and employees.

Founding team & employee coins will be locked for three years and the unlocking process is one-third per year;

Investors: 36%
Cornerstone Investors coins will be locked for three years and the unlocking process is one-third per year;

Ecosystem Development: 24%
Build the HPB brand and DApp ecosystem, promote community ecosystem development, such as application development, community operation incentives, etc.;

Reserve Fund : 20%
Used for strategic investment, token exchange, government cooperation, response to industry changes, etc.

Reserve Fund will be locked for three years and the unlocking process is one-third per year.

8. Application

8.1 Blockchain APIs & Application SDKs

The base layer of the blockchain system provides a series of blockchain data access and interaction interfaces by using JSON-RPC & RESTful API to support various data applications and development languages. It supports multi-blockchain, data query, transaction submission and other blockchain operations. In different business scenarios, the interactive access interface can be further integrated with the privilege control system.

Application SDKs will be available as well, allowing for the execution of blockchain operations and functions, packet-based encryption, data signatures, transaction generation, among other features. The SDKs will provide a comprehensive service function interface for the developers working with HPB. It can be extended to integration of specific business logic functions, and seamlessly support expansion and integration into various business system languages. Currently it supports Java, whereas the following coding languages are planned for the future: JavaScript, .NET, Ruby, Python and other SDK languages.

8.2 Smart Contract

General Virtual Machine (GVM) Mechanism

HPB supports a variety of virtual machines, with the capability of adding new virtual machines as needed over time through a modular design. The underlying virtual machine is combined with upper-level programming language parsing and transformation to flexibly support the basic applications of the virtual machine. Through customized API operations, the external interface of the virtual machine can be realized, and flexibly interact with the ledger and external data. This mechanism streamlines native code execution when running smart contracts. A GVM also supports code from other blockchains, allowing for greater flexibility

Ethereum Virtual Machine (EVM)

EVM has been the most popular solution for existing smart contracts, and can also be used on HPB. It is possible to run the HPB operating system's blockchain, and EVM smart contracts within an internal sandbox, allowing for interactions with other HPB applications with minimal alterations.

Neo Virtual Machine (NeoVM)

NeoVM is actively being used for enterprise-level finance solutions while also having a strong presence in other industries. When future NeoVM users run into scenarios requiring high-performance, they can interact with HPB with only small modifications.

Smart Contract Lifecycle Management

The system handles smart contracts as digital assets, managing their full lifecycle from start to finish. It functions as a complete controlled management system of submission, deployment, usage, and cancellation of the assets. Comprehensive smart contract management can be fully implemented when paired with the right management mechanism.

Smart Contract Auditing

Smart contract auditing is achieved through secure auditing, a combination of automated auditing tools and professional auditors. With automated code review, formal verification, and integrated unit coverage testing tools, the smart auditing process provides security for most main points of vulnerability of smart contracts.

Smart Contract Template

By increasing the number of smart contracts written and executed, active adoption of the smart contract will build a flexible portfolio of templates for businesses to use, supporting flexible configurations for a multitude of scenarios.

8.3 System Management

System Configuration

The system architecture can be divided into four levels: hardware, hardware abstraction, middle, and implementation layers.
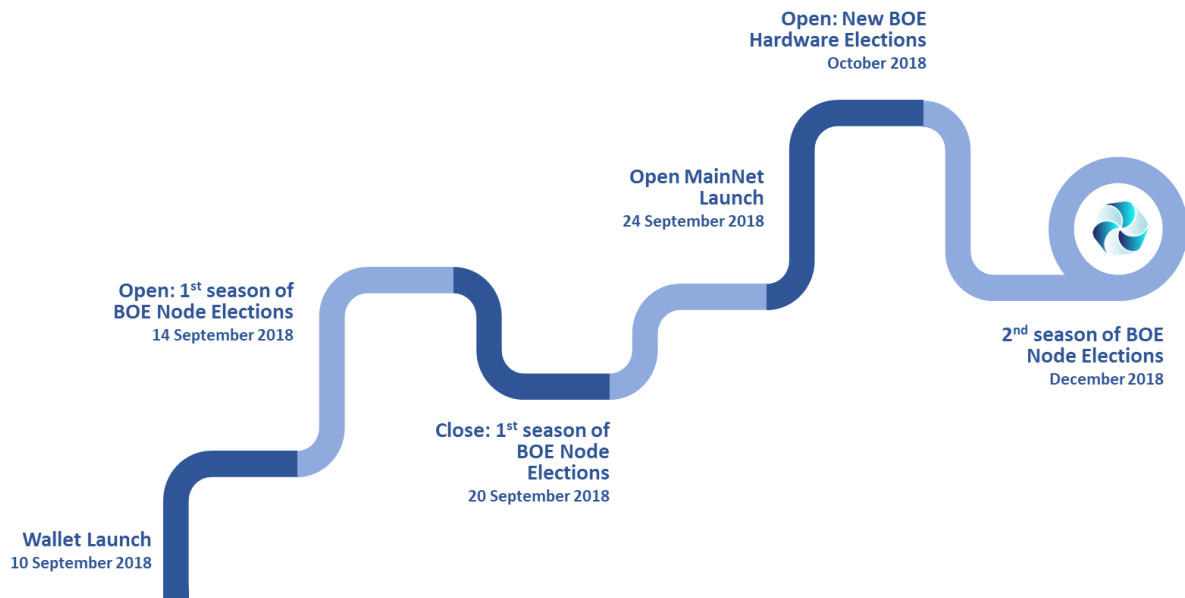
The software and hardware versions of the overall architecture must be compatible with each other. As such a novel approach may be a new undertaking for some systems, HPB provides a system upgrade service to help with compatibility. With simple commands, various levels of compatibility checks, automated downloads and upgrades, and deployments can be implemented for clarity and ease of use.

System Monitoring

HPB provides the whole ecosystem with comprehensive monitoring, logging dashboard applications, and real-time activity alerts and notifications. Remote fault recovery and network system restart services are also provided by HPB in cases of technical troubles, and integrated monitoring and expansion for specific business needs.

9. Roadmap

As of the writing (Q3 2018), we have strived for and achieved many steps towards our vision. Throughout 2018, our MainNet has launched and our platform has grown. In 2019 and beyond, we will push for greater use cases, with partnerships that will strengthen and add to our core competencies to build a strong DApp ecosystem, and HPB market economy.

Open: New BOE Hardware Elections
October 2018

Open MainNet Launch
24 September 2018

Open: 1st season of BOE Node Elections
14 September 2018

2nd season of BOE Node Elections
December 2018

Close: 1st season of BOE Node Elections
20 September 2018

Wallet Launch
10 September 2018

10. Use Cases

10.1 Smart Big Data

Security and privacy are quickly becoming the focal points of media and consumers concerning big data. Large multinationals are not immune to breaches in security as numerous widely publicized incidents have shown, from stolen information through online methods to stolen hardware through offline means. Preventing direct attacks on the server in question does not completely nullify the threat however, as even tertiary and auxiliary collection of benign data may eventually become robust enough to identify customers, and a breach to their systems will result in breach of privacy.

We can help combat those concerns by not only securing its data through its blockchain, but also the accompanying services. Our blockchain ensures transparency, the BOE ensures security through encryption, and a suite of monitoring services ensures integrity of the system. Through this holistic approach in alleviating big data's concerns, we have gained recognition from industry leaders in big data. **UnionPay Smart** for example, has partnered with us in an effort to preserve data integrity and performance. With an annual turnover of 80 trillion Yuan, UnionPay Smart is specialized in big data innovation and currently is responsible for 80% of China's banking transaction data. The partnership will bolster the authentication, certification, and traceability aspects of their data, with a tentative launch date set at Q3-4, 2018.

10.2 Gaming:

The global gaming market is hitting unseen heights, having reached $109 billion USD in 2017. With such a vast market, new business models and trends are constantly presenting themselves, such as the rise of Free-to-Play (F2P) games. One-time paid games, the traditional model of the industry where the consumer pays up front to buy the game, has been overtaken by the F2P model in revenue share, offering in-app purchases for in-game benefits ranging from items and services. Currently, almost all games are created and run by centralized game content providers, responsible for administering the game assets, trades, and all of the in-game logic.

Personal Owned Game Asset:

In virtually all of the centralized games, in game currencies and assets are stored and managed by the company's administration. This gives the content provider the capability to manipulate the user's in-game assets freely.

Through our infrastructure, virtual in-game commodities may be stored on the blockchain, and in turn will be owned solely by the user; once the asset has been issued to the user, the right to modify or transfer said assets would only belong to the user.

Fair and Transparent Virtual Assets Marketplace:

As the game provider hold all administrative access and rights to the network, trading activities are controlled and monitored by the game provider. They hold the power to intervene on any trades between users, or even forbid any activity when needed, even if fiat currencies are involved. A prime example in recent memory is the third iteration of a widely popular MMO. The game had a thriving auction house, where in-game or real currencies could be used to trade between players. The new feature became necessary because previous releases had allowed user-to-user trading and players came together in online forums and traded their items, sometimes leading to fraudulent activity. Despite the feature being an

attempt at controlling the trading environment, the game publisher ultimately decided that the trading was harmful to the longevity of the game and shut down the auction house, leaving players that had invested large amounts of fiat into the game with no retribution.

Through us, players can trade assets freely. The blockchain infrastructure will be responsible for authentication in the trading process, with no possibility of third-party intervention.

Fair and Transparent Game Rule Written by Smart Contracts:
In centralized games, game rules, logic, and code are often held server-side, hidden from players. The users can only trust the provider and hope that the process is as represented and fair. This is not a problem for a lot of casual games, but once fiat gets involved with probability, it could make the difference between an ethical transaction and a money-grab. In online casino gaming, players may have a great amount of money riding on probability calculations that are done server-side, with no way to ensure the fairness of the system.

With blockchain technology, a game provider may publish their game logic on the chain and have the system run accordingly. The player would then be able to clearly see how the calculations are done, and judge the fairness of the system by their own standards, and not by blind hope that the provider is playing fair. Through Smart Contracts, it is not only ensured that the player will not cheat, but also the administrator, becoming a fully fair and transparent system.

10.3 Anti-Counterfeit Traceability
Information asymmetry results in difficulty in the traceability of products, and leave consumers and businesses alike to counterfeiting. Mainstream technologies only provide a one-way traceability, such as barcodes and QR codes. Enabling a two-way traceability with these technologies requires an immense investment by the producer, implementing a complex logistics chain and a way for the end-user to access such data.

With distributed ledgers, and ledger traceability, two-way traceability blockchain technology can solve the traceability issue, combatting counterfeiting by ensuring each and every product can be traced back to the source, step-by-step.

11. The HPB Team

HPB has a team of over 50 staff dedicated towards realizing the high performance blockchain solution. Our talent pool includes experts from a variety of different backgrounds including IT, tech quants, banking, consulting and many more.

11.1   Founding Team

Xiaoming Wang
HPB Founder & CEO

Xiaoming Wang is the CEO of HPB and a true blockchain pioneer. Well known in the Chinese blockchain community, he is popular with his nickname '*Lan Lianhua'* (Blue Lotus). He has been involved for over 10 years in internet technology development and was one of the founders of Union Pay Smart, Union Pay's Big Data team. With his expertise in technology architectures and extensive inter-disciplinary knowledge in cross-border e-commerce, financial big data and blockchain, he later became CTO of Beltal. His contribution to the blockchain industry also includes being one of the main authors in a series of published Blockchain Development Guide books, participating in highly-recognized videos and TV programs introducing blockchain technology.

Jinxin Li
HPB Co-Founder & CFO

Jinxin Li is a co-founder of HPB and is heading HPB's Strategic Development. He was one of the first Ethereum investors and miners in China. Having participated in multiple digital asset investment projects, he achieved an annual portfolio return of 5,000% for two years. Prior to joining HPB, Jinxin Li was the chief blockchain analyst at Guotai Junan Securities. He also holds a PhD in Finance from the Central University of Finance and Economics.

Xu Li
HPB Co-Founder & CTO

Xu Li is one of the Co-Founders of HPB and currently sits as its CTO. With over a decade of experience in chipset development and management, expertise in large-scale planning, and design of complex system software and hardware systems, Xu Li leads HPB Tech-team's core product design, R&D, and hardware development. Prior to joining HPB, he led the development of China's first desktop emulation product and led an architecture development team for a satelllight hardware system during his tenure with the Institute of Chinese Academy of Sciences.

Shanlin Lou
HPB Co-Founder & Tech VP
Lou Shanlin is one of the Co-Founders of HPB and currently sits as the Tech VP. He leads the HPB Tech-team's software architecture design. Prior to joining HPB, he primarily worked in software development, having over 10 years of experience in research and development of embedded and underlying software. He has worked for China's first server vendor, Inspur, as the Chief Engineer of Embedded Software. His experience includes software and hardware development, image recognition algorithms and application platform development. Shanlin Lou has been involved in multiple national scientific research projects.

11.2 Core International Team

Emma Zhu
Chief Marketing Officer

Emma is the CMO of HPB and coordinates the marketing operations for the firm. Prior to joining HPB, Emma worked in Guotai Junan Securities, one of the largest investment banks in China, where she focused on blockchain market research. Prior, she also worked at McKinsey&Co and YUM Group, where she participated in numerous cross-industry Digital Marketing campaigns with Alipay & Tencent Gaming and gained rich experience in Digital Marketing Communications. Emma holds a Master degree in International Affairs from Columbia University with a concentration on International Finance.

Danny Rowshandel
Managing Director of Overseas Business Development
Danny has joined the HPB International Team as Business Development Director. He helps to drive HPB's growth in overseas markets by seeking new strategic partnerships and investments. Prior to joining HPB, Danny primarily worked for major Chinese financial institutions. At HNA Technology, a Fortune 500 investment conglomerate with a focus on IT services, he worked as a Senior Finance Manager, successfully closing multiple large-scale cross border M&A and fundraising projects. Earlier he also worked for ICBC, China's largest state-owned bank to support the development of its financial leasing business in different geographic regions.

Julien Passagne
Business Development Director

Julien has joined the HPB International Team as Business Development Director. His focus is on the international markets and the expansion of the blockchain operations of the firm. Before joining HPB, Julien was a practitioner at Deloitte Switzerland and focused on providing management consulting services to private and leading universal banking clients. Furthermore, Julien was deeply engaged at Deloitte's Blockchain services offering driving eminence in the market as early subject matter expert. Julien was also leading the Blockchain-tech group, driving internal initiatives such as creating and facilitating cross-industry Blockchain introduction and specialized tech trainings, running an internal code-sharing platform and publishing eminence pieces.

11.3   Core Domestic Team

Jason Hu
DApp Infrastructure Lead Developer

Jason Hu acts as the technical lead for DApp infrastructure development for High Performance Blockchain. He is overseeing the DApp development of various projects and manages a large developer team. Prior to joining HPB, he primarily worked on developing core financial infrastructure for financial institutions as a Senior Project Director at ChinaSoft and Ruimin Software. Jason has over ten years of experience in product design, project implementation and large-scale software project management.

Chris Chen
Business Development Director
Chris Chen is a Business Development Director at HPB, leading HPB's ecosystem expansion within the Chinese market. Prior to joining HPB, Chris worked for Alibaba Group as an Operations Expert. He participated in a number of Alibaba's business expansion campaigns ranging from expanding its new retail business to helping Alibaba realize its ambitions of becoming a key market player in rural East-China. He has also been involved as a consultant for one of China's leading E-commerce platforms, Dazhong Dianping, providing strategic planning advisory to the management.

Amanda Yu
Marketing Director

Amanda Yu is a Marketing Director at HPB, focusing on managing domestic investor relations and public relations. Since college, she has had five years of entrepreneurial experience and managed several large teams. Her previous experiences also include providing software training to education institutions and cooperating with IBM where she was involved in technical consulting for an IT cooperation project of WPP, the world's leader in communication services. She holds a Bachelor's degree in Japanese and software engineering.

12. Acknowledgements

HPB is honored to have had the contributions of some of the most talented people in finance, business, and IT. The project could not have had the successful start it had the privilege to experience if not for the investors, advisors, and partners that kickstarted the development. Be it large and sophisticated institutions, or weathered and wise individuals, we are humbled and grateful for their guidance and support.

Although humbled by the aid we have received so far, we are also excited about opportunities to come, and the brilliant minds that we may work with. We look forward to the future, where all those who have had an impact on HPB's prosperity and the industry itself will be there with us when blockchain stakes its claim in the world as a lasting tool in society.

The HPB Foundation