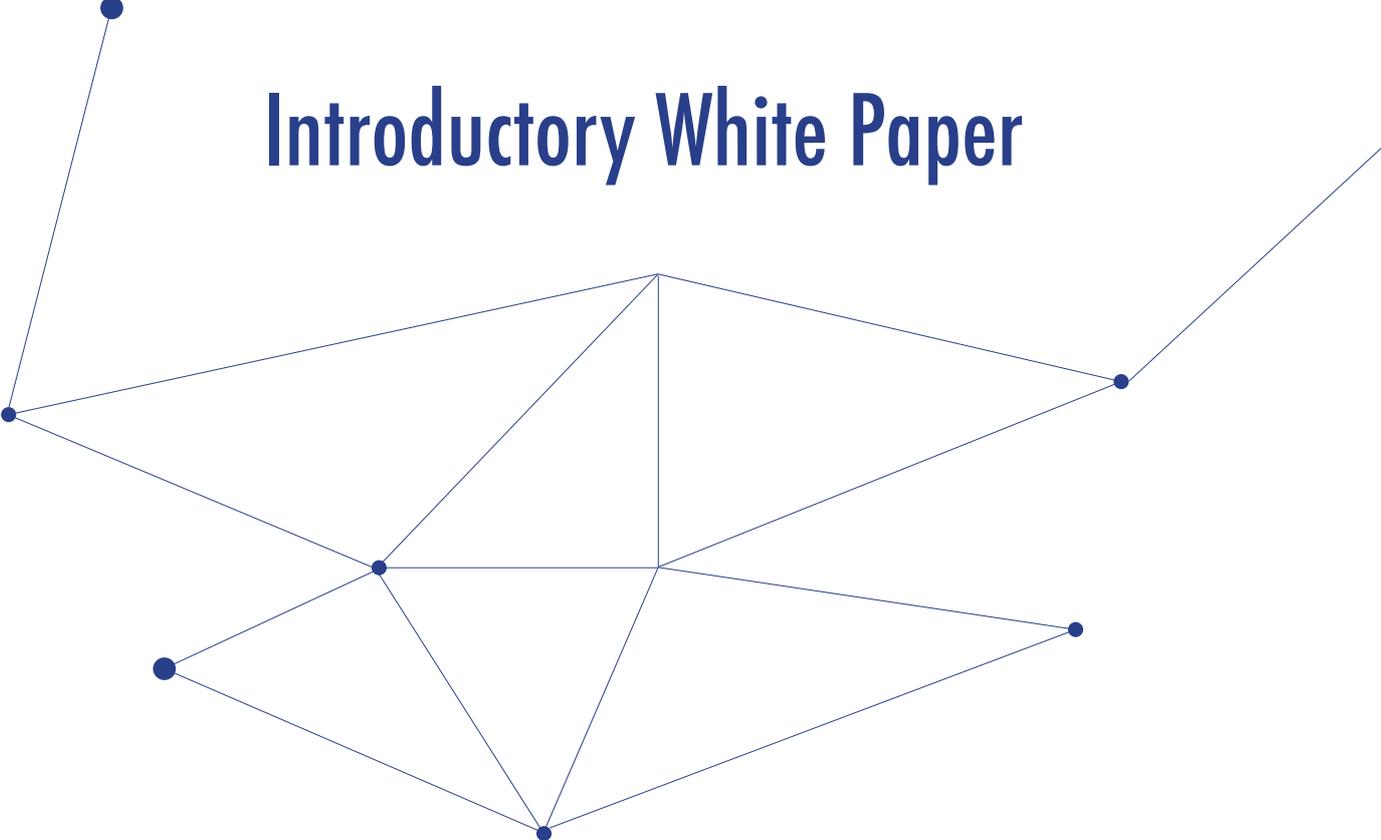


# Blockchain-based Service Network (BSN)

## Introductory White Paper



BSN Development Association  
September 2019

# CONTEXT

Chapter I	Objectives	01
Chapter II	Permissionless Blockchains and Permissioned Blockchains	01
Chapter III	BSN Introduction	04
Chapter IV	BSN Framework	06
Chapter V	BSN Advantages	10
Chapter VI	BSN Development Association	12
Chapter VII	BSN Development Planning	13
Chapter VIII	BSN Web Portal	16

# White Paper Contributors

Sequence No.	Name of Unit
1	State Information Center Informationization and Industry Research Department
2	China Mobile Communications Corporation Government and Enterprise Service Company
3	China Mobile Group Design Institute Co., Ltd.
4	Research Institute of Electronic Payment , China Unionpay Co.,LTD
5	China Mobile Financial Technology Co., Ltd.
6	Beijing Red Date Technology Company Limited
7	China Mobile Group Zhejiang Co.Ltd

**Note:**

1. The abovementioned units participated in the writing of this white paper or, during its composition, contributed valuable editing opinions and supplementary content;
2. The Blockchain-based Service Network Association will subsequently publish *the Blockchain-based Service Network Technical White Paper* and *the Blockchain Service Network Business White Paper*.

# Chapter I

## Objectives

The Blockchain-based Service Network (hereafter “Service Network” or “BSN”) is a global infrastructure network based on consortium blockchain technology and consensus trust mechanisms.

The BSN aims to remedy the high cost of local area network frameworks used by current consortium blockchains by providing public blockchain resource environments to developers using the internet concept, thus greatly reducing costs associated with the development, deployment, operations, maintenance, and regulation of blockchain applications to accelerate the development and universal application of blockchain technology.

# Chapter II

## Permissionless Blockchains and Permissioned Blockchains

Three hundred thousand years ago, mankind began formulating language systems. Since then, script, telephones, telegrams, computers, and the internet have successively emerged. The development of alternate modes of information storage, transmission, and computation has brought about continuous revolutions in informatization, promoting the rapid development of human productivity. Blockchain technology produced by internet-based information transmission protocols combined

with the consensus and trust mechanisms required by modern society further optimize current production relationships and business logic and will lead to a new informatization revolution.

Currently, blockchain frameworks mainly consist of two types: public blockchains, or permissionless blockchains, and permissioned blockchains. Although blockchain technology has been under development for more than a decade, many people still confuse permissionless and permissioned blockchains and their relationship with cryptocurrencies.

Under a permissionless blockchain framework, any user may anonymously enter or withdraw from a blockchain application and is not subject to administered data transactions or information diffusion. This type of framework is transparent, private, and completely decentralized. According to the requirements of current Chinese laws and regulations, it is very difficult to legally operate permissionless blockchains in China due to their lack of administration and liberal nature. Moreover, once a permissionless blockchain application is put into operation, it is very difficult to change or flexibly adjust its internal business logic, resulting in a failure of permissionless blockchain technology to satisfy the requirements of many enterprise applications. Apart from being used for most virtual cryptocurrencies, there are practically no other information applications that use a purely permissionless blockchain framework.

A permissioned blockchain framework does not have the characteristics of being decentralized and transparent; all business attributes are formulated by the application owner, and users are required to seek approval from the application owner before they are able to use the application. Under a permissioned blockchain framework, if the application owner is an alliance composed of multiple organizations, then all members of the alliance will commonly formulate all internal mechanisms of the application. This type of permissioned blockchain structure is

known as a consortium blockchain. If only one organization controls all application rights, privileges, and regulations, then it is known as a private blockchain.

Consortium blockchain technology can be used to optimize the business flow of many traditional information systems, particularly for use in business scenarios that are not strongly centralized, that are collaborative among multiple organizations, and in which risks can be controlled. The shared ledger mechanism of consortium blockchains can greatly reduce the cost of ledger reconciliation, increase the efficiency of data collection, introduce fault tolerance, solidify the trust basis, and prevent malicious counterfeits. At the same time, administrative organizations of all countries are able to effectively implement legal and technical regulations of consortium blockchain applications. For example, many countries can formulate their own regulatory policies in relation to the Libra consortium blockchain founded by Facebook but are powerless over the permissionless blockchain framework of Bitcoin. Unless otherwise specified, all blockchains mentioned hereafter in this article refer to consortium blockchains.

In traditional consortium blockchain applications, all participating organizations commonly develop a consensus order node (orderer) and individually create, operate, and maintain their own dedicated peer node (peer). These nodes require a physical server or cloud services, and all of the nodes are linked via the internet or the cloud services' internal networks, thus forming an isolated blockchain application similar to that of a local area network. With this type of traditional structure, when users of the application participate in more isolated consortium blockchain applications, they are required to create a series of blockchain operation environments, resulting in an excessive burden. In most cases, server resources run at a low load or rest in an idle state. This high-cost deployment, operation, and maintenance framework is

**NOTE:**

*The terminology used in this article, including peer node (peer), consensus order node (orderer), chain code, etc., are derived from the most widely used consortium blockchain, Fabric. Other frameworks use other terms; however, the functions and mechanisms expressed are the same.*

the major bottleneck of blockchain development. In addition, there is no uniform technical standard for the low-level platform heterogeneous structure used by each local area network-style blockchain application, such that business data cannot be exchanged and blockchain technological transformation and commercial deployment are restricted. For this reason, there is an urgent need within the industry to create a public infrastructure network that is commonly recognized by all organizations.

The underlying intentions of the design and creation of the Blockchain-based Service Network (BSN) are to provide a public infrastructure network that allows the low-cost development, deployment, operations, maintenance, and regulation of consortium blockchain applications. The BSN will not support any form of permissionless blockchain applications.

## **Chapter III**

### **BSN Introduction**

The BSN is composed of public city nodes and a consensus order cluster service. Each city can build one or more public city nodes that are linked via the internet to form a nationwide (and in the future, worldwide) physical city node blockchain service network. Blockchain application publishers need only to deploy the application to multiple city nodes in the BSN, then participants may enter at practically no cost through the city node gateway. Within each city node, all deployed applications share server resources. For high-frequency applications, city nodes will be able to intelligently and automatically allocate individual high-processing function peer nodes. For low-frequency applications, multiple applications will be able to share a single peer node. This type of resource-sharing mechanism enables the BSN to lower the cost of resources to between one-third and one-fifth of the cost of traditional

blockchain cloud services. In addition to peer nodes, traditional blockchain applications are required to individually create and maintain a consensus node, whereas the BSN only has to provide one uniform consensus node cluster service that is developed, built, operated, and maintained by China UnionPay and that provides services to each blockchain application within all of the city nodes.

The BSN is an information infrastructure; for example, rather than every household digging a well to gain access to water, each household shares the same water supply provided by the public water facility built by the city, and this lowers social costs. With the BSN, blockchain application publishers and participants do not need to purchase any additional physical servers or cloud services to build their own blockchain operating environment; instead, they can use uniform public services provided by the BSN and lease shared resources as needed. This greatly reduces the publisher's and participants' costs. Research reveals that according to current mainstream cloud service provider quotations, the lowest annual cost to build a traditional consortium blockchain local area network environment is more than RMB 100,000. However, by using the BSN, one application requires only RMB 2,000–3,000 a year to form a chain and become operational. This will encourage a vast number of small, medium, and micro-sized enterprises and individuals such as students to use the BSN to invent and innovate, thereby accelerating the rapid development and widespread use of blockchain technology.

Developing the isolated framework of traditional blockchains into the resource-sharing framework of the BSN complies with the development pattern of the internet from a collection of many isolated local area networks to its progressive expansion into a worldwide web infrastructure. The BSN can be viewed as being based upon the internet data transmission protocol, now becoming a second generation of smart and dedicated internet using consensus mechanisms between organizations.

# Chapter IV

## BSN Framework

All public city nodes and consensus order cluster services in the BSN are linked via the internet. Application publishers choose a certain number of city nodes according to the business requirements and the transactions per second, storage, and bandwidth for each node required to publish the application. According to rights and privileges, they allocate rules so that the application can be flexibly set as a private blockchain or a consortium blockchain. The publisher can select any grouping of city nodes to publish an unlimited number of applications, and provided they have obtained the necessary permissions, application participants can access any city node deployed by the application to participate in the relevant business. Throughout the entire process, application publishers and participants can combine their efforts to bring about innovation and conduct business without incurring any additional costs of building and maintaining their own blockchain operations environment.

The core framework of the BSN comprises the following key parts:

### **I. Public city nodes**

Public city nodes are a basic operational element of the BSN. Their main function is to provide system resources such as access control, transaction processing, data storage, and computing abilities for blockchain applications. The owner of each city node is a provider of cloud resources or data centers. The owner installs public city node software in the cloud resources and, once linked to the network, can create a city node in the BSN. After the node is created, the application publisher can search for the node in the portal and purchase its resources as one of its city nodes deploying the application. Once the use of a city node's resources approaches a

saturation point, the owner can add system resources at any time to increase the load capacity of the city node.

According to the number and simultaneous requirements of operational applications, each city node actively deploys a certain number of peer nodes, and through a load-balancing mechanism, high-concurrency applications are actively allocated a single, dedicated high-performance peer node, while multiple low-concurrency applications share a single peer node. This mechanism enables city node resources to be used with maximum efficiency and lowers the overall running costs of the BSN.

In principle, the BSN is a multi-chain, multi-ledger blockchain system. Each application deployed on a certain number of city nodes uses a dedicated channel for transaction processing, data communication, and storage. There is complete isolation from channel to channel; however, if two applications share mutual authorizations, data can be mutually allocated. This mechanism thus guarantees the absolute privacy of each application while maintaining sufficient flexibility to conduct chain-to-chain business.

## **II. Consensus order cluster services**

Each traditional consortium blockchain application requires the deployment and maintenance of an individual consensus order node. The type of node determines the order in which a transaction that has reached consensus is delivered to each peer node and permanently written into the ledger. As the data processing hub of an application, the consensus order node has high performance and concurrency requirements. Sharing the same concept as the peer nodes within the public city node, in order to lower the cost of blockchain application deployment and operations, the BSN provides uniform consensus order cluster services to all applications. According to the gradual increase in the business development and concurrent transaction capacity of the BSN, the consensus order cluster services use one of two

modes (collective clustering or distributed clustering) and through the load-balancing mechanism provides different resource configurations for applications with different loads, optimizing the overall running costs of the BSN.

China UnionPay is responsible for the creation and operation of consensus order cluster services. As one of very few Chinese companies that possesses experience in handling high-concurrency transactions, China UnionPay provides highly efficient, trustworthy, and cost-controllable, high-quality services for all applications on the BSN. In addition to consensus order cluster services, China UnionPay is also responsible for promoting the formulation of financial regulations for the BSN and creating a regulatory mechanism to ensure that financial applications and financial transactions on the BSN comply with the relevant requirements of Chinese laws and regulations.

### **III. Permission management chain**

The permission management chain is a basic, system-level chain used by the BSN to manage the relationship between the role and permissions configuration of each application. It is deployed within each city node to provide each application with a permission management mechanism that is uniformly stored on the chain, is fully controllable by the developer, and uses application-role-based control (ARBAC).

Based on their business characteristics, applications can define multiple classifications of the ARBAC management model, such that different role participants have different privileges for data processing. When a participant accesses a BSN application through the city node, the system will implement data processing permission control and audits according to the application's internal ARBAC model.

The permission management chain provides applications with two modes of organized management: the consortium mode and the centralized authority mode. Under the consortium management mode, participating organizations

in an application are on equal footing and are able to jointly participate in the management of the whole application, such as in regard to user access and cancellation, and the mechanisms used to allocate participant rights and privileges are subject to the vote and resolution of all consortium members. Under the centralized management mode, the application publisher is the sole administrative organization, determining all internal application mechanisms.

#### **IV. Smart gateway**

Blockchain technology is a type of distributed database technology based on shared ledgers, point-to-point transmission, and encryption algorithms. For this reason, complex business logic cannot be formed by solely relying upon application chain code. For the most part, each participating organization in a blockchain application has its own business system underlying the chain, and the business system is linked to the blockchain chain code to form the complete application. Smart gateways deployed within each city node are responsible for adapting external systems to city nodes, and in addition to providing identification certification, operation permission checks, and access management for applications, the gateways also provide universal and easy-to-learn application programming interfaces (APIs) so that the complexities of the BSN are hidden from external business systems, assisting in the ease with which business systems connect to the chain and allowing the BSN to be used with high efficiency.

In regard to certain application participants with extensive security and encryption requirements, the BSN can provide a corresponding software development kit according to the chain-linked business system's running environment so it can manage the encryption key for BSN access and data encryption mechanisms from within its own environment.

#### **V. Pre-built chain code mechanism**

To further reduce developers' costs and to simplify the learning process for developers using the BSN, the BSN promotes a pre-built chain code mechanism. In many traditional business systems, blockchain is a type of special business database; when operating actual chain code, most business requirements can be achieved with a simple addition, deletion, or modification. When publishing an application on the BSN, the application publisher can directly select the basic pre-built chain code package provided by the BSN to complete its deployment. The combination of smart gateways and the pre-built chain code mechanism allow traditional business system developers with no blockchain development personnel and with absolutely no understanding of blockchain programming language to use their own familiar programming language and running environment to access the BSN, process blockchain data, and give blockchain functionality to traditional business systems.

There is a chain code market on the developer's portal of the BSN where expert blockchain developers can upload and process more complex business pre-built chain code for convenient use, free or for a fee, by other developers.

## Chapter V

### BSN Advantages

#### **I. Cost-savings in blockchain application deployment, operations, and maintenance**

The BSN provides a one-stop shop blockchain operation environment so that developers do not need to individually purchase cloud services or a software server to build and maintain their own blockchain system. Public city nodes and consensus order cluster services work on the principles of load-balancing mechanisms and

resource sharing to enable the BSN to provide long-term, high-performance, stable, and reasonably priced services to blockchain applications. Furthermore, the cost of chain-building is reduced to just RMB 2,000–3,000 per year, allowing all enterprise and individual developers access to the blockchain industry.

## **II. Lower threshold for blockchain application development**

Very few developers are proficient at blockchain-related programming language. Smart gateways and pre-built chain code open vast possibilities to developers so that they can use the BSN with ease and add blockchain functionality to traditional business systems. In the future, the BSN will mimic traditional databases and the internet to become a conventional choice for developers in the process of business design, system development, and product operations.

## **III. Increased level of convenience with which users can participate in blockchain applications**

When users participate in blockchain applications under a traditional local area network model, different consortium blockchains need to deploy independent node operating environments. Moreover, each consortium blockchain needs to possess its own separate identification certificate. This makes participating in applications a repetitive and overly complicated process. With the BSN, users can share the same identification certificate and access an unlimited number of applications at any time. When authorities are mutually recognized between applications, users can also carry out data interactions conveniently between chains.

## **IV. Provides flexible access modes**

Application participants can access nearby city nodes via the internet or dedicated line connections to access the BSN. Most consortium blockchain applications

are finance or payment-related. To guarantee the security of information, many financial systems require data to be transmitted over a dedicated line. Most traditional cloud service providers use centralized data centers, and because the cost of using cross-province and cross-region dedicated lines is extremely high, many cloud service providers are unable to provide complete dedicated line services to blockchain applications. Furthermore, the BSN has city nodes in every prefecture-level city nationwide, with all city nodes supporting same-city dedicated line access—the cost of which is much lower than that of cross-province and cross-regional dedicated lines.

## **V. Rapid networking mechanism**

To allow the BSN to follow in the steps of the internet and achieve widespread use and high-speed development, the BSN networking mechanism observes the same spirit of development as the internet: the construction of public city nodes makes full use of idle and existing cloud services and data centers without repeated investment. Provided that they comply with BSN standards and regulations, at a global level, any organization that possesses cloud services or data center resources can apply to create a city node and enter the BSN. Just like the internet, the BSN is not solely owned by any one entity, and the owner of the cloud services or data center becomes the owner of the related city node.

# **Chapter VI**

## **BSN Development Association**

The Blockchain Service Network Development Association (BSN Development Association) is responsible for the management, operations, and maintenance of the BSN. All matters of the BSN, including regulatory design, technical standards,

development and operations management, running modes, price-setting for services, and external cooperation, are determined and implemented by the BSN Development Association according to its internal mechanisms. The BSN Development Association was launched by six units:

1. State Department: State Information Center Smarter City Development and Research Center
2. Communications industry: China Mobile Group Design Institute Co., Ltd., China Mobile Communications Corporation Government and Enterprise Service Company
3. Financial industry: China Unionpay Co.,LTD, China Mobile Financial Technology Co., Ltd.
4. Software industry: Beijing Red Date Technology Co., Ltd.

The BSN is a vast engineering project requiring continuous innovation and optimization. The Development Association invites organizations that share the same vision of concept and have the corresponding accumulation of technology and operations experience to join the organizational structure, including supervisory authorities, telecommunications carriers, financial institutions, cloud service providers, hardware producers, software developers, and marketing promoters.

## **Chapter VII**

# **BSN Development Planning**

### **I. Global deployment**

With the support of China Mobile's network of 31 provincial-level companies, the

BSN has already created 40 public city nodes in provinces throughout China. It is expected that once the BSN is officially launched, there will be approximately 100 city nodes. Furthermore, operators and cloud resource providers from Southeast Asia and Europe are already holding discussions and mapping out issues surrounding local deployment of city nodes. To a certain extent, the BSN optimizes blockchain base-level technology, creates new standards for blockchain data transmission, and possesses low-cost, rapid expansion and ease of management characteristics. It provides a foundation for the rapid spread and deployment of blockchain technology globally. The special features of blockchain technology and the BSN increase the management and collaborative efficiency of all types of multinational cooperation, including the “Belt and Road” initiative, cross-border trade, financial services, project management, and freight and logistics industries. Once the BSN is deployed globally, it will become the only global infrastructure network autonomously innovated by Chinese entities and for which network access is Chinese-controlled.

## **II. Adaptable toward the data processing requirements for all types of pioneering technologies**

Currently, there is rapid development in pioneering technologies such as 5G, the Internet of Things, and AI, with huge industrial potential in these areas. These technologies include high requirements for the concurrency, frequency, and flow-rate of data transmission and storage, pushing centralized servers to their limits. The blockchain consensus mechanism and distributed mode storage characteristics of the BSN will be able to keep pace with such pioneering technology and provide fixed-point, fixed-orientation data adaptation development, further promoting the BSN as a core infrastructure to support the development of China’s digital economy and smart society.

### **III. Supports multiple consortium blockchain frameworks**

The BSN currently uses the Linux Foundation's flagship Hyperledger Fabric consortium blockchain as its base framework. The security, stability, compatibility, and expandability of the framework has already been authenticated by numerous blockchain operators. In the future, the BSN will also be able to adapt to other Chinese or internationally developed mainstream consortium blockchain frameworks (including Fabric with Chinese SM4 Encryption Algorithm) to give developers even more choices.

### **IV. Future core system open sources**

Once a comprehensive protocol standard for the BSN has been formulated, the BSN Development Association will open source city node systems. Everyone will have access to source code, subject to copyright and protocol limitations, and can publish their own modified and optimized versions, enabling city nodes to provide developers and terminal users with a more complete, flexible, and stable service environment. The BSN will adhere to being an open, inclusive, tolerant, and development-minded concept seeking common ground and mutual gain with a far-reaching community of developers to jointly promote the optimal advancement of the information ecological environment.

### **V. Second-generation dedicated internet**

The ultimate objective of the BSN is to become a second-generation specialized internet based on the existing internet. Traditional internet has resolved, in a low-cost manner, the issue of instantaneous transmission of data between two computers

anywhere in the world, and the BSN, in a low-cost manner, will resolve the issue of the mutual trust of data between multiple business organizations anywhere in the world.

## Chapter VIII

### BSN Web Portal

Please visit <http://bsnbase.com> for the latest status reports or to use the Blockchain-based Service Network.