Blockchain-based Service Network User Manual

Version 1.8.1

BSN Foundation

CONTENTS

Preface

Blockchain-based Service Network (BSN or Service network) is a worldwide infrastructure network that provides a one-stop-shop solution for blockchain and distributed ledger technology (DLT) applications (DApp). BSN is a complex system that involves programming, software development, resource and environment configurations, application deployment, gateway APIs, local SDK, key certificates, etc. To facilitate utilization, BSN International (www.bsnbase.io) has prepared this document for developers and users to learn how to use BSN. We hope that BSN will become the first choice for developers to develop and run their DApps.

BSN provides developers three types of services: Permissioned, Permissionless, and Interchain services.

Permissioned services are divided into two parts. The first part demonstrates how developers can deploy smart contracts to the selected public city nodes through the BSN portal; the second part describes how developers can connect their off-BSN systems to the corresponding smart contracts through the public city node gateway and conduct data transaction processing.

Permissionless services determine how developers can choose the appropriate public city nodes, plans, and public chain frameworks, to deploy and publish their DApps.

BSN's "Interchain Communications Hub" (ICH) integrates the interchain solution based on the relay chain mechanism (Poly Enterprise developed by Onchain). It enables cross-chain interoperability among standard permissioned chains, open permissioned chains and public chains. We will continue to integrate more cross-chain protocols to achieve the interoperability of all blockchains adapted to BSN.

Please feel free to contact us if there are any further questions. Our contact information can be found in Chapter 14. Contact Us. We strongly recommend users access the Online Documentation section to explore BSN technical details further.

1 BSN Introduction

1.1 Brief Introduction

The BSN design and concept as taken from the Internet, is a connected set of devices across data centers using the TCP/IP protocol. BSN is formed by the connection of the public city nodes using a set of blockchain operating environment protocols. Just like the Internet, BSN is also a cross-cloud, cross-portal, cross-framework, global infrastructure network.

With BSN, there are three types of participants: cloud service providers, blockchain framework providers, and portal operators.

Cloud service providers, through the installation of free BSN public city node software, can make their cloud service resources (computing power, storage, and bandwidth) accessible and sell through BSN to end-users.

Blockchain framework providers align with the BSN's framework adaptation standards and deploy them on BSN so developers can use it to develop and deploy applications. The Permissionless service only applies to the BSN international portal and international public city nodes.

Portal operators can easily and quickly build a Blockchain as a Service (BaaS) platform on their existing websites using BSN APIs. This allows them to provide BSN capabilities to their end users without users leaving their websites.

BSN is an open network that any cloud service provider, framework provider, or portal operator, that complies with BSN requirements and standards is free to use and stop using the service network at any time.

Similar to the Internet, most users of BSN are developers and technology companies. They can use any BSN portal to purchase cloud resources that charge based on transactions per second (TPS), storage quantity, and bandwidth from any public city node around the world. They select any pre-adapted framework to conveniently develop, deploy, and manage permissioned blockchain applications at a very low cost. Blockchain developers only need to deploy the application to one or more public city nodes on BSN so participants can connect to the application at no cost through any public city node gateway. All deployed applications share server resources in every public city node. For high-frequency applications, public city nodes can intelligently allocate a dedicated peer node with high processing capacity. For low-frequency applications, they share the same peer node. This resource-sharing mechanism allows BSN to reduce the resource cost to one-twentieth of the cost of traditional blockchain cloud services.

BSN is a blockchain infrastructure network. Just as households do not need to dig their own wells, but instead, enjoy the water supply services provided by public water plants in cities, BSN blockchain application publishers and participants do not need to buy physical servers or cloud resources to build their blockchain operating environment.

They use the public services provided by BSN and rent shared resources as needed, thus greatly reducing their costs. According to recent research, it takes about 20,000 USD per year for developers to build and deploy a traditional permissioned blockchain LAN-type environment. However, with BSN, the minimum cost to run such an application is as low as one dollar a day. Cost is a huge factor and will encourage a large number of small, medium, and micro enterprises and even individuals (including students) to innovate and start businesses through BSN. This will undoubtedly promote rapid development and popularization of blockchain technology. In general, the development from the closed architecture of the traditional blockchain to the resource-sharing architecture of BSN completely mimics the development process of the Internet, which gathered numerous isolated LANs in the early days to the global connectivity facilities we have today. We hope to make BSN the blockchain Internet.

1.2 BSN Services

As mentioned above, BSN provides a one-stop-shop solution for developers to deploy, operate, and manage DApps. BSN provides three types of services: Permissioned, Permissionless, and Interchain services.

1.2.1 Permissioned Services

BSN is continually adapting most of the mainstream permissioned blockchain frameworks. On the BSN portal users can deploy DApps on any public city nodes based on the type of selected framework and the number of peer nodes. The number of peer nodes per application can be up to 60 and can be distributed among public city nodes based on different cloud services. Users can easily complete the DApp deployment process by uploading smart contracts and configuring the corresponding parameters. This service mode allows developers to focus on business innovation, smart contract programming. All work related to environment construction, system maintenance, application deployment, node transmission, and network configuration is done by BSN.

The pricing strategy for the Permissioned service is based on three resource elements of each peer node of the published application. The three elements are TPS, storage, and data traffic. Among them, TPS and storage in the BSN portal are pre-paid, while data traffic will be charged based on actual usage. This pricing strategy is designed to minimize resource costs and provide users with the best services. Based on the data provided by the BSN portal, if a user deploys a three-peer Fabric DApp, and each peer node supports 10TPS and 10GB storage capacity, the monthly fee is only 20 USD.

The pricing strategy of BSN dedicated node services is based on the host configuration, hard disk, and data usage of the cloud platform selected for the service, where the host configuration and hard disk are prepaid, and the data usage fee is postpaid according to the actual amount incurred; the pricing strategy of interchain services is postpaid according to the actual number of cross-chain calls occurred; the permissioned services, oracle services and interchain services provided by the BSN Testnet services are all free of charge.

1.2.2 Permissionless Services

The Permissionless service is only applicable to the BSN international portal

(www.bsnbase.io) and international public city nodes. Compared with the complexity of the Permissioned service, Permissionless service has the virtue of simplicity. The Permissionless service mainly provides developers who develop public chain DApps, with unified access service covering numerous public chain nodes. Developers may choose different plans on the BSN portal, and can simultaneously deploy DApps and process transactions on all BSN adapted public chain nodes through the selected public city nodes.

We offer a free plan and different premium plans. The free plan includes up to 2,000 requests per day. There are 3 types of premium plans, priced at $20, $100, and $500 per month. The premium plans include up to 20,000 requests, 125,000 requests, and 750,000 requests, respectively, per day. All requests can be assigned to any public chain freely.

Permissionless services only provide shared nodes and access environments and do not involve any business of the public chain itself. The gas fees incurred in publishing and running DApps on any public chain shall be borne by the developers themselves and have nothing to do with BSN.

1.2.3 Interchain Services

The vision of BSN is to become the Internet of blockchains. In the future, millions of DApps will be deployed and run on BSN. Both Permissioned and Permissionless DApps will be very easy to call and they can interact with each other just like applications currently do on the Internet. From this perspective, Interchain will become a very core part of the BSN technical architecture.

The BSN's "Interchain Communications Hub" (ICH) is now commercially available and integrated with Onchain's Poly Enterprise cross-chain solution. It supports cross-chaining between permissioned chains and cross-chaining between permissioned chains and the ETH Ropsten testnet and NEO testnet.

The demo version of ICH is also live on the BSN Testnet, integrating the cross-chain solution based on the relay chain mechanism (Poly Enterprise developed by Onchain). We welcome all developers to try it out and provide feedback and suggestions to us, and we will continue to improve the cross-chain functionality.

The BSN's "Interchain Communications Hub" (ICH) integrates the cross-chain solution based on the relay chain mechanism (Poly Enterprise developed by Onchain). It enables cross-chain interoperability between standard permissioned chains, open permissioned chains and public chains. We will continue to integrate more cross-chain protocols to achieve the interoperability of all blockchains adapted to the BSN.

1.3 Terminologies

- **Public city node (PCN):** This is the core element of BSN but the “node” part doesn’t refer to the blockchain nodes and BSN isn’t a blockchain. With BSN, each PCN is a virtual data center used to allocate a portion of resources from the cloud service or data center on which it was deployed. An entire blockchain operating environment has been built within this resource pool and includes multiple

blockchain frameworks, shared peer nodes, CA management, authority chain, PCN gateway, and PCN manager systems.

- **DApp:** This is a generic term for blockchain and distributed ledger technology application.
- **DApp Service or Service:** This is a DApp that is already deployed and in use on BSN that users can access with an invitation from the DApp publisher. The invitation allows them to directly join and use the service.
- **Service Publisher:** This is the individual or enterprise who published and deployed the DApp service on BSN and is responsible for granting access to users who apply to participate in the service.
- **Service Participant:** This is a user that uses the BSN DApp service via a BSN portal or the publisher's system. Also, the user's off-BSN system can connect to the DApp service via the PCN gateway to execute transactions and query data.
- **Off-BSN system:** A business IT system developed and managed by a DApp service publisher or a service participant outside BSN.

2 Release Notes

Release date	Version	Notes
2024/10/18	1.8.7	• The BSN International's website www.bsnbase.io has taken down Permissionless Chain dfuse-EOS.
2024/08/14	1.8.6	• The BSN International's website www.bsnbase.io has taken down Permissionless Chain klaytn and Findora.
2023/08/02	1.8.5	• The BSN International's website www.bsnbase.io discontinue support for the IRITA protocol in interchain services.
2023/06/19	1.8.4	• The BSN International's website www.bsnbase.io has taken down Permissionless Chain Casper.
2023/05/31	1.8.3	• The BSN International's website www.bsnbase.io has taken down Permissionless Chain Polkadot.
2023/05/29	1.8.2	• The BSN International's website www.bsnbase.io has taken down Permissionless Chain Oasis Network.
2022/04/24	1.8.1	• Optimized DID Services functions and interfaces; • Added Unsubscribe function in Permissioned Services.
2022/01/23	1.8.0	• Iterative optimization and technical optimization of the BSN international website (www.bsnbase.io) to enhance user experience; • Added the cross-chain function of Hyperledger Fabric V2.3.2 framework by Poly Enterprise and IRITA in the Interchain Communications Hub; • Integrated Hyperledger Fabric V2.3.2 to the BSN Testnet; • Upgraded the version of Hyperledger Fabric from 2.2.0 to 2.3.2 in the Dedicated Node Services; • Integrated Klaytn public chain and provide external services on the international website and international nodes; • Fixed bugs and enhanced the stability of the system.
2021/10/31	1.7.0	• Iterative optimization and technical optimization of the BSN international website (www.bsnbase.io) to enhance user experience; • Added Hyperledger Fabric V2.3.2 framework to Permissioned Services; • Added Configuration Upgrade function in the Dedicated Node Services; • Upgraded IRITA in the Testnet to support Ethereum Ropsten network and Chainlink oracle services; • Launched BSN DID Services to support credential issuance, authentication and authorized access management in a unified identity management system; • Integrated Cypherium public chain and provide external services on the international website and international nodes; • Fixed bugs and enhanced the stability of the system.
2021/07/31	1.6.0	• Iterative optimization and technical optimization of the BSN

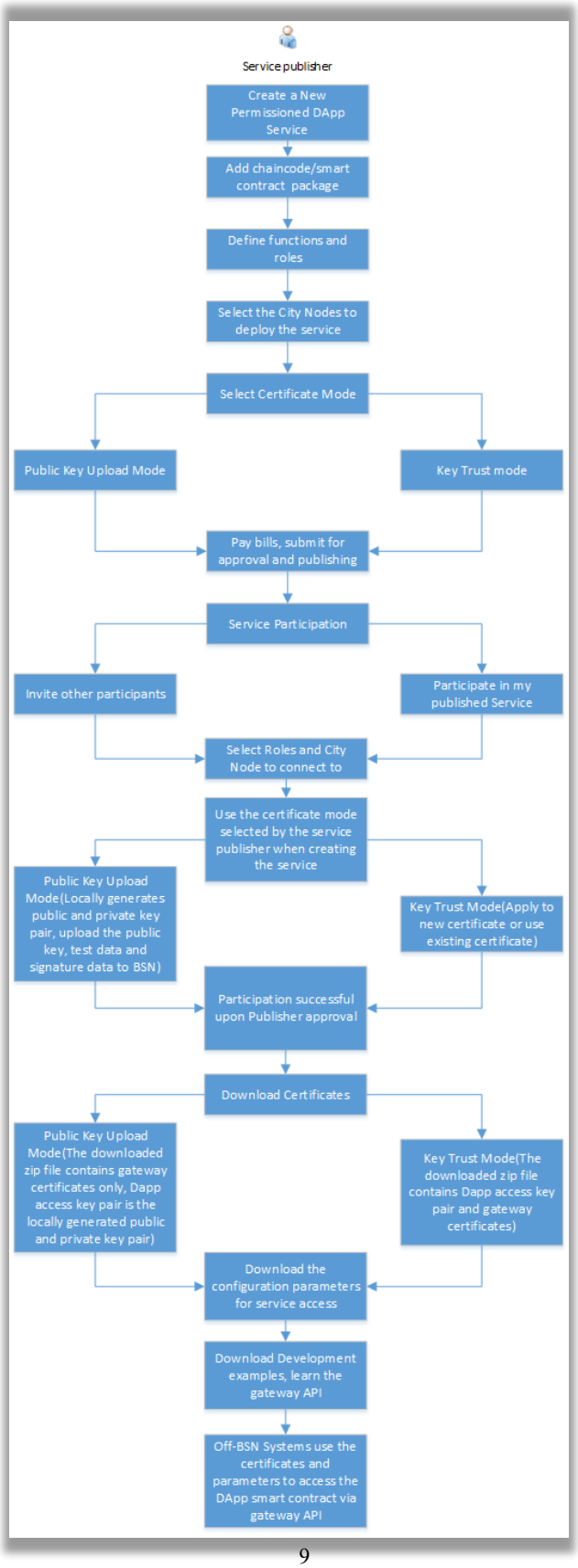
		international website (www.bsnbase.io) to enhance user experience. • Launched BSN dedicated node services based on Hyperledger Fabric V2.2.0 and Hyperledger Besu V21.1.2 frameworks. • Optimized and improved Interchain Communications Hub's protocols and service stability. • Updated the interface of the BSN Empowerment Platform to provide the DApp service management APIs of Open Permissioned Blockchains and BSN Testnet to BSN portals. • Fixed some bugs and enhanced the stability of the system.
2021/05/31	1.5.1	• Launched IDE Services, supports frameworks including Hyperledger Fabric, FISCO BCOS, Ethereum, Nervos and Algorand.
2021/04/30	1.5.0	• Iterative optimization and technical optimization of the BSN international website (www.bsnbase.io) to enhance user experience. • Launched BSN dedicated node services based on ConsenSys Quorum framework. • Launched the commercial service of Interchain Communications Hub based on IRITA. • Fixed some bugs and enhanced the stability of the system.
2021/03/19	1.4.1	• Added public chain main net and test net nodes along with native API access services. Including: Casper, Findora and Near.
2021/01/31	1.4.0	• Iterative optimization and technical optimization of the BSN international website (www.bsnbase.io) to enhance user experience. • Launched the commercial service of Interchain Communications Hub based on Poly Enterprise. • Fixed some bugs and enhanced the stability of the system.
2020/11/30	1.3.1	• Added public chain main net and test net nodes along with native API access services. Including: BTY, Oasis and Polkadot.
2020/10/31	1.3.0	• Optimized the BSN International website (www.bsnbase.io) to improve user experience. • Launched BSN Permissioned Blockchain Testnet, providing developers with a free testing environment supporting: Hyperledger Fabric R1, FISCO BCOS K1 DApp Services publication -Interchain testing services • Launched the BSN Interchain Communications Hub on BSN Testnet based on Poly Enterprise and IRITA. • Added the BSN empowerment platform APIs to allow third-party portals to access BSN Permissionless Services. • Added the TPD (Transactions Per Day) limit control function in the Permissionless Services • Fixed some bugs and enhances the stability of the system.

2020/9/24	1.2.1	• Updated the BSN Global website address to https://www.bsnbase.io. • Added public chain main net and test net nodes along with native API access services. Including: Algorand, ShareRing and Solana. • Added Enable Key function in the public chain project.
2020/8/10	1.2.0	• Redesigned the user interface toprovide better navigation and user experience. • Added public chain main net and test net nodes along with native API access services. Including: Nervos, Neo, ETH, Tezos, EOS, IRISnet, etc. • Added commercial functionality for Hyperledger Fabric and FISCO BCOS frameworks. • Updated FISCO BCOS framework to support SECP256 K1 encryption algorithm. • Added the following functionality to Permissioned services: recurring payment mechanism for service charge and data usage charge, service configuration upgrade. • Added Permissionless service plan purchase and upgrade. • Added "My Account" in User Center to make it easier for users to update credit card information, check bills, pay bills and download invoices (we process all credit card activities directly on Stripe). • Added Online Help Manual to provide developers and portal users easy-to-follow instructions. • Added PCN gateway SDK and all examples on Github: https://github.com/bsnda. • Fixed a few bugs to enhance the stability of the system.
2020/4/25	1.1.0	• The BSN global portal has officially launched. Beta testing will be held from April 25th, 2020 to June 25th, 2020. • Developers can deploy one three-peer DApp (service) at up to three public city nodes (PCNs) free of charge during beta testing. • There is a total of 10 available PCNs during beta testing. They are deployed on AWS, Microsoft Azure, Google Cloud, China Mobile Cloud, and Huawei Cloud. • During beta testing, there are two frameworks to choose from, Hyperledger Fabric V1.4.3 or FISCO BCOS V2.4.0. • Developers can choose “Key Trust Mode” or “Public-Key Upload Mode” to manage their service users’ certificates and keys. • Basic information and chaincode/smart contracts in deployed services can be modified anytime. PCNs, however, cannot be changed once chosen. • Published services are private by default. Developers will need to apply for a public listing. After approval, they will be available on the App Store.

		• Developers will need to grant permissions to other users to participate in their services. The participants then follow the services' instructions to generate service access keys and user transaction keys by using either "Key Trust Mode" or "Public-Key Upload Mode". • The PCN gateway provides a set of user registration APIs for deployed services. Developers can register service users via these APIs from their off-BSN systems. Developers do not need to log in to the BSN global portal. • The PCN gateway APIs support "Key Trust Mode" for both Fabric and FISCO BCOS. "Public Key Upload Mode" is only supported for Fabric. • For more info on gateway APIs, please refer to the developer's manual.

3 Quick Start

3.1 Permissioned Blockchain

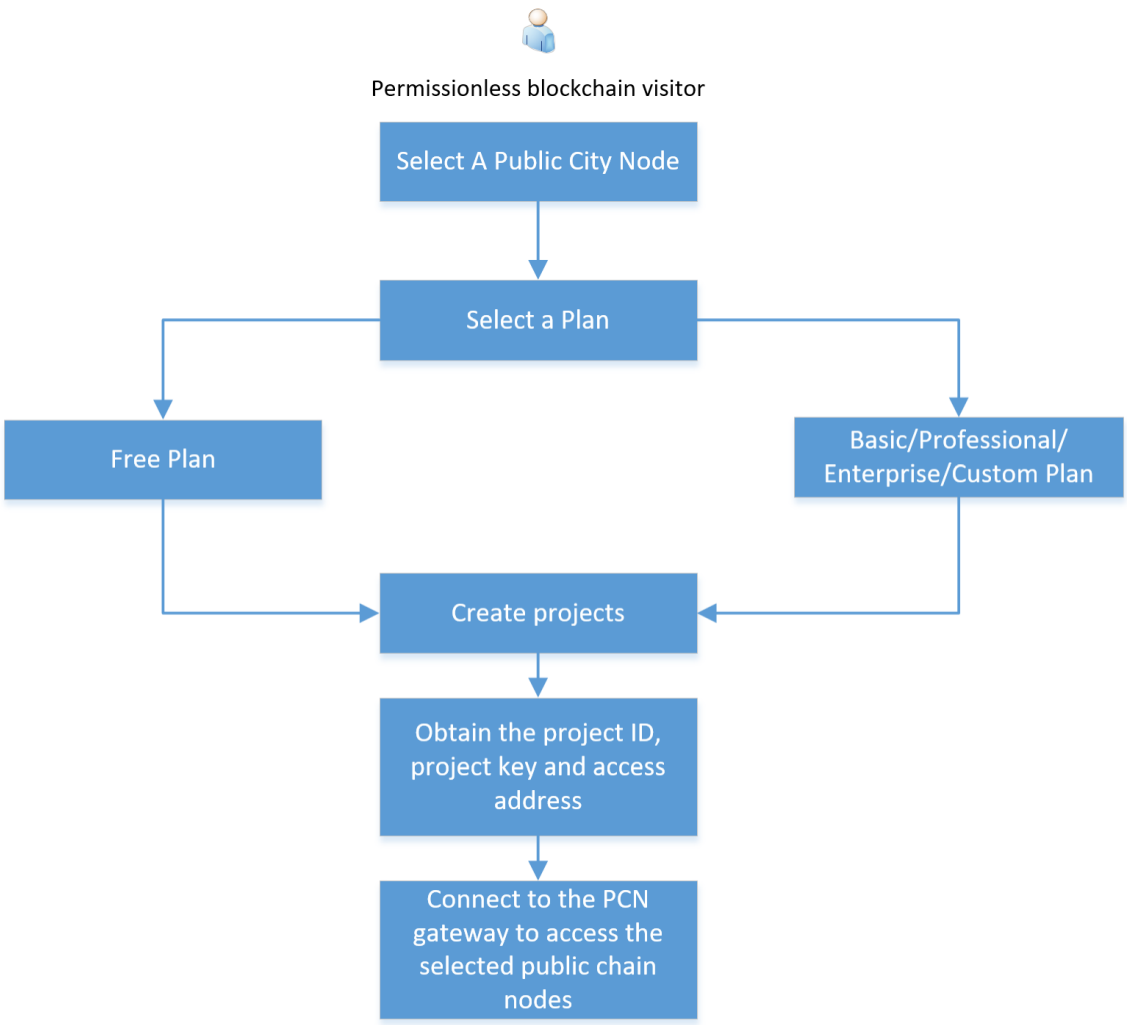


Permissioned DApp Service publishers can create DApp services in the BSN portal. To create the service, it is necessary to upload the smart contract/chaincode package, define the service functions and roles, select the public city nodes and select the participant certificate mode (including Key Trust mode and Uploaded Public Key mode). After that, publishers pay the bills and submit the service deployment request to the network operator for approval and publishing.

After the successful publication of the service, publishers can participate in their service or invite other users to participate in the service. To participate in the service, participants should select designated roles and the access public city node, then generate the certificates according to the certificate mode set by publishers. Participation will be successful after being approved by service publishers.

Once successfully participating in the service, participants can download the certificate, and use the certificate and service access configuration parameters to access the chaincodes/smart contracts through the gateway API.

3.2 Permissionless Blockchain



Permissionless services allow visitors to select public city nodes and plans to participate in a service. There are 2 types of plans, the free plan, and premium plans. Visitors can choose plans according to their business requirements. To connect to the public chain nodes, users can create projects to obtain project IDs, project keys, and access addresses to access the public chain services.

3.3 Documentation

The direct users of the BSN portal are developers. As the environment and tools of the blockchain application's development, deployment, and operation, BSN is relatively complex in its overall operation. We strongly recommend that all developers start by examining the documentation and examples so that they will be able to master the use of BSN within a day or two.

For your convenience, all examples we've provided are available on Github. We hope that developers with serious interest can help us optimize and enrich the examples so that other developers are able to adapt and learn about blockchain development. Developers who share their samples, will receive small gifts and be invited to BSN's internal technical seminar.

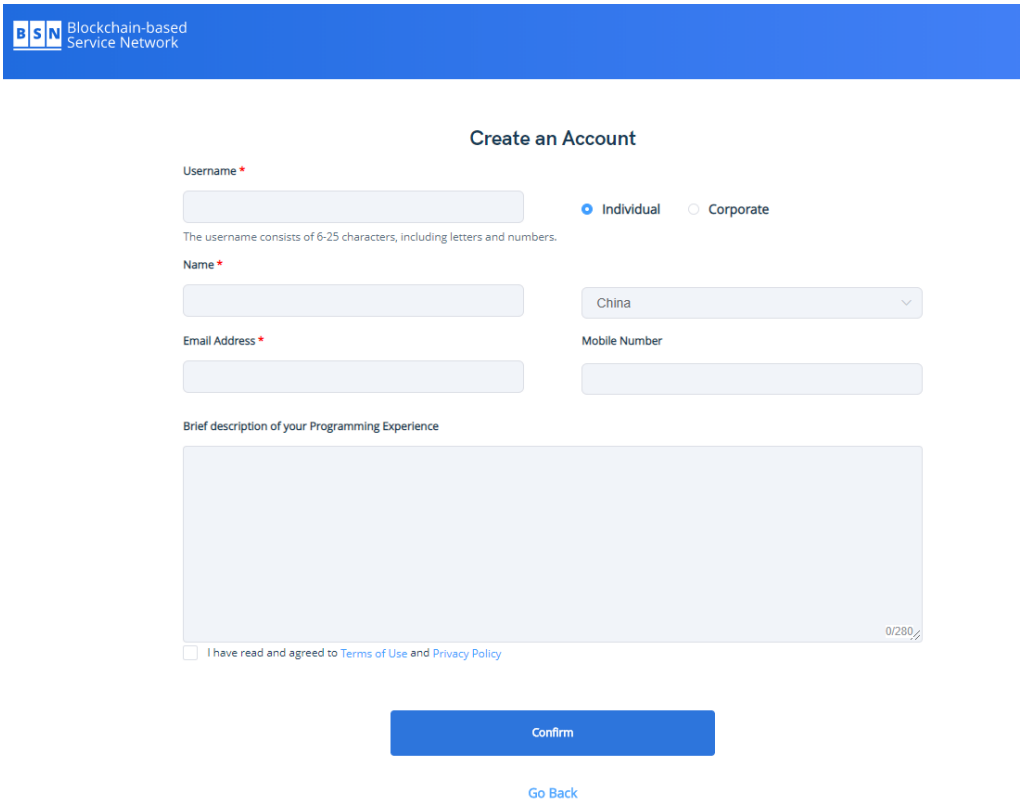
For links to all documents and examples, please visit Chapter 13. Online Documentation.

4 Registration and Activation

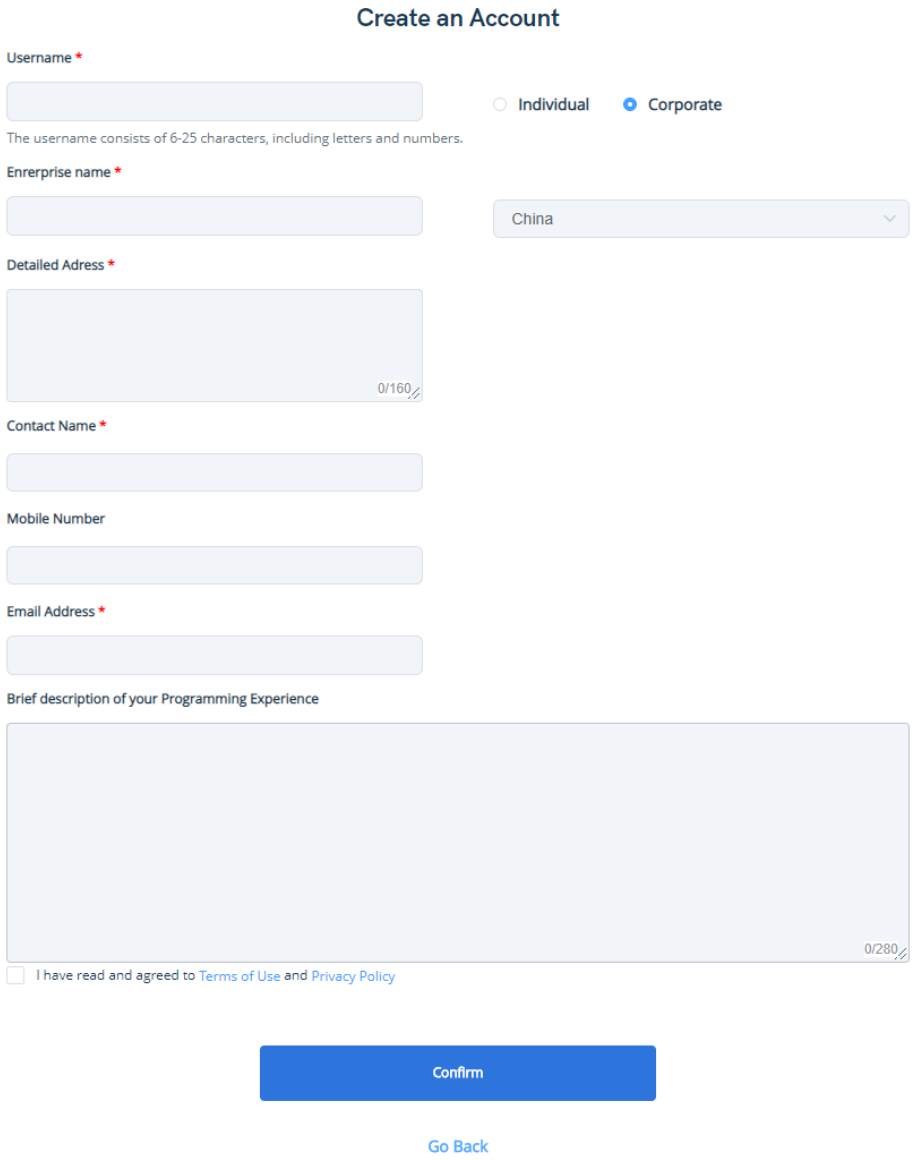
BSN requires its users to register and confirm their registration before they can access the network to carry out services and actions across the network. As a first-time user, follow these steps to register:

4.1 Registration

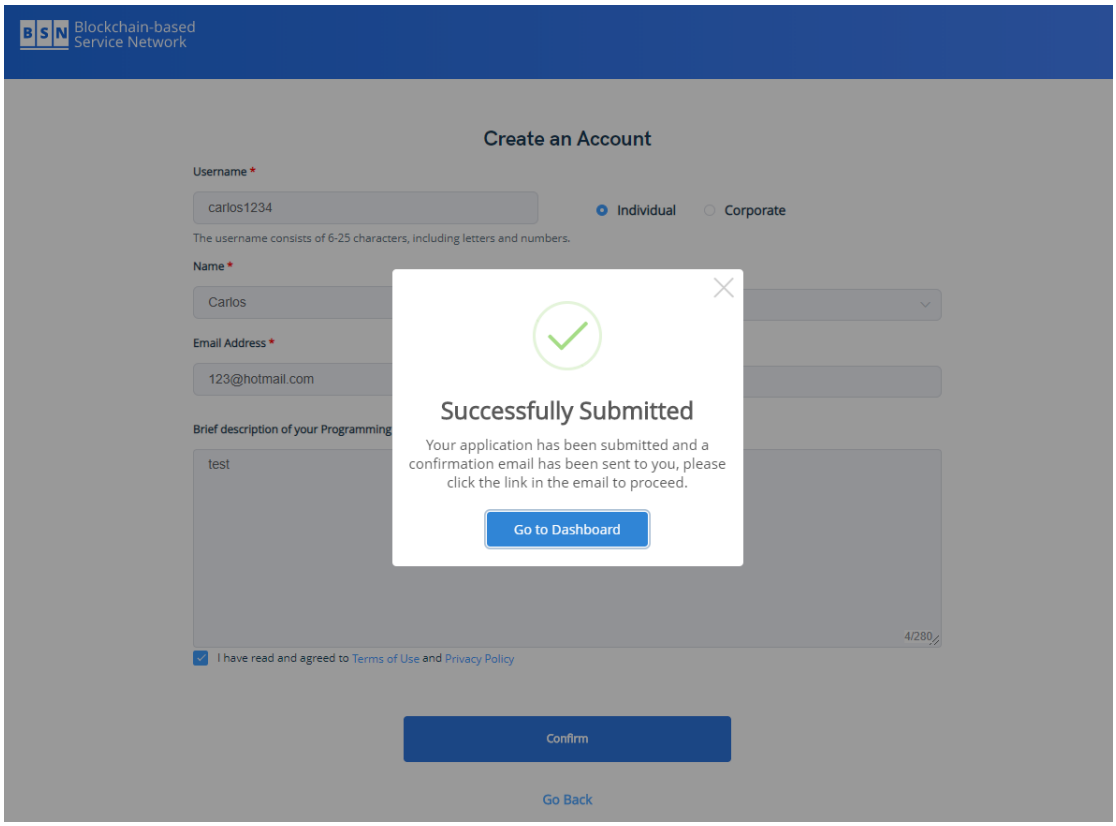
1. Click here to access the website at www.bsnbase.io.
2. With the blockchain-based service network, you can access the system either as an Individual or a Corporate entity.
3. To register as an Individual, enter or select the following:
   - **Username** – Enter a preferred username
   - **Nationality** – Click the dropdown to select your country from the list of countries
   - **Name** – Enter your real name, different from the username
   - **Mobile Number** (Optional) – Enter your mobile number
   - **Email address** – Enter an email address you have access to
   - **Brief description of your programming experience** (Optional) – If you have some experience in programming, we would love to hear about it
   - Check the **I have read and agree to Terms of User and Privacy Policy** box
   - Click **Confirm** to finish the registration.



4. To register as a Corporate entity, enter or select the following:
   - **Username** – Enter a preferred username
   - **Nationality** – Click the dropdown to select your country from the list of countries
   - **Enterprise Name –** Enter the legal name of your corporate body or company name
   - **Detailed Address –** Enter a verifiable address of the company location
   - **Contact Name –** Enter a contact name that represents the company
   - **Mobile Number** (Optional) – Enter your corporate mobile number
   - **Email address –** Enter a corporate email address that you have access to
   - **Brief description of your programming experience** (Optional) –If you have some experience in programming, we would love to hear about it
   - Check the **I have read and agree to Terms of User and Privacy Policy** box
   - Click **Confirm** to finish the registration.



5. A confirmation dialog box will be displayed confirming your registration. Click **Go to Dashboard**.

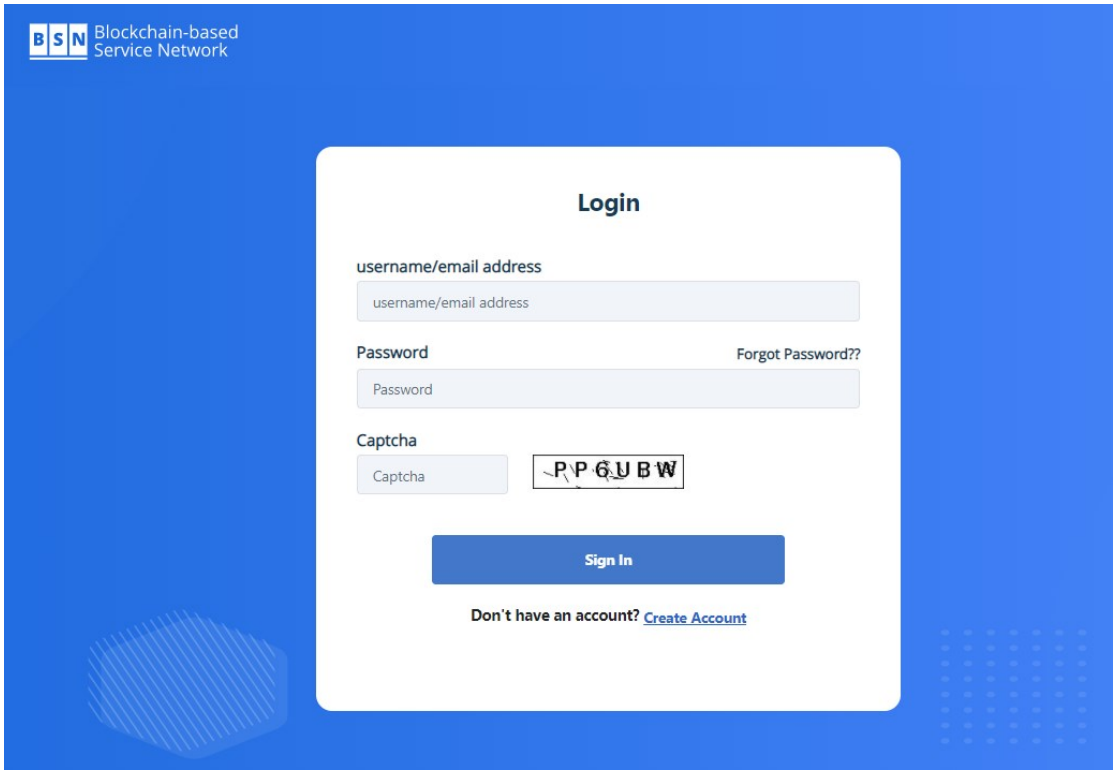


6. You will receive an email from BSN requesting that you confirm your registration.
7. Click on the link in the email to confirm your registration and enter your **Password** and **Password Confirmation**.
8. Click **Confirm** when done to return you to the login page.

4.2 Login

After you have successfully registered your account on BSN, you can login by following these steps:

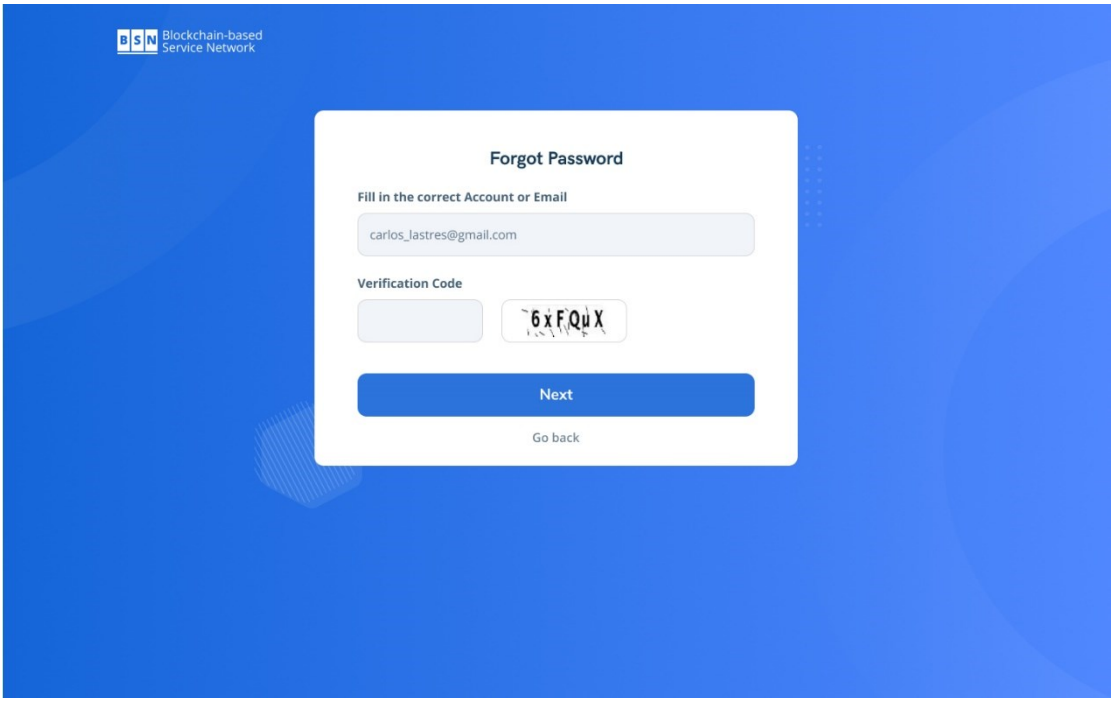
1. Click on the Login link to access the login page.
2. On the login page, enter the **Username/Email**, **Password,** and the **Captcha Code**.
3. Click **Sign In** to access the **Home** page.



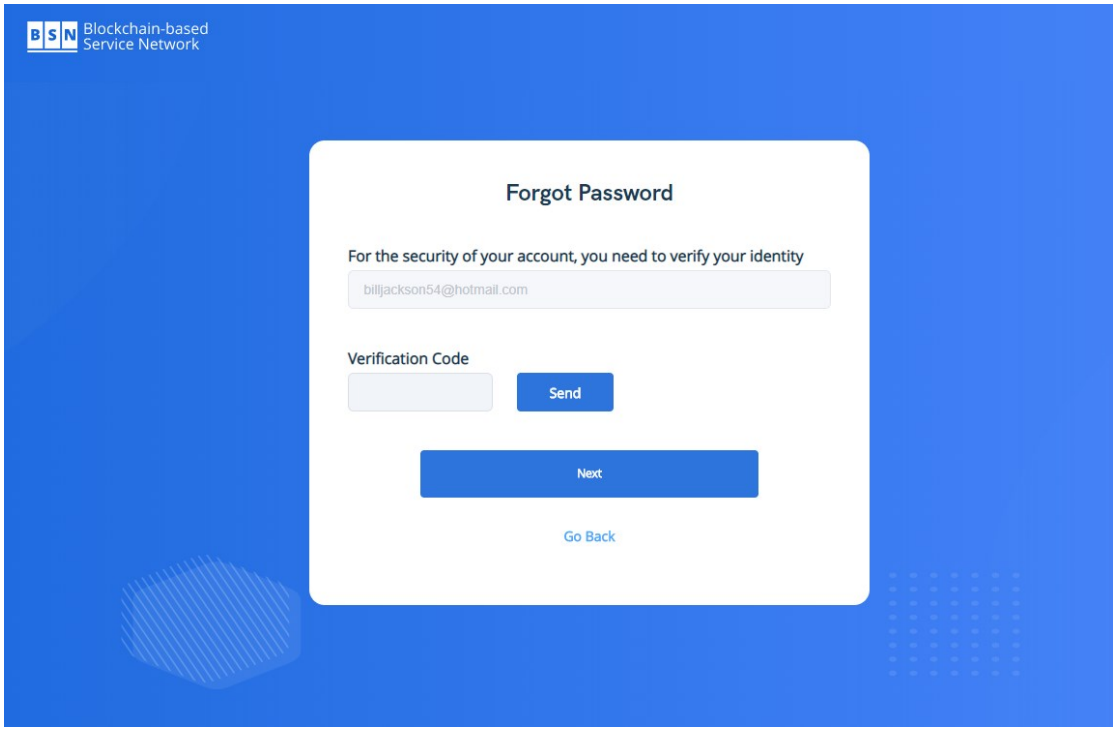
4.3 Forgot Password

If at any time you have forgotten your password, you can follow these steps to retrieve it:

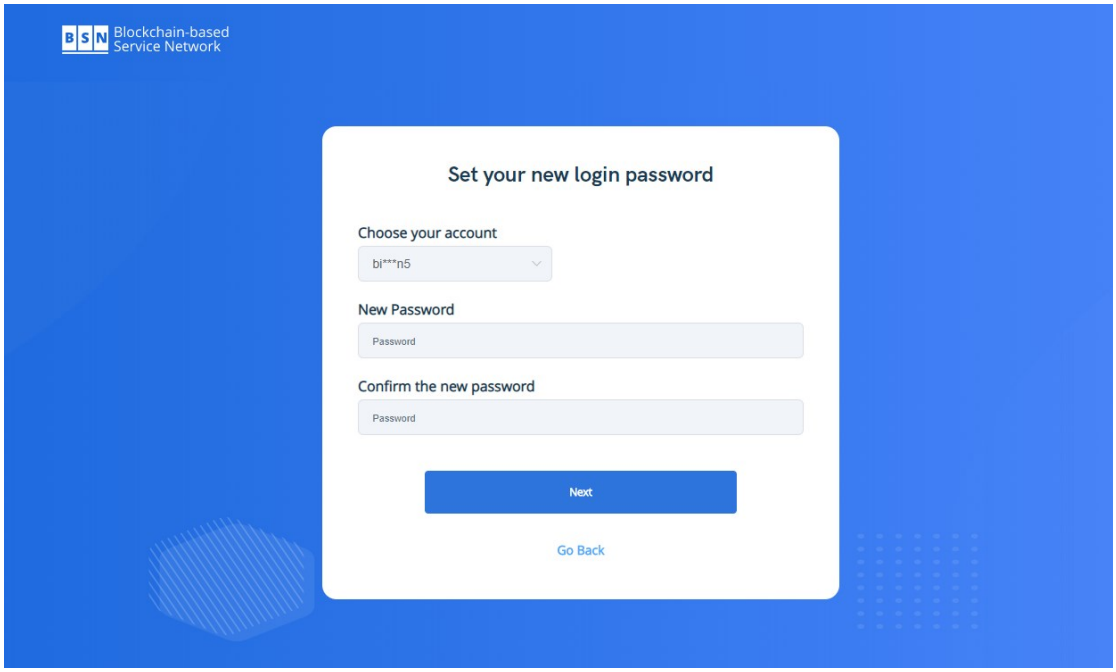
1. On the **Login** page, click the **Forgot Password** to open the forgot password page.
2. On the page, enter the **correct account or email**.
3. In the **verification code**, enter the displayed code. If you wish to generate another code, click on the code to generate another.



4. Click **Next** to view the **Authentication** page.
5. On the **Authentication** page, click the **Send** button to get verification code. This will generate a code that will be sent to your registered email address.



6. Enter the code that was received in your mailbox and click **Next**.
7. On the reset login password page, enter your **New password** and **Confirm password**.
8. Click **Confirm** to change your password.



5 Permissioned Services

5.1 Overview

The Permissioned service is one of the core services provided by BSN. Its goal is to make it easy for developers to publish decentralized applications (DApps) based on the framework of the permissioned blockchain on their selected public city nodes. Compared with the permissionless blockchain DApp, the permissioned blockchain DApp is more flexible in terms of architecture design, operation efficiency, and smart contract programming. It also has a larger space for innovation. However, from the perspective of development, because the developers need to build their underlying environments, and the environment for the public chain is readily available, the development, operation and maintenance of the permissioned chain DApp are relatively difficult. The developer's off-BSN system can access to DApp for data processing through the BSN public city node gateway.

Although BSN has greatly reduced the difficulty of permissioned blockchain DApp development, developers still need to have an in-depth understanding of the following three aspects which will be explained in detail in the following chapters.

1. Keys and Certificates Mechanism: the blockchain application itself is based on encryption algorithm technology, so the requirements of the keys and certificates are very high.
2. DApp services publication and participation: To build a permissioned blockchain DApp, the developer should firstly set up the chain and deploy the smart contracts. This part is entirely carried out on the BSN global portal (www.bsnbase.io), including the operations of smart contract upload, certificate mode selection, role's permissions setting, peer node configuration, public city node location, etc. Finally,

developers need to upload or download keys to facilitate the access from off-BSN system.

3. Off-BSN system access: This part contains a detailed description of the access parameter configuration, SDK usage, and the description of public city node gateway APIs to which the off-BSN systems connect. The API section includes all APIs of the currently permissioned blockchain frameworks that BSN has adapted.

5.2 BSN Keys and Certificates Mechanism

5.2.1 BSN Keys and Certificates Mechanism

Once a publisher deploys a permissioned DApp on BSN, the off-BSN systems of all participants (including the publisher) connects to the DApp via the PCN gateways to execute and record transactions based on the DApp's smart contracts. During this process, the participants need two key pairs to complete all steps: the *DApp Access Key Pair* and *User Transaction Key Pair*. When publishing and deploying a DApp on BSN, its publisher can choose from two modes to manage the DApp's keys and certificates: *Key Trust Mode* and *Public Key Upload Mode*. The key trust mode means that the two key pairs and related certificates will be generated and hosted by BSN when a participant joins the DApp. The participant can then download the private keys from the BSN portal, and use them to access BSN and sign transactions sent to the DApp from the off-BSN systems. The public key upload mode means that the two key pairs will be generated and stored locally on the participant's off-BSN system, and the public key is uploaded via the BSN portal or PCN gateway API, to BSN to generate the certificates. Once a mode is selected for the DApp, it cannot be changed. We strongly suggest all developers use the public key upload mode which is much more flexible and secure.

1. DApp Access Key Pair based on Key Trust Mode: DApp access key pair is used to generate the certificate to access the PCN gateway. If the DApp is on Key Trust Mode, the key pair can be generated on the BSN portal, and the private key can be downloaded. Please refer to the BSN Help Manual's service participation section.
2. User Transaction Key Pair based on Key Trust Mode: User transaction key pair is used to verify the requests and transactions sent to the DApp. If the DApp is on Key Trust mode, the key pair can be generated via the PCN gateway APIs by executing requests from the off-BSN systems. If the off-BSN systems have sub-users, it can even generate different key pairs for different sub-users. Refer to the API sections in this document for Hyperledger Fabric and FISCO BCOS frameworks to see how to generate the key pairs and use them to verify the transactions.
3. DApp Access Key Pair based on Public Key Upload Mode: In this mode, the DApp access key pair is generated and stored locally. The participant must upload the public key to BSN via the BSN portal to generate the access certificate to the PCN gateway. Please refer to section 5.2.2 below to see how to generate the key pair locally. Please refer to the "Public Key Upload" section of this document to learn how to upload the public key to BSN via the portal.
4. User Transaction Key Pair based on Public Key Upload Mode: In this mode, the

user transaction key pair is also generated and stored locally. Instead of using the BSN portal, the user transaction public key (one of the pair) is sent and registered on BSN via the PCN gateway certificate registration API. If the off-BSN systems have sub-users, they can also upload different public keys to generate different transaction certificates for different sub-users by using the API. Please refer to section 5.2.2 or the instructions inside the gateway SDK package about generating the key pair locally. Refer to the API sections in this document for registering the certificate via gateway APIs.

Please click the link to download the PCN Gateway SDK Package:

https://github.com/BSNDA/PCNGateway-Go-SDK

https://github.com/BSNDA/PCNGateway-Java-SDK

https://github.com/BSNDA/PCNGateway-PY-SDK

https://github.com/BSNDA/PCNGateway-CSharp-SDK

Currently, both permissioned frameworks Hyperledger Fabric and FISCO BCOS DApps support both Key Trust Mode and Public Key Upload Mode.

5.2.2 Locally generate the DApp access key pair

If the DApp service you participate in adopts Public Key Upload Mode for its application access key, you will need to generate the pair of public and private keys on the local client then save the private key locally and upload the public key to BSN via the portal.

It is recommended to use the latest version of OpenSSL to generate the keys. Please use the **prime256v1** cryptographic algorithm for Hyperledger Fabric and**secp256k1** for FISCO BCOS. The steps are as follows:

1. Preparation: Download the latest version of OpenSSL from https://www.openssl.org/source/ and create a data.txt file in which some test phrases are entered, such as - Hello world.
2. Input "OpenSSL" in the terminal to show the open SSL command line.

   OpenSSL>
3. Input the command - "ecparam -name **prime256v1** -genkey -out key.pem" to generate a private key file key.pem.

   OpenSSL> ecparam -name **prime256v1** -genkey -out key.pem
4. Input the command - "ec -in key.pem -pubout -out pub.pem" to generate a public key file pub.pem with the private key in the key.pem file.

   OpenSSL> ec -in key.pem -pubout -out pub.pem

   read EC key

   writing EC key

5. Input the command - "dgst -sha256 -sign key.pem -out signature.bin data.txt" to sign the data.txt file with the private key in the key.pem file to generate the signature file: signature.bin.

   OpenSSL> dgst -sha256 -sign key.pem -out signature.bin data.txt

6. Input the command - "dgst -verify pub.pem -sha256 -signature signature.bin data.txt". Use the public key in the pub.pem file to sign and verify the data.txt and signature.bin files.

   OpenSSL> dgst -verify pub.pem -sha256 -signature signature.bin data.txt

   Verified OK

7. If "Verified OK" is displayed, input the command - "base64 -in signature.bin -out signature64.txt" to convert the signature file signature.bin to base64 encoded signature64.txt.

   OpenSSL> base64 -in signature.bin -out signature64.txt

8. Input the command - "pkcs8 -topk8 -inform PEM -in key.pem -outform PEM -nocrypt -out keypkcs8.pem" to convert the private key in the key.pem file to pkcs8 format.

   OpenSSL> pkcs8 -topk8 -inform PEM -in key.pem -outform PEM -nocrypt -out keypkcs8.pem

9. Save the keypkcs8.pem file locally and copy all the contents of pub.pem, data.txt, and signature64.txt to the public key, test data, and signature data text boxes respectively on the Public Key Upload Mode page to verify the public key and submit it to BSN.

5.3 DApp Services Publication and Participation

5.3.1 Overview

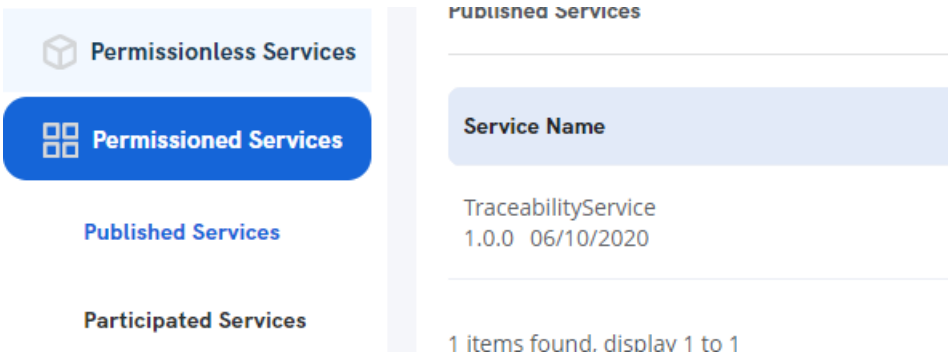
Permissioned DApp services refer to blockchain and DLT applications that are already deployed and operational on BSN. Users can use a BSN portal or the publisher's business system to apply to and join the service. Published services are private and cannot be browsed or searched by users through the BSN portal. DApp service participation must be initialized by the publishers' invitation links.

5.3.2 DApp Services Publication

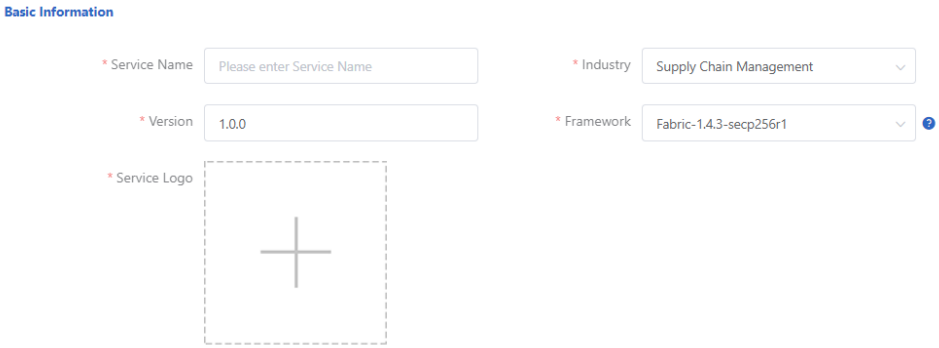
5.3.2.1 Create a New DApp Service

To create a new DApp service, follow these steps

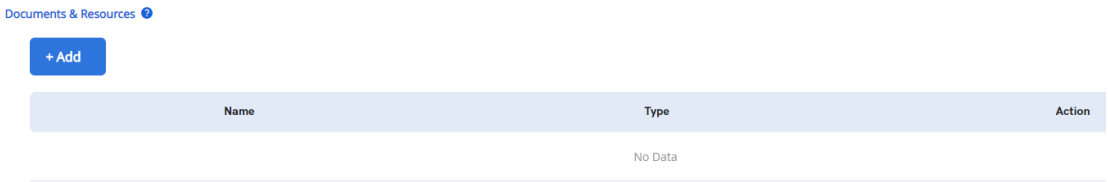
1. In the **BSN** menu, click the **Permissioned Services** dropdown, in the list, click **Published Services** to open the **Published Services** page.



2. On the published services page, click the **Create Service** button.
3. In the **Basic Information** section enter or select the following:
   - **Service Name** – Enter an applicable name for the service to be provided
   - **Industry** – In the dropdown select from the various available service types
   - **Version** – The default version 1.0.0 is entered automatically. Unless necessary, leave it as is.
   - **Framework** – Select from **Fabric-1.4.3-secp256r1**, **FISCO-2.4-secp256k1** or **Fabric-2.3.2-secp256r1**
   - **Service Logo** – Click on the icon to locate the image on your PC. Note that the image must be in png/jpg/jpeg format and should be exactly 160 x 160 pixels.



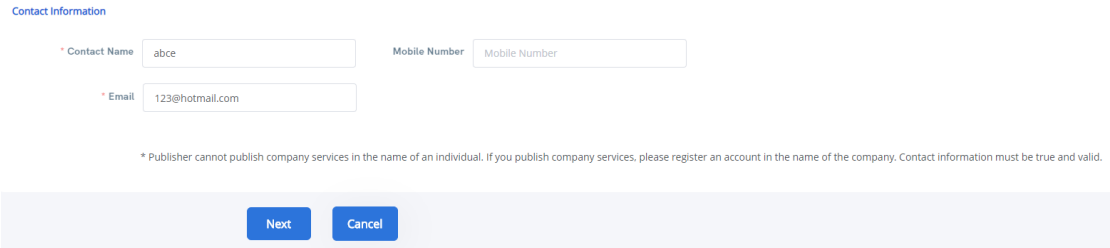
   - **Service Introduction** – Enter a brief description of the service
   - **Service Description** – Enter a detailed description of the service including text and pictures where applicable
4. **Documents** – Documents can be added so that other users can easily understand your product. Click **Add** to display the **Add Document** dialog box. Click **Select** to locate the document on your PC.



Enter a **Name**, and choose a **Type** for the document. Click **Confirm** to add the

document.

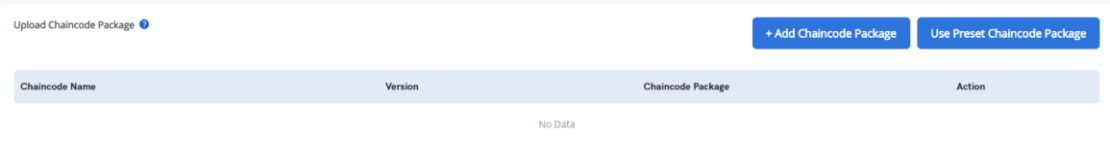
5. In the **Contact Information section**, the login details of the user are automatically populated, including the **Contacts** and **Email**. If necessary, you can add a telephone number.



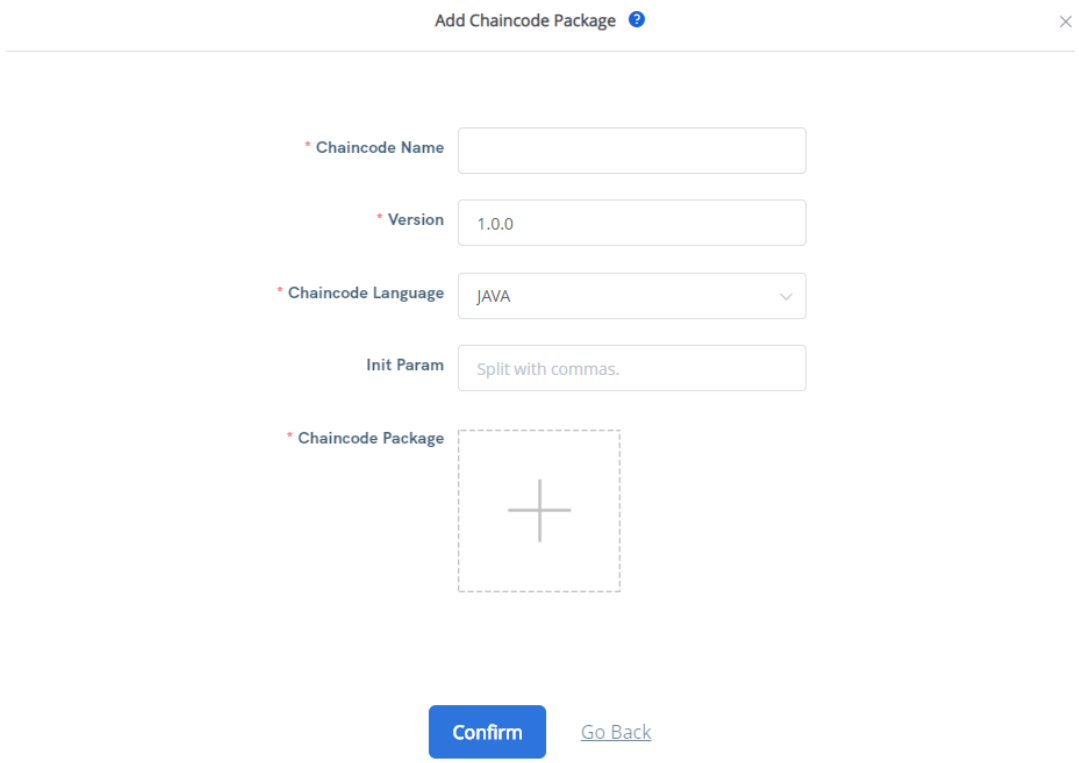
6. Click **Next** to continue.

5.3.2.2 Upload Chaincode Package

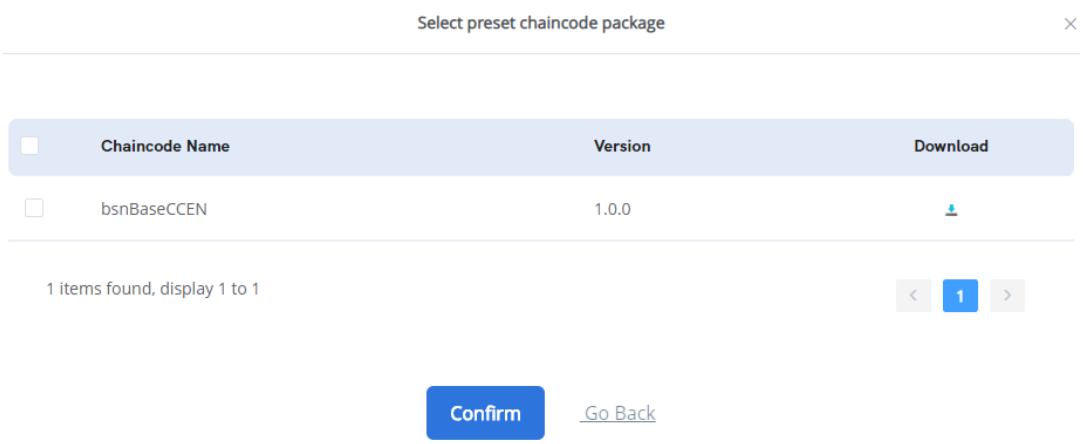
In the **Upload Chaincode Package** section, you can add your chaincode/smart contract package or use the preset chaincodes available in the system.



1. To **Add Chaincode Package,** click on the button to display the **Add Chaincode Package** where you enter or select the following:
   - **Chaincode Name** – Enter a name for the chaincode
   - **Version** – Enter the chaincode version
   - **Chaincode Language** – Select from one the languages (Java, Golang or NodeJS)
   - **Initparam** – enter the initialization parameters and if multiple, separate it with commas
   - **Chaincode Package** – Click on the icon to select the package file from the PC. Package files are to be in the .zip file format and the file name should only contain letters and numbers or underscores

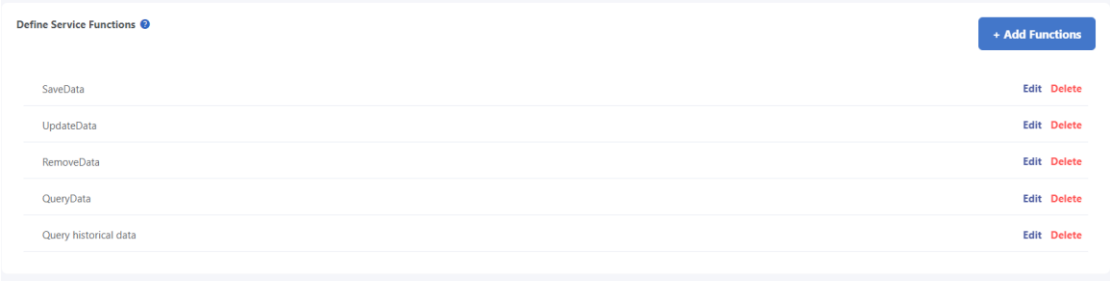


2. To **Use Preset Chaincode Package**, click on the button to display the **Select preset chaincode package** option. In the list of packages, select one of the listed packages and click **Confirm** to add it.

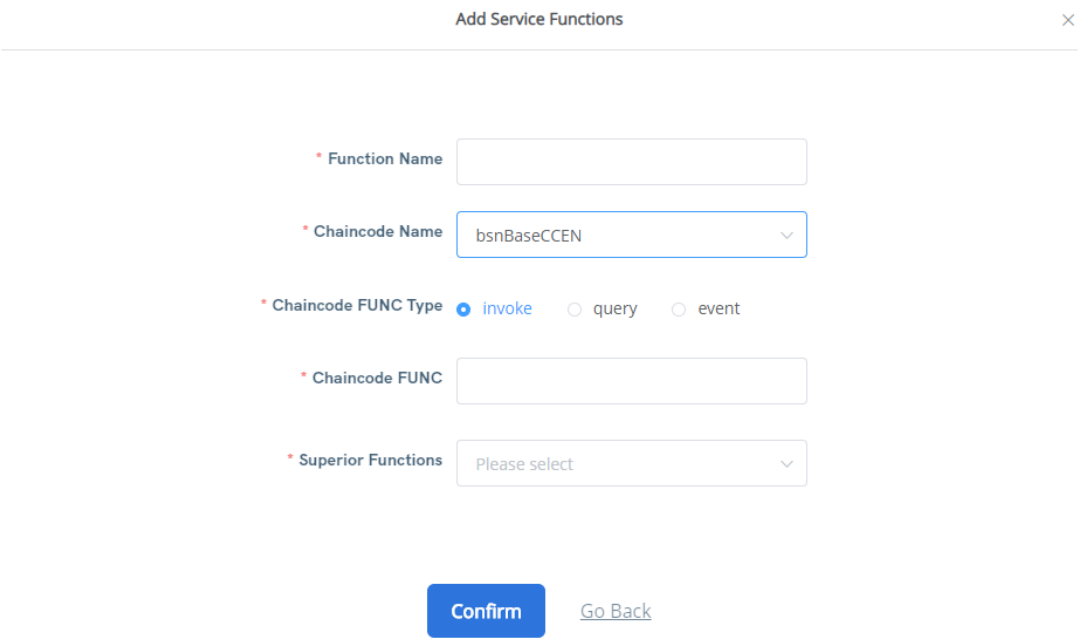


5.3.2.3 Define Service Functions and Roles

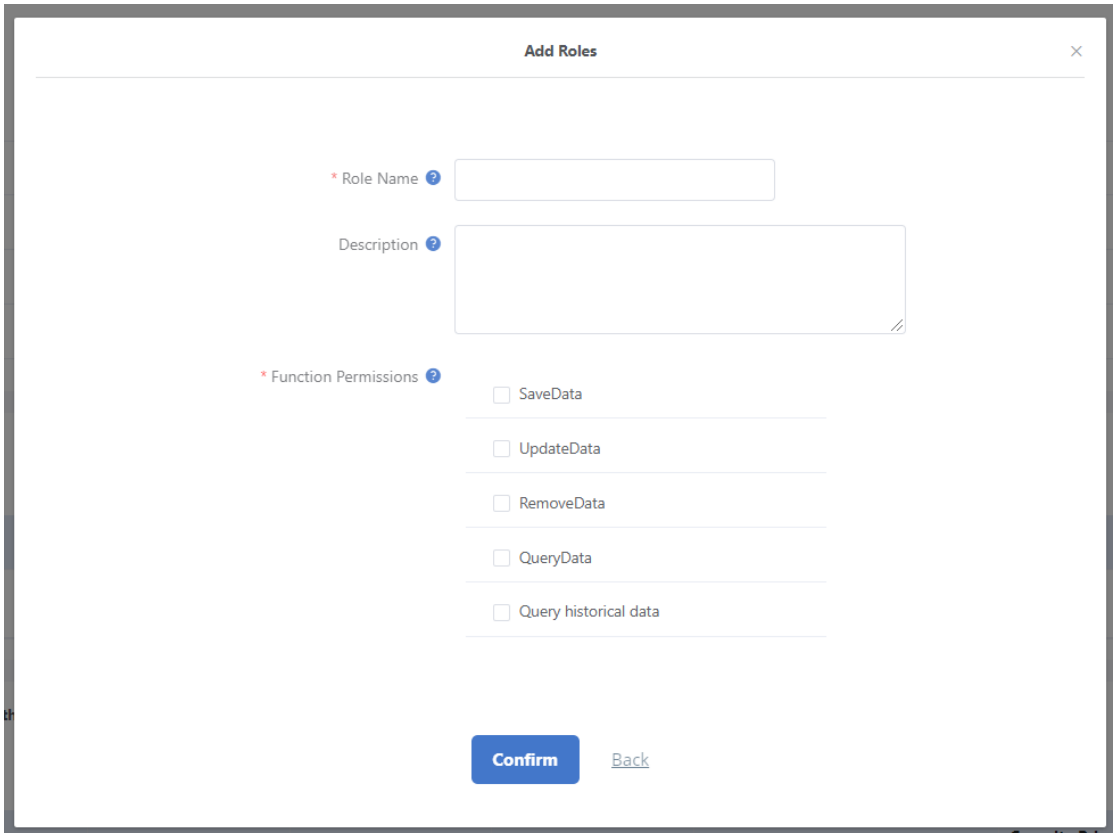
1. By selecting a **Preset Chaincode Package**, a set of automatic service functions are added to the service and each of the functions can be **Edited** or **Deleted**.



2. If you wish to add more functions, click the **Add Functions** button to display the dialog box. In it, enter or select the following:
   - **Function Name** – Enter a name for the function
   - **Chaincode Name** – Select from the list of chain codes
   - **Chaincode FUNC type** – Choose from **invoke**, **query** or **event**
   - **Chaincode FUNC** – Enter a description of the function
   - **Superior Functions** – Select a function from the list of functions in the system



3. Click **Confirm** to add it to the functions.
4. When the **Use Preset Chaincode package** is selected, a system administrator role is automatically created with full access to the published service. To create another role, Click **Add Roles** to display the **Add Roles** function and enter or select the following:
   - **Role Name –** Enter a role name
   - **Description –** Enter a description for the role
   - **Function Permissions** –Choose one or more from the DApp's existing functions, for example: **SaveData, UpdateData, RemoveData, QueryData,** and **Query historical data** from the **Preset Chaincode Package.**

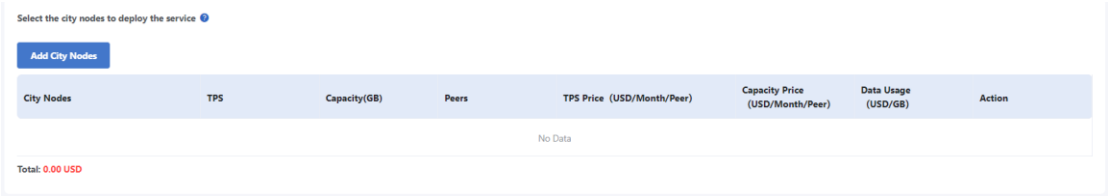


5. When done, click **Confirm** to add the role.

5.3.2.4 Select the Public City Nodes to deploy the service

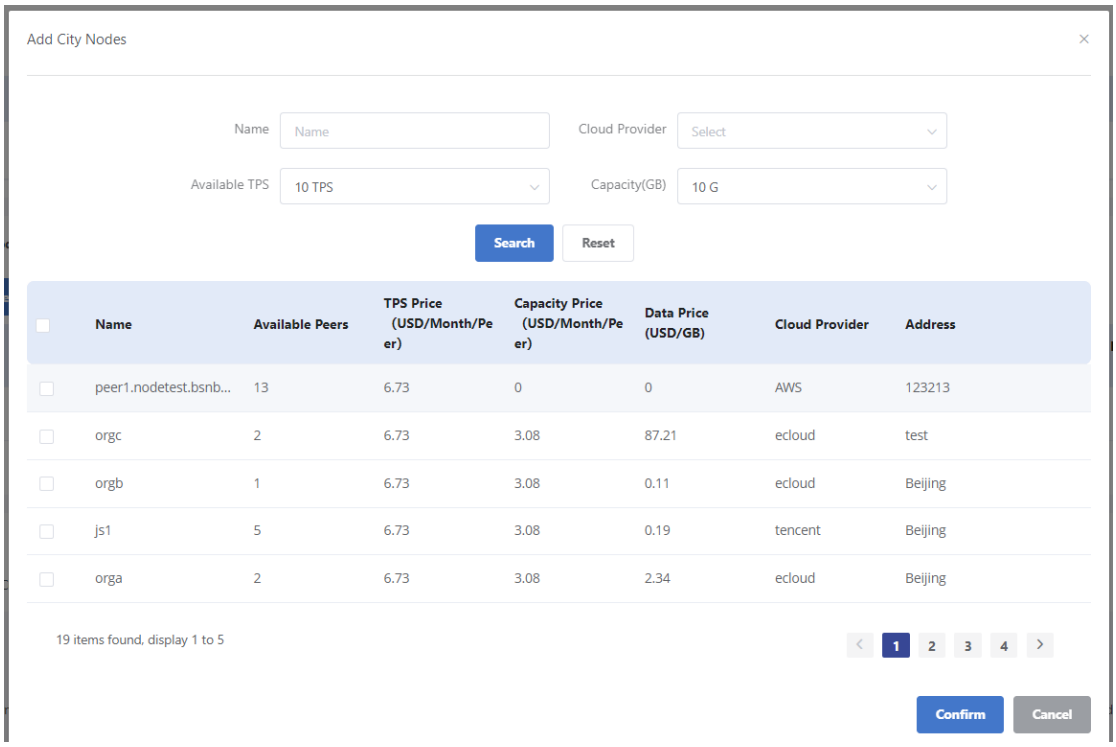
Public city nodes are used by permissioned DApp publishers to deploy DApp's peers and smart contracts. Publishers can deploy all peers into one or more PCNs, so that all peers connect together to form the DApp. We strongly suggest not to deploy all peers onto one single PCN for data safety reasons. To add a public city node, follow these steps

1. In the **Select the City Nodes to deploy the service** section, click **Add City Nodes.**



2. In the **Add City Nodes** window, enter or select:
   - **Name –** Enter a name for the city code
   - **Capacity (GB) –** 10 GB is allocated by default
   - **Available TPS –** 10 is allocated by default
   - **Cloud Provider –** All carriers are listed, however, if you prefer a particular carrier, click the dropdown and select that carrier
3. Click **Search** to list cloud providers.

4. In the list of carriers, select more than one carrier for redundancy purposes. When done, click **Confirm**.



The city nodes that have enough resources according to the TPS and storage configuration are displayed alongside their costs. The resource costs are different for each public city node.

5.3.2.5 Select Certificate Mode

There are two certificate modes, **Key Trust Mode** and **Public Key Upload Mode.** The key trust mode certificates are generated and hosted by BSN while the public key upload mode certificates are generated by developers, and the private key is stored locally and the public key is uploaded to BSN. It is recommended that all developers use the **Public Key Upload Mode.**

1. To use the certificate mode, in the **Certificate Mode** section, click either **Key Trust Mode** or **Public Key Upload Mode**.

2. Click **Next** to continue.

5.3.2.6 Pay bills and submit for approval

In the bill detail section, the resource usage fees from the added city nodes are displayed alongside a monthly total payment fee. If the bill is satisfactory, click the **Confirm** button to proceed and make the payment. However, if you need to make changes to the bill, click **Back** and make changes in the **Add City Nodes** section.

Billing Summary

City Nodes	TPS	Capacity(GB)	Peers	Data Usage (USD/GB)	TPS Price (USD/Month/Peer)	Capacity Price (USD/Month/Peer)
orgc	10	10	1	87.21	6.73	3.08
orgb			1	0.11	6.73	3.08
js1			1	0.19	6.73	3.08

Total Amount: 112.59 USD Per Month 1228.53 USD Per Year (Discounts 122.55 USD)

Once the payment is successfully made, you will receive an email in your mailbox informing you that your BSN service has been submitted successfully and will be reviewed. You will be informed via email when the reviewed has finished.

Once the service has been approved, the service will be seen in the **Published Services** section.

Published Services

Service Name	Framework	Participants	Status	Payment Status	Action
PolyCrossChain 1.0.1 02/03/2021	Fabric-1.4.3-secp256r1	1	Published	Paid	•••

5.3.3 DApp Services Management

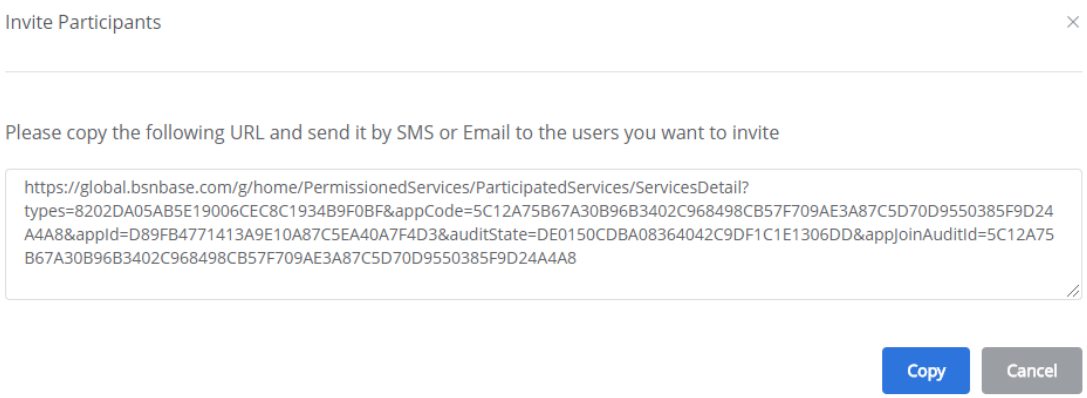
After the request for a service approval has been given, it will be listed in the Permissioned Services - **Published Services** section. For each listed service some Actions can be carried out. This includes **Invite Participants, Edit Basic Information, Service Upgrade, Configuration Upgrade** and **Details**.

5.3.3.1 Invite Participants

After the service has been approved and the service is in use, you can invite other users of the blockchain network to participate in your service. To invite participants, follow these steps:

1. In the **BSN** menu, click the **Permissioned Services** dropdown and click **Published Services** to display the list of published services.
2. In the **Action** column, select the **Invite Participants** link to display the details to send to participants who intend to join the service.

Click **Copy** to copy the link details. This can be emailed to the participants who login with their BSN credentials to join or register with BSN first to use the service.



5.3.3.2 Edit Basic Information

After the service has been running and participants have joined, the publisher can edit basic information regarding the service including **Service Name, Industry, Framework, Version, Service Logo, Documents**, and **Contact Information.** To edit the basic information, follow these steps:

1. In the list of published services, locate the service to be edited. In the **Action** column of the service, select **Edit Basic Information** to display the editing page.
2. Add, edit or remove the basic detail of the service and click **Save** to store changes. If no changes were made click **Back** to return to the **Published Services** page.

5.3.3.3 Service Upgrade

After a service has been published, the publisher can use the **Service Upgrade** option to update the smart contracts and other functions. It will be reviewed again before it can be used. To edit the **Service Upgrade**, follow these steps:

1. In the list of published services, locate the service to be edited. In the **Action** column of the service, choose **Service Upgrade.**
2. In the **Basic Information** page, change the **Version Number**, which is mandatory and/or any other details in the **Basic Information** page. Click **Next** to upload the new smart contracts and set functions and roles as described before.

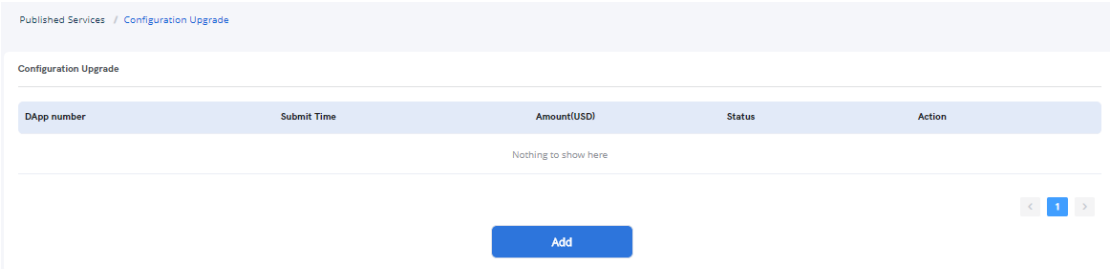
When done, click **Confirm**

5.3.3.4 Configuration Upgrade

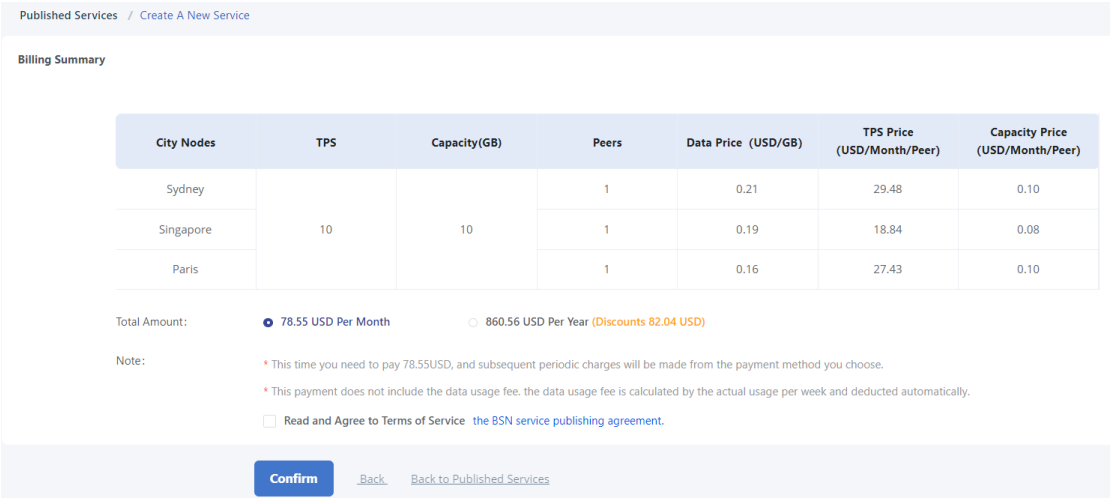
In order to join the DApp services, the publisher should send out invitation links to the potential participant. The potential participant can then click on the link to the services' main page and apply for the service.

To upgrade the configuration, follow these steps:

1. Go to **Published Services** and select the enabled service on the list. Click **configuration upgrade** to enter the configuration upgrade list page as below:



2. Click **Add** to create a configuration upgrade application form, and then click **Add city nodes** to add new city nodes:



3. Click **Submit** to submit the configuration upgrade application. When submitting, the system will prompt the publisher to pay the corresponding configuration upgrade fee. After the publisher confirms, the system generates the configuration upgrade bill and deducts money from the user's credit card. Whether the payment is successfully charged, or not, the configuration upgrade application will go through the review process. If the payment is successfully charged and the application is approved, the system will conduct a configuration upgrade process and complete the upgrade; if the charge fails, the bill will be kept for 72 hours and then expires. If the publisher still wants to upgrade the configuration, he/she needs to apply again.

Note: The fee paid when configuring the upgrade is the upgrade fee, which makes up the difference in the remaining payment period between the pre-upgrade configuration and the post-upgrade configuration of the billing cycle. After the upgrade is successful, future charges will be made according to the new configuration from the next period.

5.3.3.5 Details

The **View** option allows the publisher to view all the details of the published service including **Basic Information**, **Chaincode and Deployment**, **Roles, Review Records**, **Operating Status**, **Comments/Inquiries**, and **Historical Version.** To view these options, follow these steps:

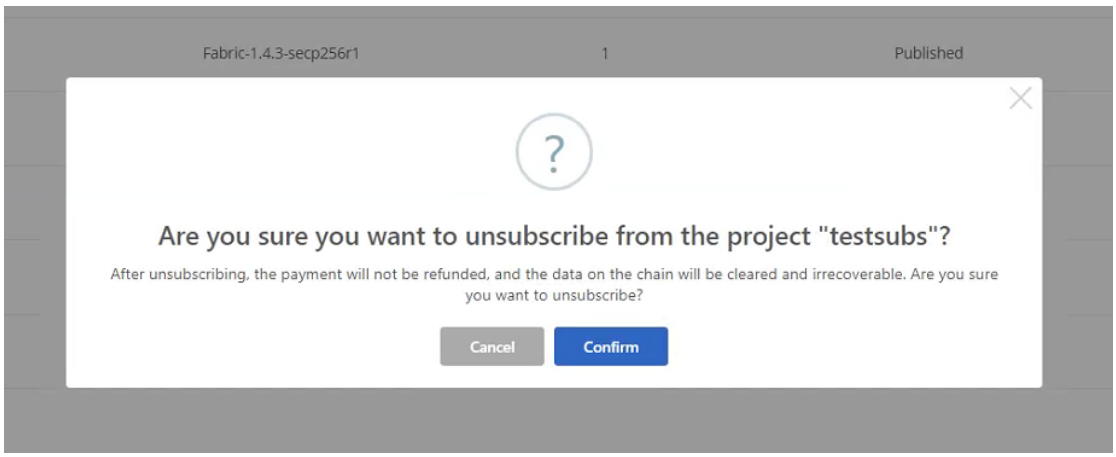
1. In the list of published services, locate the service to be edited. In the **Action**

column of the service, click **Details** to display the view page tabs.

2. In the **Basic Information** tab, you can see all the details of the service that has been deployed including the **Service Name**, **Industry**, **Version**, **Framework**, **Service Logo**, **Service Introduction, Service Description, Documents,** and **Contact Information.**
3. In the **Chaincode and Deployment** tab, the information that can be viewed includes the **Chaincode Package**, **Service Functions**, and **City Nodes**.
4. In the **Roles** tab, the roles and their related functions are listed. To **View** a role, click on the **view** link for that role name.
5. In the **Review Records** tab**,** you will see all the requested approval and their status as well as time logs.
6. The **Operating Status** tab shows more information about the published service than any other tab. It shows the parameters of **City Nodes**, **number of transactions, Peer Information, Chaincodes, Blocks**, and **Logs** of how the activities took place.
7. The **Comments/Inquiries** tab shows the comments made on the published service that can be viewed by the publisher.
8. The **Historical Version** tab shows the history of the service including the **Service Name, Version, Industry, Service Introduction,** and **Action.**

5.3.3.6 Service Unsubscribe

Users can unsubscribe published services. Click **Unsubscribe** in the published service list.



For users whose service resources are paid monthly, no refund will be generated when they unsubscribe; for users whose service resources are paid annually, refunds will be made at the point of time from the next month to the end of the billing cycle, and the refundable month will be cancelled when the refund is made, and the refund will be tallied according to the actual remaining months.

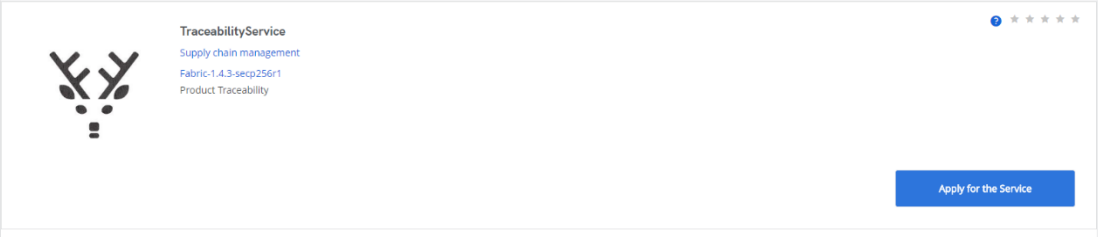
5.3.4 DApp Services Participation

In order to join the DApp service, the publisher should send out invitation links to the potential participant. The potential participant can then click on the link to the services' main page and apply for the service.

5.3.4.1 Apply for a Service

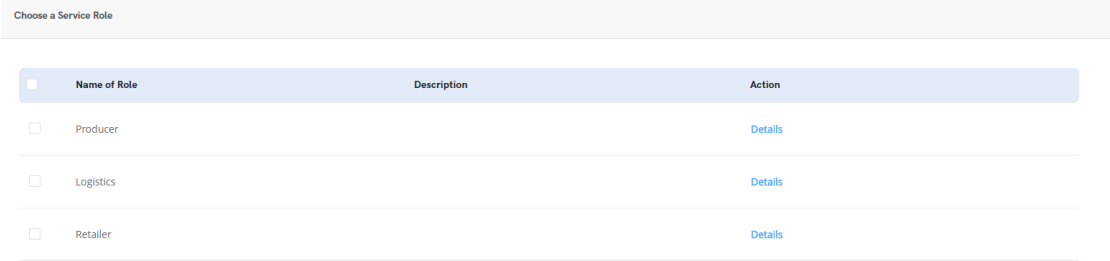
To apply for a service, follow these steps:

1. Click the link that was shared. This will take you to the service information page.
2. In the service header, click **Apply for the Service**.

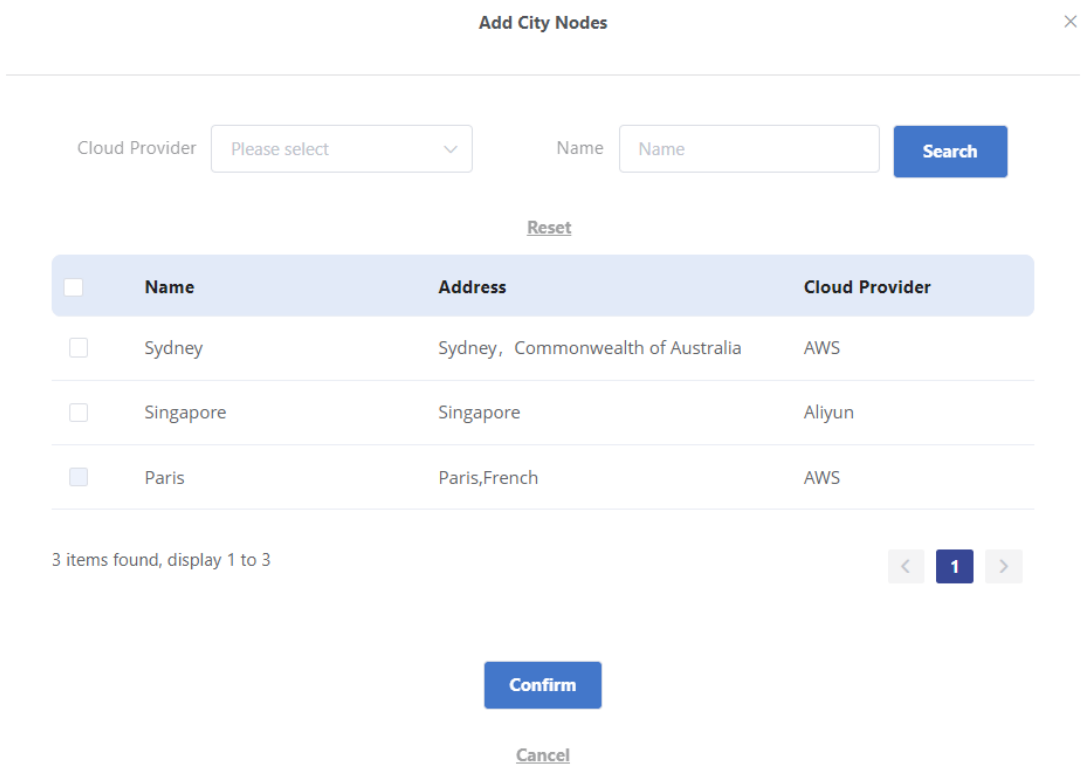


5.3.4.2 Select Roles and City Nodes

1. In the list of roles, select a role you want to use. You can click the **View** link in each of the roles to see more details about the role. You can select more than one role.



2. In the Public **City nodes**, click **Add city nodes** to display the Public City Nodes the DApp is deployed on. You can select more than one node. The selected nodes' gateways are where the off-BSN systems connect to. Please select the public city node that is closest to you.

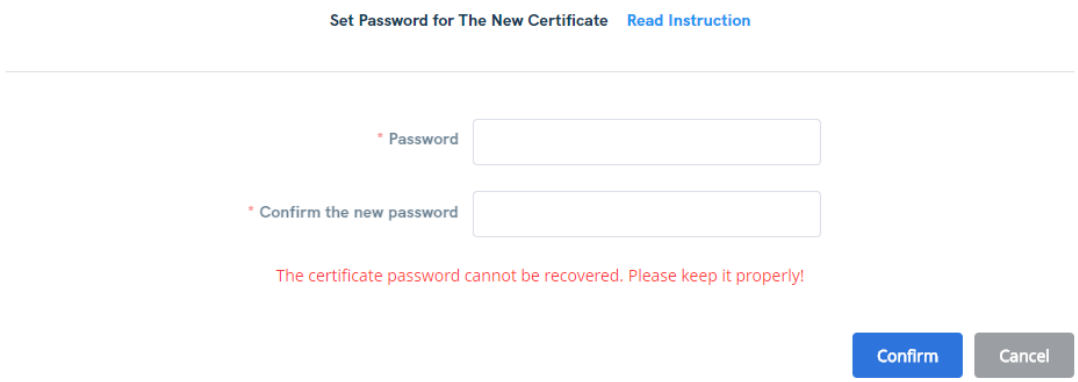


Click **Confirm** to view the nodes that were selected.

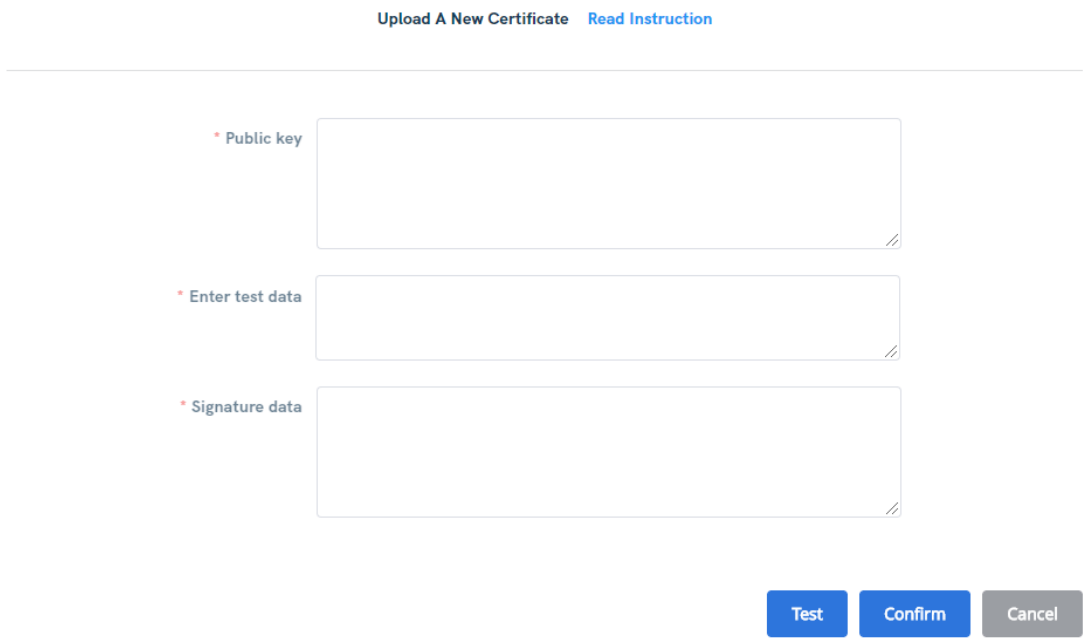
5.3.4.3 Apply Certificate Mode

Depending on the settings of the service publisher, there are two certificate modes for service participation: Key Trust Mode and Public Key Upload Mode.

Key Trust Mode: Participants can select existing certificates on the city node or apply for a new certificate.

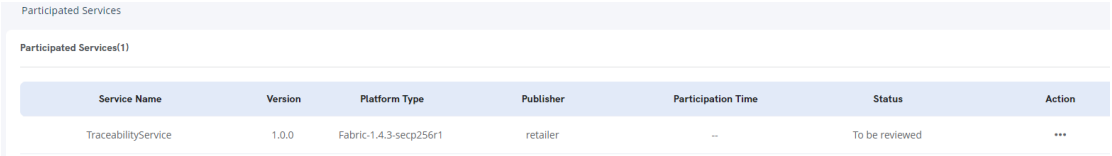


Public Key Upload Mode: Participants should upload the public key, test data and signature data. The generation of public and private keys can be viewed by clicking **Read Instruction**.



5.3.4.4 Submit for approval

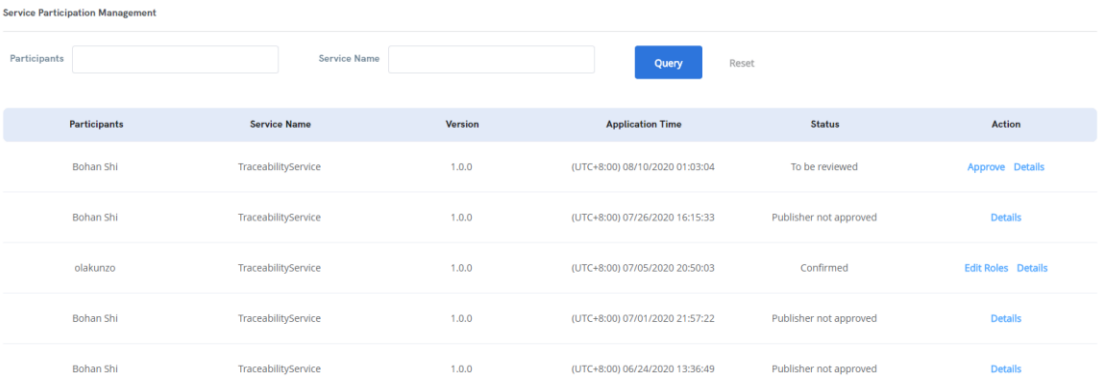
Click **Confirm** to join the service pending the **publisher's approval**.



5.3.4.5 Approve the Request

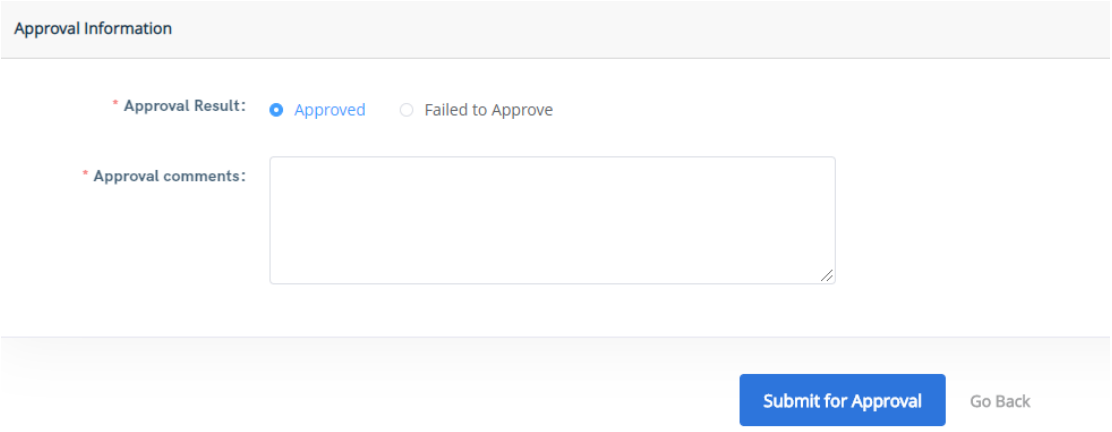
As the publisher of a service, in the **Participation Management** list, the publisher can approve, deny or disable a participant from using the service. To perform any of these actions, follow these steps:

1. In the **Participation Management** section, locate the participant to review.



2. For the participant to be reviewed, click the **Review** link in the **Action** column to view the participant details. In the **Review Result** section select either **Approved** or **Not Approved** and write a comment in the **Comment** box to give details.

3. Click **Confirm** or **Back** to return to the participant's list.



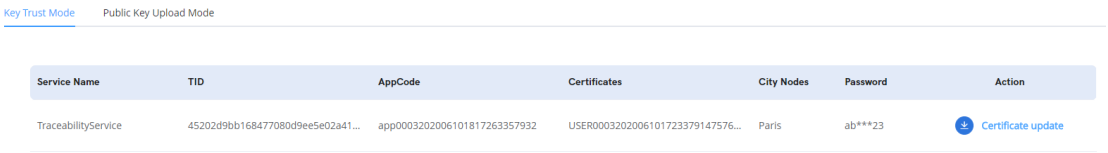
4. If the participant is approved, a message will prompt showing that the service participation approval was successful.
5. After the approval has been given, the participant can view the service from their **Participated Services** page as well as add more **city nodes**.

5.3.4.6 Download and renew a certificate

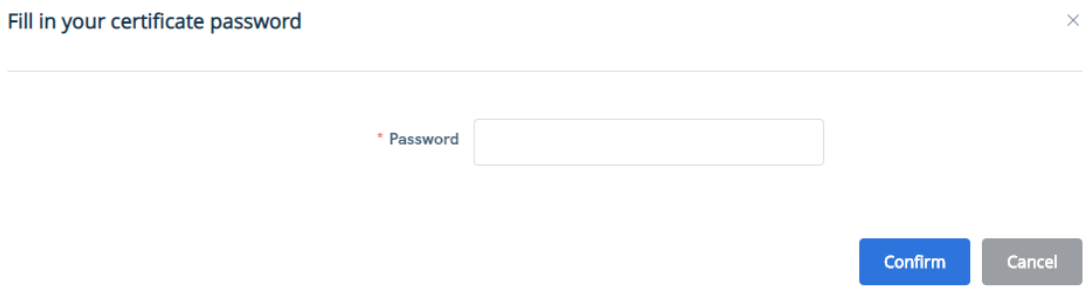
The BSN development team intends to build BSN into a most secure blockchain infrastructure network. The certificate and key mechanisms of BSN are complex. There are two kinds of key pairs used in generating certificates: DApp Access Key Pair and User Transaction Key Pair. For each, there are two modes, the Key Trust Mode and the Public Key Upload Mode. To work with certificates, follow these steps:

Key Trust Mode:

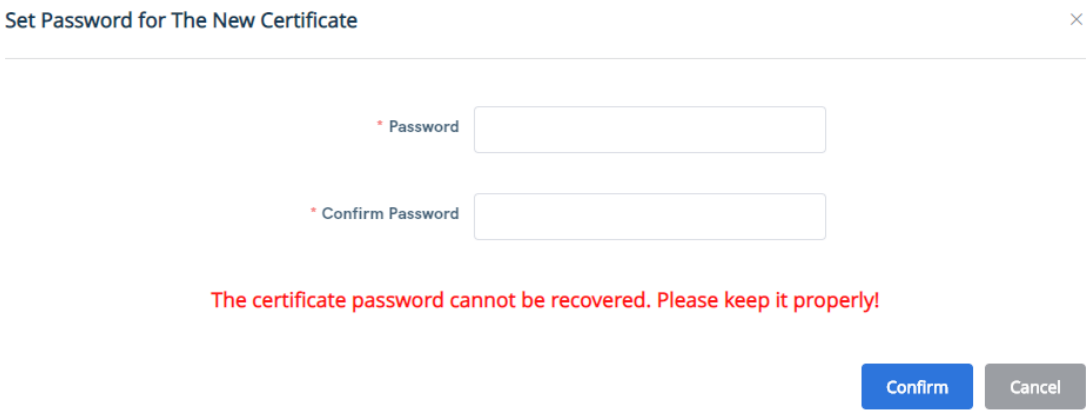
1. In the **My Certificates** menu, click **Key Trust Mode**. The certificate page will be displayed.



2. To download the certificate, click the  icon. You will be required to enter the certificate password.



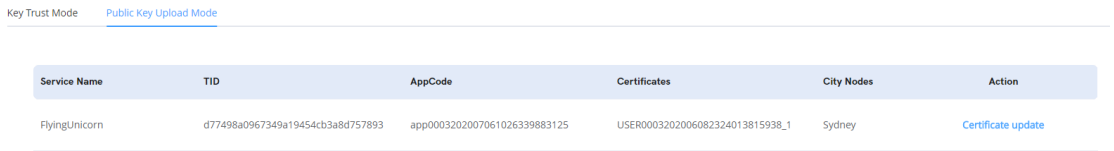
3. To update the certificate, click the **Certificate update** link. You will be requested to set a password for the certificate and confirm the password.



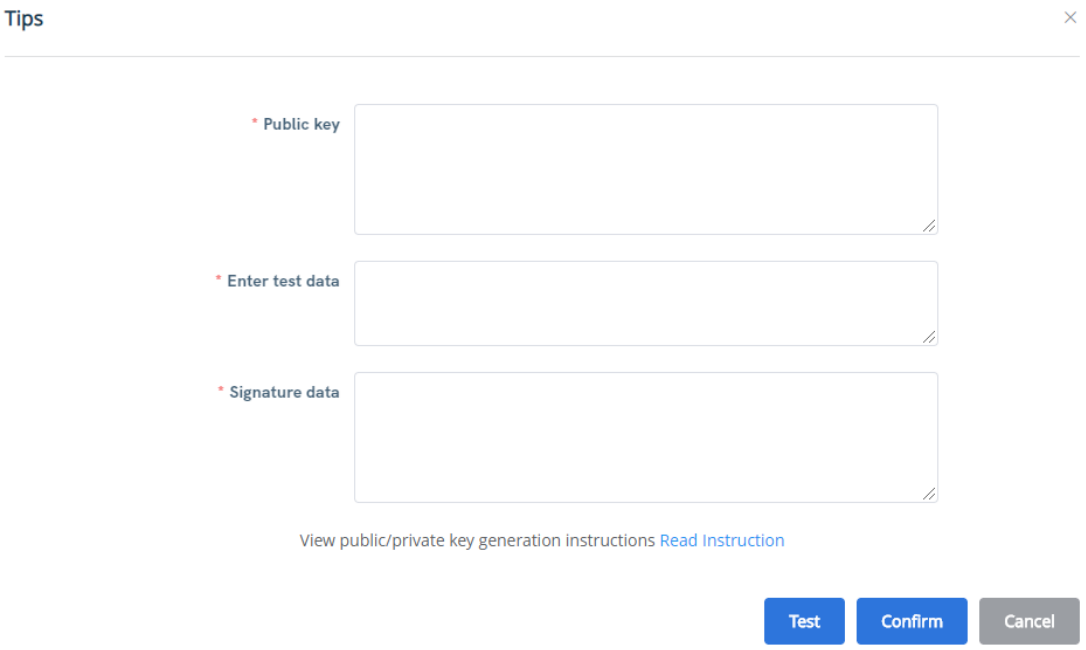
4. Click **Confirm** to update the certificate.

Public Key Upload Mode:

1. In the **My Certificates** menu, click **Public Key Upload Mode**. The certificate page will be displayed.



2. To update the certificate, the public key, test data and signature data need to be re-uploaded, and the update can only be completed after the test passes.

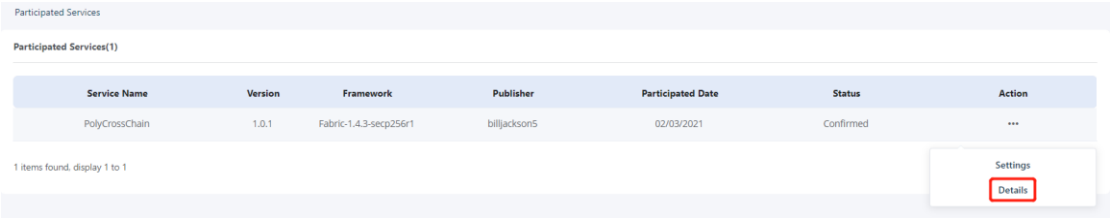


3. The user only needs to upload the public key in the Public Key Upload Mode. The private key is kept locally by the user, so there is no need to download the certificate.

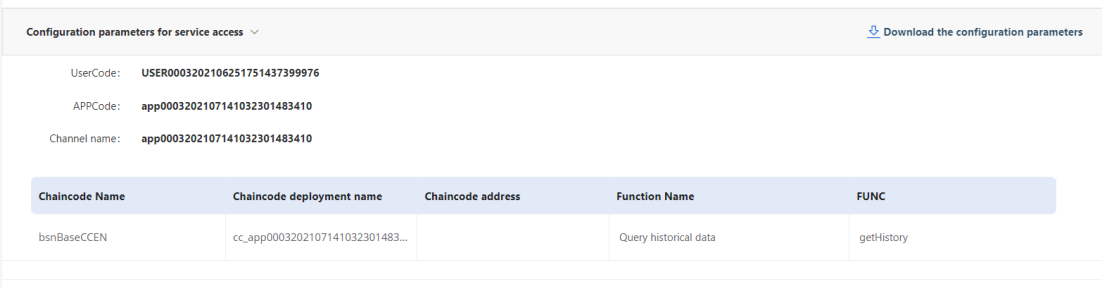
5.3.4.7 Configuration parameters for service access

To view and download the configuration parameters, follow these steps:

1. In the **Permissioned Services** menu, click **Participated Services**.
2. In the list of services, click the **Detail** option in the **Action** column for the service.



3. Click the dropdown beside the **configuration parameters for service access** to view its configuration.



4. To download the **parameters for service access**, click **Download the configuration parameters** to begin the download.

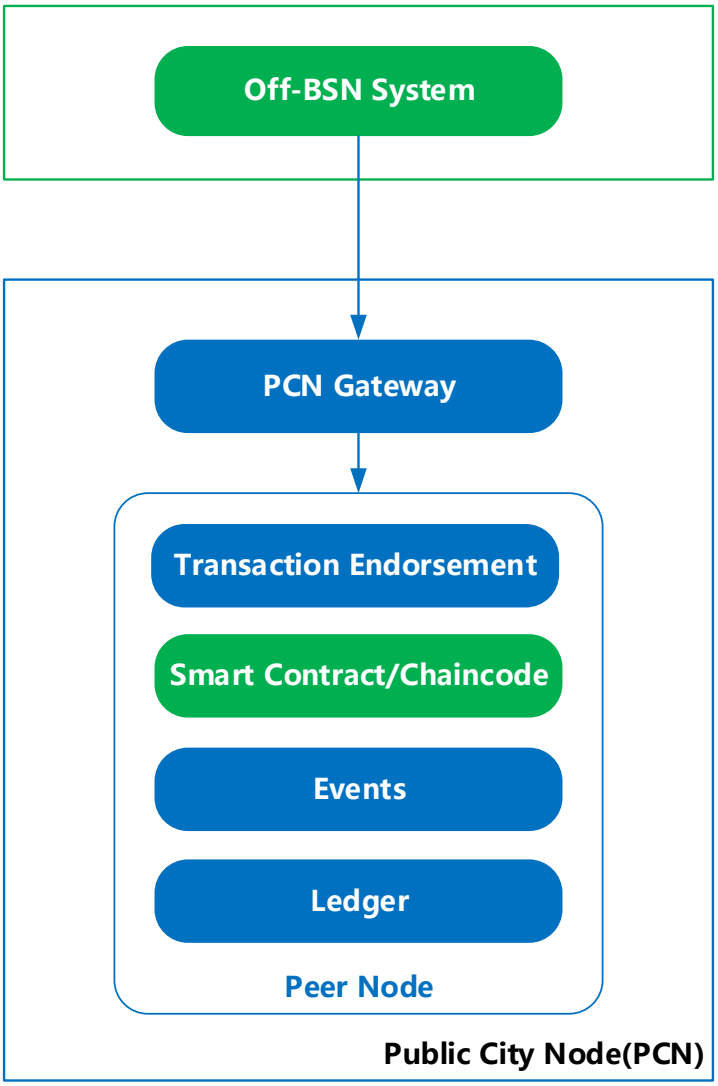
5.4 Off-BSN System Access Guide

5.4.1 Overview

Blockchain-based Service Network (hereinafter "Service Network" or "BSN") is a cross-cloud, cross-portal, cross-framework global infrastructure network to deploy and operate all types of blockchain and distributed ledger technology (DLT) applications (DApp).

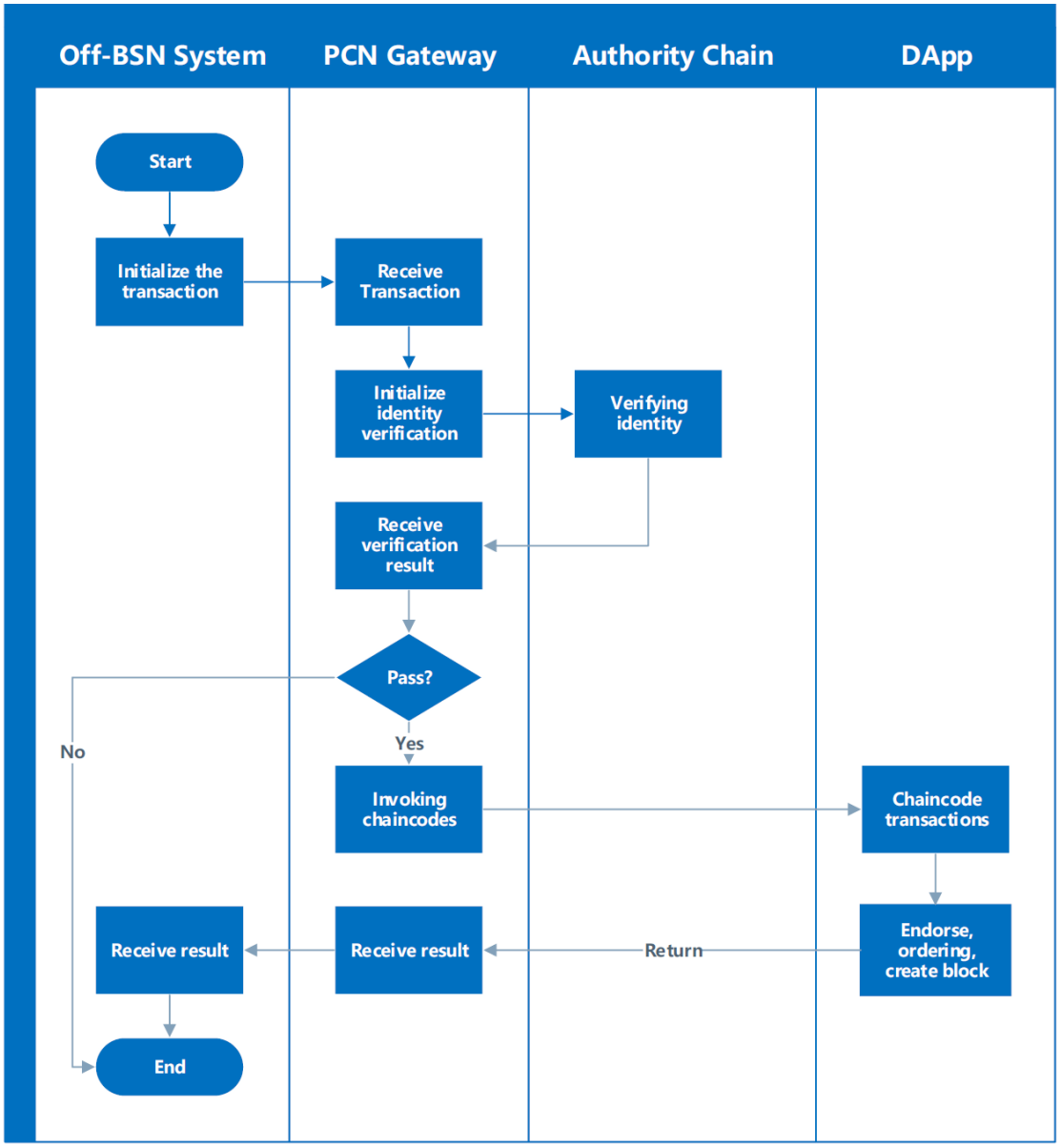
BSN aims to lower the cost of developing and deploying DApps by providing public blockchain resources and environment to developers, just like the internet. It can further reduce the costs associated with the development, deployment, operations, maintenance, and regulation of DApps and, thereby, accelerate the development and universal adaptation of blockchain and DLT technologies.

A complete DApp system based on BSN generally consists of two parts: the on-BSN DApp smart contracts and the off-BSN systems. The off-BSN systems use the BSN Public City Note (PCN) gateways to invoke the DApp smart contracts deployed on the PCN to carry out on-chain operations such as executing transactions, writing data chain, data queries, etc. The DApp service publishers and participants can deploy their off-BSN systems on any cloud services they choose and then connect to the BSN PCN gateways through the internet access DApp smart contracts and data.

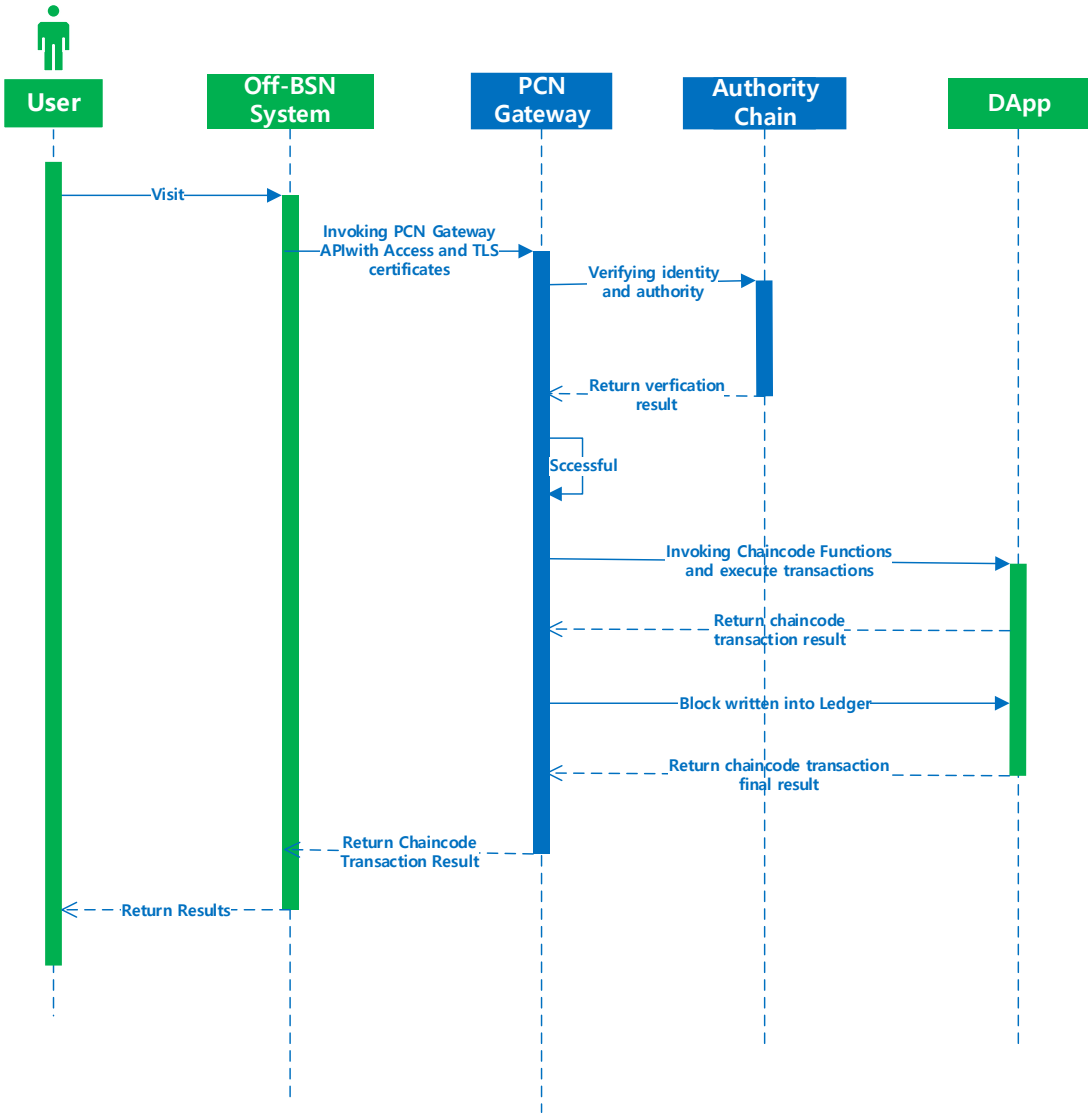


The BSN DApp service publishers and participants should have their off-BSN systems so that they can access the DApp smart contracts to execute transaction and query data via the PCN gateway APIs. The following are the charts to show the connecting flow and transaction sequences.

Off-BSN System Connection Flow:


Off-BSN System
PCN Gateway
Authority Chain
DApp
Start
Initialize the transaction
Receive Transaction
Initialize identity verification
Verifying identity
Receive verification result
Pass?
No
Yes
Invoking chaincodes
Chaincode transactions
Endorse, ordering, create block
Return
Receive result
Receive result
End

Off-BSN System calling sequence:



5.4.2 BSN Smart Contract Package Requirements

A smart contract, also known as chaincode in Hyperledger Fabric, is a computer protocol intended to digitally facilitate, verify, or enforce the negotiation or performance of a contract. Smart contracts allow the performance of credible transactions without a third party. These transactions are trackable and irreversible. A smart contract is invoked to automatically execute a transaction and operate ledger data. A DApp service on BSN can deploy multiple smart contracts. Each smart contract can contain multiple functions.

5.4.2.1 Hyperledger Fabric smart contract package requirements

Hyperledger Fabric ("Fabric") chaincode can be compiled by multiple programming languages, including Golang, java, and node.js. Each chaincode program must implement a chaincode interface which usually consists of three basic functions: Init, Invoke, and Query.

- **Init:** This function is called during the chaincode instantiation and its purpose is to prepare the ledger for future requests. This function must be implemented in all chaincodes.
- **Invoke:** The Invoke function is called for all future requests from the off-BSN systems towards the DApps. Here all DApp custom functions or what the DApps can do (for example, to read data from the ledger, to write data in the ledger, to update data, to delete data) are defined. Simply put, Invoke can be understood as an entry point to the chaincode functions. The Invoke function also must be implemented in all chaincodes.
- **Query:** The Query function provides a method of querying ledger data. This function can only be used for query purposes and does not offer any operations of ledger data. The Query function is not required to be implemented in all chaincodes.

Note: Fabric 1.4 chaincode package cannot be directly used in Fabric 2.3.2, you need to modify the contract according to the latest chaincode dependencies with the corresponding language.

To realize the automatic deployment of DApp services and to improve deployment efficiency, the following Fabric chaincode packaging requirements have been issued with different programming languages.

1. Golang

The main function must be at the same or higher level as all chaincodes in the project. The zipping path must be the same level folder where the main function is located, and the main function path is the src-based path.

Example: BsnBaseCC Package (the preset chaincode package)

```
BsnBaseCC
├─main.go
├─ChainCode/
├─models/
└─utils/
```

The package should be zipped under BsnBaseCC/ (package name is not required), and the main function path (reference path) is BsnBaseCC.

Example: FabricBaseChaincode chaincode package on github (preset chaincode package)

```
github.com
    └──BSNDA
      └──FabricBaseChaincode
        └──chaincode
          └──go
            └──bsnBaseCC
              └──main.go
              └──ChainCode/
              └──models/
              └──utils/
```

It should be zipped under github.com/BSNDA/FabricBaseChaincode/chaincode/go/bsnBaseCC/ (package name is not required), and the main function path (reference path) is github.com/BSNDA/FabricBaseChaincode/ chaincode/go/bsnBaseCC.

Description: main.go: the entry; ChainCode: chaincode; models: entities; utils: utilities.

Note: Below is the structure of the Fabric 2.3.2 preset chaincode package

```
chaincode-demo
  └──main.go
  └──chaincode/
  └──vendor/
 └──go.sum
  └──go.mod
```

2. Java

   gradle or maven-built projects, the projects must contain build.gradle or pom.xml files.

   Example: BsnBaseCC package

```
BsnBaseCC
    └──build.gradle
```

```
└──src
  └──main
    └──java
      └──com.example.javacc
        └──javacc.java
```

Package must be zipped under BsnBaseCC/, and there is no requirement for the name of .zip package.

Note: src/main/java: project directory; com.example.javacc: package name; javacc.java: chaincode information

3. Node.Js

   package.json file must be built into the project's root directory. Package needs to be zipped under the directory of BsnBaseCC/. There is no requirement of the name of .zip package.

   Example: BsnBaseCC package

```
BsnBaseCC
  └──marbles_chaincode.js
  └──package.json
```

Description: marbles_chaincode.js: chaincodes

Note: when publishing DApp services in the BSN portal, chaincode packages should be created in the project's root directory using .zip format.

5.4.2.2 Hyperledger Fabric preset smart contract package

A preset chaincode package (Golang) is provided to BSN developers which contains basic functions such as add, delete, edit, and query. New DApp developers can learn from this package about Fabric chaincode programming and further extend the functions if needed. The chaincode in this package supports data types such as string, integer, float point, and sets (map, list), etc.

Please click this link to download:

Fabric 1.4.3:

https://github.com/BSNDA/FabricBaseChaincode

Fabric 2.3.2:

https://github.com/BSNDA/FabricBaseChaincode/tree/master/chaincode/go/bsnBaseChaincode

DApp publishers can also select the preset chaincode package directly from the DApp publishing page on the BSN portal.

The Preset Chaincode package functions are as follows:

1. Add data (set)

   Input parameter description:

   baseKey: a unique primary key identifier of data

   baseValue: stored data information

   Example: {"baseKey": "str","baseValue": "this is string"}

   Of which, the baseKey cannot be a blank string and the baseValue can be any type of data. If the baseKey already exists, then directly return that it already exists and cannot be added; if it does not exist, then add data.

2. Update data (update)

   Input parameter description:

   baseKey: a unique primary key identifier of data

   baseValue: stored data information

   Example: {"baseKey": "str","baseValue": "this is string"}

   Of which, the baseKey cannot be a blank string and the baseValue can be any type of data. If the baseKey does not exist, then it cannot be updated; if it already exists, then update the data.

3. Delete data (delete)

   Input parameter description

   baseKey: a unique primary key identifier of data

   Example: "str"

   Of which, the baseKey value cannot be blank and must exist, else it cannot be deleted.

4. Get data (get)

   Input parameter description

   baseKey: a unique primary key identifier of data

   Example: "str"

   Of which, the baseKey value cannot be blank and must exist, else it cannot be retrieved.

5. Get historic data (getHistory)

   Input parameter description

   baseKey: a unique primary key identifier of data

Example: "str"

Of which, the baseKey value cannot be blank. Response results: transaction Id (txId), transaction time (txTime), whether to delete (isDelete) and transaction information (dataInfo).

We welcome developers to share their custom chaincodes as preset chaincode packages for the BSN and work with us to expand the blockchain application support capabilities of the BSN.

5.4.2.3 FISCO BCOS smart contract package requirements

To realize automatic audit and deployment of FISCO BCOS (FISCO) DApp services and to improve efficiency, the following FISCO smart contract packaging requirements have been issued:

1. Package Structure of the Solidity smart contract

All smart contracts must be stored in a single-level folder including smart contracts, libraries, and external contract interfaces. Import method of all contracts is import "./XXXX.sol".

2. Smart Contract deployment instruction document (deploy.md)

deploy.md is used to explain clearly how the smart contract is initialized and deployed. It consists of three main parts:

- Contract Description: to briefly describe the basic information of each contract.
- User Description: to describe the basic information of each transaction signing users during initialization and deployment.
- Contract initialization description: to describe the steps of smart contract initialization and deployment, so that BSN tech personnel can follow to complete the process.

3. Contract uploading specifications

When uploading a chaincode package (smart contract package), fill in the chaincode name (contract name) that is consistent with the main contract class name and the main contract file name.

Example: BsnBaseGlobalContract chaincode package (preset chaincode package)

```
BsnBaseGlobalContract
    └──BsnBaseGlobalContract.sol
    └──Table.sol
```

Package must be zipped under BsnBaseGlobalContract/. The zipped package name is not required. If the main contract class name is BsnBaseGlobalContract, the main contract file name should be BsnBaseGlobalContract.sol, and the chaincode name (contract name) must be filled in as BsnBaseGlobalContract.

4. BSN Adaptation for FISCO Solidity Version Descriptions

Currently, FISCO BCOS in the BSN only supports Solidity 0.4.25 and older versions.

5.4.2.4 FISCO BCOS preset smart contract package

The FISCO Preset Smart Contract package is chosen from the Table.sol provided by the FISCO BCOS development team, and can provide developers with basic functions such as insert, remove, update, or query (using Solidity). New DApp developers can learn from this package

about FISCO smart contract programming and further extend the functions, if needed. The stored data types supported by this smart contract include int256(int), address, and string, of which string cannot exceed 16MB. To ensure on-chain performance, there is no analysis of duplicate base_id and base_key. This should be handled by the off-BSN system. It is recommended that each base_id has only one corresponding base_key and base_value.

Please click this link to download:

https://github.com/BSNDA/FISCOBaseContract

The preset smart contract functions are as follows:

1. Insert data (insert)

   Input parameter description

   base_id: the primary key identifier that requires inserting

   base_key: the key of the data to be inserted

   base_value: the value of the data to be inserted

   Example: {"base_id": "1","base_key":1,"base_value":"this is string"}

   Of which, base_id and base_value cannot be blank strings and the base_key is in int256 data type.

2. Update data (update)

   Input parameter description

   base_id: the primary key identifier that requires updating

   base_key: the key of the data to be updated

   base_value: the value of the data to be updated

   Example: {"base_id":"1","base_key":"1","base_value":"this is string"}

   Of which, base_id and base_value cannot be blank strings and the base_key is in int256 data type. If the base_id and base_key do not exist, then they cannot be updated; if they already exist, then the data will be updated.

3. Remove data (remove)

   Input parameter description

   base_id: the primary key identifier that requires removing

   base_key: the key of the data to be removed

   Example: {"base_id":"1","base_key":"1"}

   Of which, the base_id and base_value cannot be blank and must exist, otherwise they cannot be removed.

4. Select data (select)

   Input parameter description

   base_id: the value of the primary key identifier that requires being selected

   Example: {"base_id":"1"}

Of which, the base_id cannot be blank and must exist, otherwise, it is not possible to select the corresponding data.

5.4.3 PCN Gateway Fabric API

A PCN gateway is deployed on each public city node (PCN) to receive off-BSN system requests signed and verified by DApp access keys. Then requests are routed to the corresponding Fabric-based DApp chaincodes. Invoking the PCN gateway is realized by sending HTTP requests to each PCN gateway service. The gateway is responsible for verifying user and application identities and then uses these identities and chaincode functions to process chaincode parameters and to send the chaincode transaction results back to the off-BSN systems.

5.4.3.1 DApp Access Signature Algorithm

Whenever an off-BSN system sends requests to the PCN gateway, the HTTP request message should be signed with the participant's DApp access private key. When the PCN gateway receives the message with the digital signature, it will verify the authentication and message integrity with the corresponding hosted or uploaded DApp access public key. The gateway will only process the request message further after the verification is passed.

1. Assemble signature string

Convert the request parameters into a joined string according to the order of the parameter table, of which the request parameter prioritizes joining UserCode and AppCode of the Header and the response parameter prioritizes joining code and msg. Then join the parameters in the Body according to the order of the parameter tables in the definition of APIs.

2. Different type conversion formats

Type	Rule	Example	Result
String	No conversion	abc	Abc
Int/int64/long	Decimal conversion	-12	-12
Float	Decimal conversion; see notes for values after decimal point	1.23	1.23
Bool	Convert to "true" or "false"	true	True
Array	Join according to parameter sequence and type	{"abc", "xyz"}	Abcxyz
Map[key]value	Join key and value according to parameter sequence	{"a":1, "b":2}	a1b2
Object	Convert the attributes in the object one by one according to the document in the above-described format	{"name": "abc", "secret": "123456"}	abc123456

3. Signature rules

- Getting the Hash value - The converted string to be signed is required to be computed with the SHA256 algorithm with UTF-8 encoding.
- Sign the Hash value - The hash value and private key should be encrypted with the ECDSA (secp256r1) algorithm. If signed with SHA256WithECDSA, which includes hash value computation, the first step is not necessary.
- Encoding the signature result to Base64.

4. Example

Parameters:

{"header":{"userCode":"user01","appCode":"app01"},"mac":"","body":{“userId”:”abc”,”list”:[“abc”,”xyz”]}}

Result: user01app01abcabcxyz

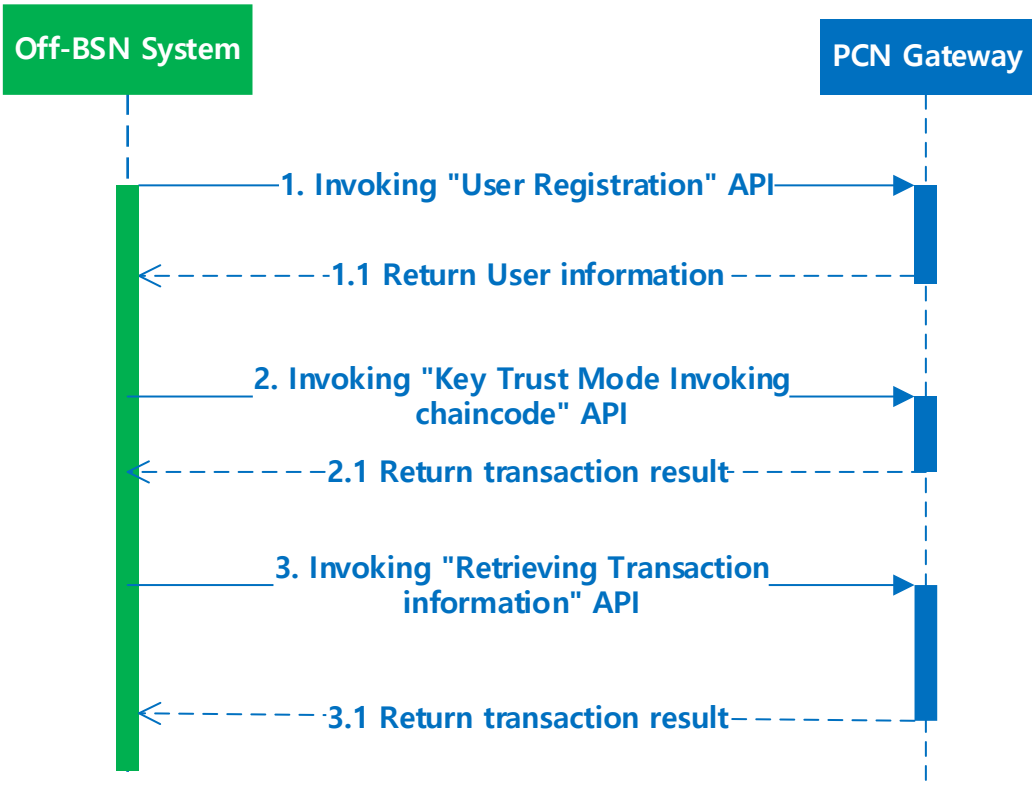
5.4.3.2 Keys and Certificate Modes

1. Key Trust Mode

As described in chapter 5, DApp participants require two sets of key pairs to access the DApp: DApp access key pair and user transaction key pair. With key trust mode, the pairs are generated and hosted by BSN. The participants only need to download the private key (DApp access key) from the BSN portal.

- DApp Access Key Pair: After the participant has successfully joined the DApp, BSN will generate one key pair (private and public keys) that corresponds to the DApp’s framework algorithms under the Key Trust Mode. The participant can download the private key from the “My Certificates” section of the BSN global portal and use it to sign the request message sent to the PCN gateway. The gateway will use the hosted public key from the generated key pair to validate the signature.
- User Transaction Key Pair: This is the identity of a participant used to invoke the chaincodes. Under the Key Trust Mode, after successfully joining a DApp, a participant’s user transaction key pair will be created automatically by BSN by default. The participant’s off-BSN system can use the participant’s UserCode to invoke the certificate generated by the key pair. If the participant’s off-BSN system has multiple sub-users, the off-BSN system can invoke the gateway’s “User Registration API” to register the sub-users and generate separate user transaction key pair for each sub-user. The sub-users can use their UserCode to connect to the DApp to execute transactions.

Transaction process:

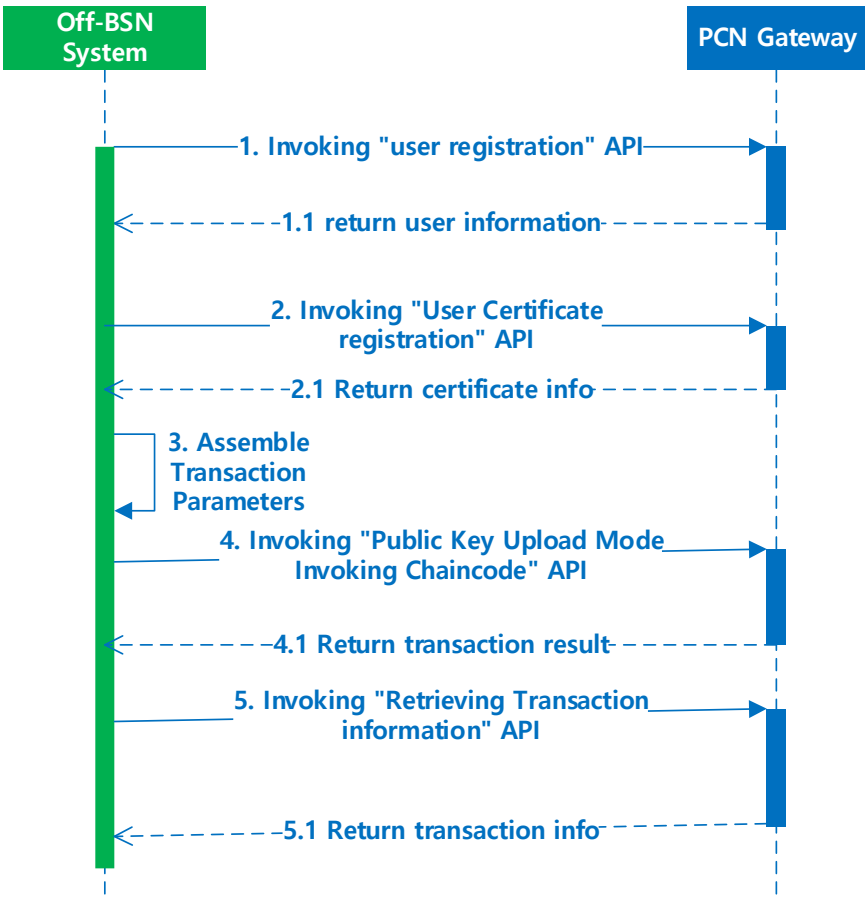


2. Public Key Upload Mode

As described in chapter 5, DApp participants require two sets of key pairs to fully access the DApp: DApp access key pair and user transaction key pair. With public-key upload mode, the key pairs are generated and stored locally by the participants. The participants only need to upload the public keys to BSN via the BSN portal or gateway APIs.

- DApp Access Key Pair: The DApp participant must generate the DApp access key pair locally according to the DApp framework algorithm after successfully joining the DApp. The participant stores the private key locally and uploads the public key to BSN via the BSN global portal. The participant's off-BSN system uses the private key to sign the transaction messages when invoking the PCN gateway. The PCN gateway will use the public key uploaded by the participant to verify the signature and validate the legality of the transaction.
- User Transaction Key Pair: This is the identity of a participant to invoke the chaincodes. Under the Key Trust Mode, the participant must generate the user transaction key pair locally and use the public key to generate the "public key registration application.", then from the participant's off-BSN system to submit the registration application to BSN by invoking the "Public Key Upload Mode user certification registration" API on the PCN gateway to receive the public key certificate. If the off-BSN system has sub-users, it should first invoke the "User Registration" API to register the sub-users before sending their public key registration applications.

Transaction process:



5.4.3.3 Get DApp information API

Invoke this interface to get basic DApp information; this interface can be used with Public Key Upload Mode transactions.

1. Interface address:

   https://PCNgatewayAddress/api/app/getAppInfo

2. Call Method: POST
3. Signature Algorithm: Not Required
4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Yes	
2	Body	body	Map	No	
3	Signature value	mac	String	Yes	
Header					
1	User unique ID	userCode	String	Yes	
2	DApp unique ID	appCode	String	Yes	
Body					
Example:					

{"header":{"userCode":"USER00012020041519580108712 92","appCode":"app0001202004161020152918451","tId":""},"mac": "","body":{}}

5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature value	mac	String	Y	
Header					
1	Response ID	code	int	Y	0: successful -1: failed
2	Response Message	msg	String	Y	
Body					
1	DApp name	appName	String	Y	
2	DApp type	appType	String	Y	
3	DApp encryption key type	caType	Int	Y	1: Key Trust Mode 2: Public Key Upload Mode
4	DApp algorithm Type	algorithmType	Int	Y	1: SM2 2: ECDSA (secp256r1)
5	City MSPID	mspId	String	Y	
6	DApp chain name	channelId	String	Y	Fabric corresponding channelId, fisco corresponding groupId
Example:					


```
{
  "header": {
    "code": 0,
    "msg": "Transaction Successful"
  },
  "mac":
"MEUCIQDE9zv0E/w4V/ILG6wUCFP08a7NDCAtX/IoZOcCyY4gIQIgUTYWsFTA1KE8
8gE6452jKnnVBrhznGVOV2HPMCbNh8A=",
  "body": {
    "appName": "sdktest",
    "appType": "fabric",
    "caType": 2,
    "algorithmType": 2,
    "mspId": "OrgbNodeMSP",
    "channelId": "app0001202004161020152918451"
  }
}
```


5.4.3.4 User Registration API

In both Key Trust Mode and Public Key Upload Mode, when a user participated in a Fabric DApp wants to create a unique user transaction key certificate for a sub-user of the off-chain system, the off-BSN system should invoke the User Registration API to register the sub-users on the PCN first. A sub-user's username is name@appCode in the request parameters

1. Interface address:

   https://PCNGatewayAddress/api/fabric/v1/user/register

2. Call Method: POST
3. Signature Algorithm: required and refer to Section 5.4.3.1
4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	N	
3	signature value	mac	String	Y	
Header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
Body					
1	user name	name	String	Y	Length<20
2	user password	secret	String	N	For Key Trust Mode DApps, this can be blank; for public key upload mode DApp, if this is blank then return with a random password
3	extended properties	extendProperties	String	N	User extended properties, json format string
Example:					
{"header":{"userCode":"USER00012021013010221135966 89","appCode":"app0001202109171125562435760","tId":""},"mac":"MEQCID3F4z2XpN4JsCU/gRO9l0Ziw1IOICx8eVgVWUVltvWyAiA1Y0uObgCV5tm1avSz9BscYr1aycmfBtFSlQ3o19OYEQ==","body":{"name":"user20210927","secret":"123456","extendProperties":"{'key1':'value'}"}}					

5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
Header					
1	Response ID	code	int	Y	0: successful -1: failed
2	Response Message	msg	String	Y	
Body					
1	user name	name	String	Y	Length<20
2	user password	secret	String	Y	For public key upload mode DApps, if the call parameter password is blank then return with a random password
Example					

{
"header": {
"code": 0,
"msg": "Transaction Successful"
},
"mac":
"MEUCIQClfufMU8kRI1gMHIGqfWOh1iv2KIhS+H0dlUUdEuUrLQIgYJz98xp5w/KdVP6bJjHhV2pZPTe9Cn4xcOrPV4E7ZsA=",
"body": {
"name": "user01",					

```
    "secret": "123456"
  }
}
```

5.4.3.5 Invoke chaincode API in Key Trust Mode

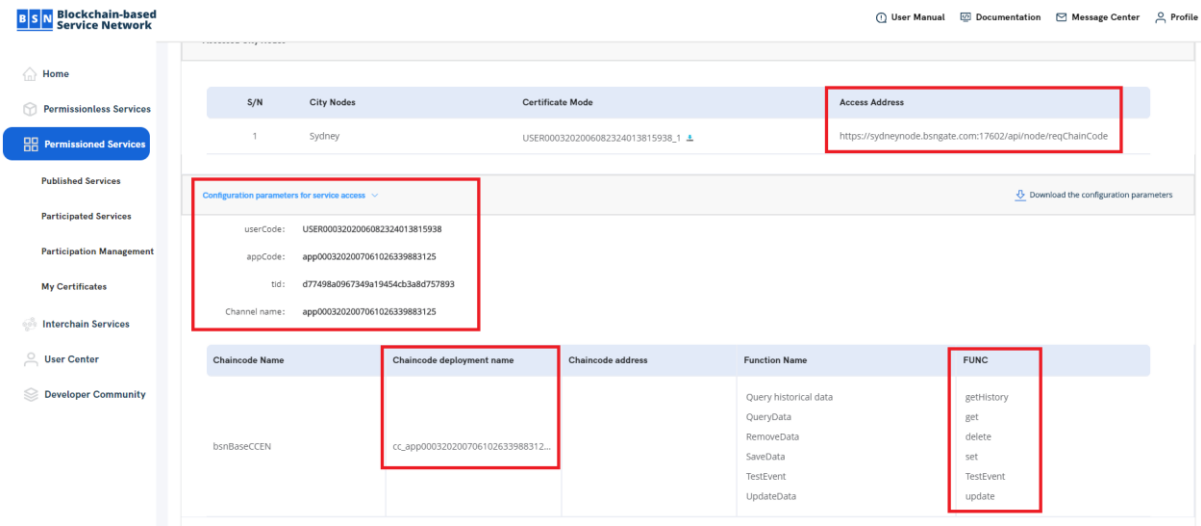
For DApps in Key Trust Mode, when the off-BSN system invokes the chaincode functions via PCN gateway, it is required to insert the parameters in the request message. The gateway will return the response message from the chaincode.

1. Interface address:

   https://PCNGatewayAddress/api/fabric/v1/node/reqChainCode

This interface will directly return the response message without waiting for the generation of block. Please use "Get transaction information API" described in section 5.4.3.8 to check the status of a block generated based on transaction ID.

Note: After a user has successfully participated in a DApp service, this participant can view and download the DApp's configuration parameters which are used for off-BSN systems to connect to this DApp's chaincodes, including the PCN gateway address and Dapp access keys, as shown below:



2. Call Method: POST
3. Signature Algorithm: required and refer to Section 5.4.3.1
4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
Header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
3	User and DApp	tId	String	N	

	mapping ID				
Body					
1	user name	userName	String	N	
	random string	nonce	String	Y	Use 24 random byte array of the base64 encoding
1	chainCode	chainCode	String	Y	
2	function name	funcName	String	Y	
3	Call parameters	args	String[]	N	
4	Transient data	transientData	Map<string,string>	N	
Example:					
{"header":{"userCode":"USER000120200416100930940741 3","appCode":"app0001202004161017141233920","tId":""},"mac":"MEQCICJpE1jfeJKtw/ZboVuKSLy2RmmSdkhrEVPGFJhm9IaIAiA/Qqs6RNz0ndSS4/AFSwBj7vC76Py1hXnqO5zMD9pNtA==","body":{"userName":"","nonce":"lgH7Ozfv6npqg9D3pSbq9c6o+rAcpa5D","chainCode":"cc_app0001202004161017141233920_00","funcName":"set","args":["{\"baseKey\":\"test2020048\",\"baseValue\":\"this is string \"}"],"transientData":{}}}					

5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
Header					
1	Response ID	code	int	Y	0: authentication successful -1: authentication failed
2	Response Message	msg	String	N	if code=0 then can be null
Body					
1	block information	blockInfo	blockInfo	N	If code is not 0, then leave blank
2	chaincode response result	ccRes	ccRes	N	If code is not 0, then leave blank
blockInfo					
1	Transaction ID	txId	String	Y	
2	Block HASH	blockHash	String	N	On synchronous mode returns Block HASH
3	status value	status	Int	Y	Refer to the detailed transaction status description in 5.4.3.17
ccRes					
1	chaincode response status	ccCode	Int	Y	200: Successful 500: Failed
2	chaincode response result	ccData	Str	N	Actual chaincode response result
Example					
{ "header": {					

```
    "code": 0,
    "msg": "Transaction Successful"
  },
  "mac":
"MEUCIQCBtfO1AfYkoJ2hIlp8CfKK1iuhVEAYkPY8YFRAdvPJlAIgDjSqYgwlORJRyF6
KZPU/uC5Fx/DxXxu9VgKwU9+JhjU=",
  "body": {
    "blockInfo": {
      "txId": "a144149150ee615a9d11c68485600f43dc2c3eb2a98d7b36de53a6b99e03c495",
      "blockHash": "",
      "status": 0
    },
    "ccRes": {
      "ccCode": 200,
      "ccData": "SUCCESS"
    }
  }
}
```


5.4.3.6 User certificate registration in Public Key Upload Mode

For DApps in Public Key Upload mode, after the participant registered the sub-users on the PCN by using "User Registration API" (section 5.4.3.4), he/she can use this interface to upload public key registration applications and receive the certificates (DApp access key pair certificates) for the sub-users. Invoking this interface from Key Trust Mode DApp will return an error message.

1. Interface address:

   https://PCNGatewayAddress/api/fabric/v1/user/enroll

2. Call Method: POST
3. Signature algorithm: required and refer to Section 5.4.3.1
4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	N	
3	Signature Value	mac	String	Y	
Header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
Body					
1	user name	name	String	Y	user name used at registration
2	user password	secret	String	Y	Password created at registration
3	Certificate Application file content	csrPem	string	Y	Use the ECDSA (secp256r1) algorithm to generate the certificate application

					file; the certificate CN is name@appCode

Example:

{"header":{"userCode":"USER00012020041519580108712 92","appCode":"app00012020041610201529184 51","tId":""},"mac":"MEQCICQaYMzs+edIQkfpt5hoaSO5dWqcrY7Q75FYwyJo/B4rAiAQ10aEpdNATsZYHVcJJ4TxVCgY8XdQBBIyTAOqUmSjkw==","body":{"name":"user01","secret":"123456","csrPem":"-----BEGIN CERTIFICATE REQUEST-----\nMIHoMIGQAgEAMC4xLDAqBgNVBAMMI3VzZXIwMUBhcHAwMDAxMjAyMDA0MTYxMDIw\nMTUyOTE4NDUxMFkwEwYHKoZIzj0CAQYIKoZIzj0DAQcDQgAEnguk1xunmuU1bnKB\nam8QmeK6Geg/O6kL2D2ig85UMQTpG/sb9iYkduz8iC9SRnF9TvLiHuvJX2FGAOAQ\nK1Vz8aAAMAoGCCqGSM49BAMCA0cAMEQCIE19Iin91KlfEvfFIbxhF14enFHhtvOU\n5rK86huFiMMQAiBYXO4fJBq6eLGjaavR71O9fOvVZ5W7X+GQjIlQDuDgPQ==\n-----END CERTIFICATE REQUEST-----\n"}}

5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
Header					
1	Response ID	code	int	Y	0: successful -1: failed
2	Response Message	msg	String	Y	
Body					
1	Certificate content	cert	String	Y	

Example

{
"header": {
"code": 0,
"msg": "Transaction Successful"
},
"mac":
"MEUCIQCE0gg5VHWsZluNKAV2+xOJANGnCkw6f9J4+mFT1TWz/gIgfu93jqzTzk0DU2lfMKnExcwVbgelWMLvLmwKplCXNBA=",
"body": {
"cert": "-----BEGIN CERTIFICATE-----\nMIICvTCCAmSgAwIBAgIUcqn2HmCYmq/V2yKbnxuvc49KU00wCgYIKoZIzj0EAwIw\nTjELMAkGA1UEBhMCQ04xEDAOBgNVBAgTB0JlaWppbmcxDDAKBgNVBAoTA0JTTjEP\nMA0GA1UECxMGY2xpZW50MQ4wDAYDVQQDEwVic25jYTAgFw0yMDA0MjEwNTAzMDBa\nGA8yMTAwMDMyMTExMDQwMFowbDE8MA0GA1UECxMGY2xpZW50MA8GA1UECxMIb3Jn\nYm5vZGUwDgYDVQQLEwdic25iYXNlMAoGA1UECxMDY29tMSwwKgYDVQQDDCN1c2Vy\nMDFAYXBwMDAwMTIwMjAwNDE2MTAyMDE1MjkxODQ1MTBZMBMGByqGSM49AgEGCCqG\nSM49AwEHA0IABJ4LpNcbp5rlNW5ygWpvEJniuhnoPzupC9g9ooPOVDEE6Rv7G/Ym\nJHbs/IgvUkZxfU7y4h7ryV9hRgDgECtVc/Gjgf8wgfwwDgYDVR0PAQH/BAQDAgeA\nMAwGA1UdEwEB/wQCMAAwHQYDVR0OBBYEFG28toKRbzJTFa6v/xlIYr6S9EvaMB8G\nA1UdIwQYMBaAFAcI4H+kIs8vn94ZYYpkrd+5ldMKMIGbBggqAwQFBgcIAQSBjnsi\nYXR0cnMiOnsiaGYuQWZmaWxpYXRpb24iOiJvcmdibm9kZS5ic25iYXNlLmNvbSIs\nImhmLkVucm9sbG1lbnRJRCI6InVzZXIwMUBhcHAwMDAxMjAyMDA0MTYxMDIwMTUy\nOTE4NDUxIiwiaGYuVHlwZSI6ImNsaWVudCIsInJvbGUiOiJjbGllbnQifX0wCgYI\nKoZIzj0EAwIDRwAwRAIgLtlTps/DOHK8S3La7bnlChB+88b1Fko9bOAL36oAFPIC\nIHQPCC30MoTHIId/X3fC5IxNukssmlMnEuDX73zRL55/\n-----

```
END CERTIFICATE-----\n"
  }
}
```

5.4.3.7 Invoke chaincode in Public Key Upload Mode

For DApps in Public Key Upload mode, the participant needs to assemble the transaction message locally, and invoke this interface to initiate the transaction from the off-BSN system to the DApp's chaincode.

1. Interface address:

   https://PCNGatewayAddress/api/fabric/v1/node/trans

2. Call Method: POST
3. Signature algorithm: required and refer to Section 5.4.3.1
4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	N	
3	Signature Value	mac	String	Y	
Header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
Body					
1	Transaction data	transData	String	Y	the transaction data should be encoded with base64

Example:

{"header":{"userCode":"USER0001202004151958010871292","appCode":"app0001202004161020152918451","tId":""},"mac":"MEUCIQCv8EZ2OqbSbI9xGGKX06Mquh+g+NhhbUoAJBbnemXdagIgNMF7W7ecu5uej9BpVx04qwJuVijbgcp3VYIcjDK0Z38=","body":{"transData":"Cq0KCrsJCpcBCAMaCwi9gPr0BRD0o+Z2IhxhcHAwMDAxMjAyMDA0MTYxMDIwMTUyOTE4NDUxKkBjM2M2NTIzOTU4YzM4MTExOTJiOGQzNThkZDI2MTdmMWIxNGNiNjYxZGU2YjAyMmMxYTgyMjI2OWU4YThjNDhkOiYSJBIiY2NfYXBwMDAwMTIwMjAwNDE2MTAyMDE1MjkxODQ1MV8wMBKeCAqBCAoLT3JnYk5vZGVNU1AS8QctLS0tLUJFR0lOIENFUlRJRklDQVRFLS0tLS0KTUlJQ3ZUQ0NBbVNnQXdJQkFnSVVWanBGZTJFaERFaHJlOHBBVTh4bkd3dXhPbU13Q2dZSUtvWkl6ajBFQXdJdwpUakVMTUFrR0ExVUVCaE1DUTA0eEVEQU9CZ05WQkFnVEIwSmxhV3BwYm1jeEREQUtCZ05WQkFvVEEwSlRUakVQCk1BMEdBMVVFQ3hNR1kyeHBaVzUwTVE0d0RBWURWUVFERXdWaWMyNWpZVEFnRncweU1EQTBNVGt3TkRNek1EQmEKR0E4eU1UQXdNRE15TVRFeE1EUXdNRm93YkRFOE1BMEdBMVVFQ3hNR1kyeHBaVzUwTUE4R0ExVUVDeE1JYjNKbgpZbTV2WkdVd0RnWURWUVFMRXdkaWMyNWlZWE5sTUFvR0ExVUVDeE1EWTI5dE1Td3dLZ1lEVlFRRERDTjBaWE4wCk1ESkFZWEJ3TURBd01USXdNakF3TkRFMk1UQXlNREUxTWpreE9EUTFNVEJaTUJNR0J5cUdTTTQ5QWdFR0NDcUcKU000OUF3RUhBMElBQk5YZmFMVW1wMXlJSFVMMXVKeEdwMDFQNHE5Zk81V2xFMFZtallYQmVMejBhYlhqSU96NwpYb29KcGRUS1ZkUUJaZzYrZkVPWmhudm1vbURXWjRpdTRhYWpnZjh3Z2Z3d0RnWURWUjBQQVFIL0JBUURBZ2VBCk1Bd0dBMVVkRXdFQi93UUNNQUF3SFFZRFZSME9CQllFRkZZRDg5emtkVllRbzZpUEh3d2RJejNaQ1lSck1COEcKQTFVZEl3UVlNQmFBRkFjSTRIK2tJczh2bjk0WllZcGtyZCs1bGRNS01JR2JCZ2dxQXdRRkJnY0lBUVNCam5zaQpZWFIwY25NaU9uc2lhR1l1UVda

bWFXeHBZWFJwYjI0aU9pSnZjbWRpYm05a1pTNWljMjVpWVhObExtTnZiU0lzCkl
taG1Ma1Z1Y205c2JHMWxiblJKUkNJNkluUmxjM1F3TWtCaGNIQXdNREF4TWpBe
U1EQTBNVFl4TURJd01UVXkKT1RFNE5EVXhJaXdpYUdZdVZIbHdaU0k2SW1Oc
2FXVnVkQ0lzSW5KdmJHVWlPaUpqYkdsbGJuUWlmWDB3Q2dZSQpLb1pJemowR
UF3SURSd0F3UkFJZ1ZZNi9jZ1NDTmpENkxwTXVaZEQzVWYvWko5c3FSUVVT
R3hSQU9SeGZONThDCklFN0JHTDljOHRCcHJiVmpYTldtQmpObWhqeUE3N0l3S
W8rbUg1ZXp4R1B1Ci0tLS0tRU5EIENFUlRJRklDQVRFLS0tLS0KEhiQKmgB1Ibwb
gLAyoHXUNnjZSGOqBDheQMSbQprCmkIARIkEiJjY19hcHAwMDAxMjAyMDA0
MTYxMDIwMTUyOTE4NDUxXzAwGj8KA3NldAo4eyJiYXNlS2V5IjoidGVzdDIw
MjAwNDA0IiwiYmFzZVZhbHVlIjoidGhpcyBpcyBzdHJpbmcgIn0SRjBEAiB+mOUK
Y7fRjcZ1/qc96YP9GGod3UK56jJaWaE4o3J90QIgeirrjyzL6zQLN89tv3jDpI7vxKChk
GM9u8IEFiFEGYo="}}

5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
Header					
1	Response ID	code	int	Y	0: authentication successful -1: authentication failed
2	Response Message	msg	String	N	If code=0, can be null
Body					
1	block information	blockInfo	blockInfo	N	If code is not 0, then leave blank
2	chaincode response result	ccRes	ccRes	N	If code is not 0, then leave blank
blockInfo					
1	Transaction Id	txId	String	Y	
2	Block HASH	blockHash	String	N	On synchronous mode, returns Block HASH
3	status value	status	Int	Y	refer to detailed transaction status description in 5.4.3.17
ccRes					
1	chaincode response status	ccCode	Int	Y	200: successful 500: failed
2	chaincode response result	ccData	Str	N	actual chaincode response result

Example

{
 "header": {
  "code": 0,
  "msg": "Transaction Successful"
 },
 "mac":
"MEQCICXNk40O+Gkqqe2XgoaxdOoIvDQe4RfLtwXkxjC7ce8TAiBLVu6PjOqWueV
B3t4h7REpNdcVf6L0qVzfdA1yovuc7g==",
 "body": {
  "blockInfo": {

```
    "txId":
"c3c6523958c3811192b8d358dd2617f1b14cb661de6b022c1a822269e8a8c48d",
    "blockHash": "",
    "status": 0
  },
  "ccRes": {
    "ccCode": 200,
    "ccData": "SUCCESS"
  }
 }
}
```


5.4.3.8 Get transaction information API

The off-BSN system can use this interface to get the transaction information based on transaction ID.

1. Interface address:

   https://PCNGatewayAddress/api/fabric/v1/node/getTransaction

2. Call Method: POST
3. Signature algorithm: required and refer to Section 5.4.3.1
4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
Header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
Body					
1	transactionId	txId	String	Y	
Example:					
{"header":{"userCode":"USER00012020041519580108712 92","appCode":"app0001202004161020152918451","tId":""},"mac":"MEUCIQDIbcNl+C1iBbXWGW3qjhf80IRgCgvJuyxx0WXU2vn2TAIgZgA020L2aXBtrdLsYEkYPyiOJ9+AFrXOEwfuzy8B4bE=","body":{"txId":"c3c6523958c3811192b8d358dd2617f1b14cb661de6b022c1a822269e8a8c48d"}}					

5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
Header					
1	Response ID	code	int	Y	0: authentication successful -1: authentication failed
2	Response	msg	String	N	if code=0 then can

	message				be null
Body					
1	Block Hash	blockHash	String	Y	
2	Block Number	blockNumber	Long	Y	
3	Transaction status	status	Int	Y	refer to detailed transaction status description in 5.4.3.18
4	on-chain user name	createName	String	Y	
5	Timestamp Second	timeSpanSec	Int64	Y	“second” in the timestamp
6	Timestamp Nanosecond	timeSpanNsec	Int64	Y	“nanosecond” in the timestamp
Example					


```
{
 "header": {
  "code": 0,
  "msg": "Transaction Successful"
 },
 "mac":
"MEUCIQDUFw5pa4QJcEiQjYeLTl2L94HbsZbz7DArF+djgzWoTQIgU8u+dG6CcHw
BZjuf9PvhYdEFAa/ujwo8UAPbAmKxRq0=",
 "body": {
  "blockHash":
"ab9366cf63881228863c884527fceefabc9ad2e375aa0bcbf71f17f75c7d3ff5",
  "blockNumber": 7,
  "status": 0,
  "createName": "test02@app000120200416102015291845 1",
  "timeSpanSec": 1587445821,
  "timeSpanNsec": 249139700
 }
}
```


5.4.3.9 Get transaction data API

This interface can be used by off-BSN systems to obtain transaction information based on the transaction ID and then returns the string of the transaction information by base64 encryption.

1. Interface address:

https://PCNGatewayAddress/api/fabric/v1/node/getTransdata

2. Call method: POST

3. Signature algorithm: required and refer to Section 5.4.3.1

4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
Header					

1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
Body					
1	Transaction Id	txId	String	Y	
Example:					
{"header":{"userCode":"USER00012020041519580108712 92","appCode":"app00012020041610201529184 51","tId":""},"mac":"MEUCIQDIbcNl+C1iBbXWGW3qjhf80IRgCgvJuyxx0WXU2vn2TAIgZgA020L2aXBtrdLsYEkYPyiOJ9+AFrXOEwfuzy8B4bE=","body":{"txId":"c3c6523958c3811192b8d358dd2617f1b14cb661de6b022c1a822269e8a8c48d"}}					

5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	header	header	Map	Y	
2	body	body	Map	Y	
3	signature value	mac	String	Y	
Header					
1	Response ID	code	int	Y	0: authentication successful -1: authentication failed
2	Response Message	msg	String	N	if code=0 then can be null
Body					
1	Transaction Id	txId	String	Y	
2	Transaction data	transData	String	Y	String generated by base64 calculation
Example					

{
"header": {
"code": 0,
"msg": "success"
},
"mac": "MEUCIQDI63PUa4WjE01S4cdYy5spMRSYPLFzEvYGKHszTSFxtAIgND/A/Cky9XDpHLNKQzOvgyf1nb6edVy3JQisBn7OuIM=",
"body": {
"txId": "b1b2ef26cff816dce49a40be3527092a2b0d43d244d57611bb2b95a05c063feb",
"transData": "CtYgCosgCrIKCpgBCAMa....."
}
}					

5.4.3.10 Get block information API

After the data is uploaded to the chain, the off-BSN system can use this interface on the PCN

gateway to get the block information of the current transaction (body.blockInfo), the status (body.blockInfo.status), and transaction ID (body.blockInfo.txId). If the status value is 0, it signifies that the transaction has been successful and a block has been created. The block information can be queried according to the transaction ID.

1. Interface address:

   https://PCNGatewayAddress/api/fabric/v1/node/getBlockInfo

2. Call Method: POST
3. Signature algorithm: required and refer to Section 5.4.3.1
4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
Header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
Body					
1	Block number	blockNumber	Int64	N	Can't be null at the same time
2	Block HASH	blockHash	String	N	Can't be null at the same time
3	Transaction Id	txId	String	N	Can't be null at the same time
Example:					
{"header": {"userCode": "USER000120200415195801087129 2","appCode": "app00012020041610201529184 51","tId": ""},"mac": "MEUCIQCrGthrAvNalUsWEdnDxZkNXF4nCpXOxIFQdp1YYhGvugIgKvYql9Ex6RCcOhqt6coufNPH/QhtKYNeThWJ2rEL+4g=","body": {"blockNumber": 6,"blockHash": "","txId": ""}}					

5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	header	header	Map	Y	
2	body	body	Map	Y	
3	signature value	mac	String	Y	
Header					
1	Response ID	code	int	Y	0: authentication successful -1: authentication failed
2	Response Message	msg	String	N	if code=0 then can be null
Body					
1	Block Hash	blockHash	String	Y	
2	Block Number	blockNumber	Long	Y	
3	Previous Block Hash	preBlockHash	String	Y	

4	Block Size	blockSize	Long	Y	byte
5	The number of transactions on current block	blockTxCount	Int	Y	
6	Transaction detail	transactions	[]Transaction Data	Y	Transaction Detail
TransactionData					
1	Transaction Id	txId	String		
2	Transaction Status	status	Int		refer to detailed transaction status description in 5.4.3.18
3	Transaction Provider	createName	String		
4	Transaction timestamp second	timeSpanSec	Int64		
5	Transaction timestamp nonasecond	timeSpanNsec	Int64		
Example					


```
{
  "header": {
    "code": 0,
    "msg": "Transaction Successful"
  },
  "mac":
"MEUCIQC8nfFnHw4sEYJmaSTT1xepxMGgomxyJtt0ysyGgPB0AwIgfuuiegdGEbBi/2wmF
Cco39wmik3isLWtvnN9ZmJDTdk=",
  "body": {
    "blockHash": "fc83c306677925efee540b4d7b7ca73e06f144cae34c706f1101d6b395ada2da",
    "blockNumber": 6,
    "preBlockHash":
"93c86551d812229274e144093cd4bd17dacb35bc6a01779930e11f43f886bf34",
    "blockSize": 7020,
    "blockTxCount": 1,
    "transactions": [
      {
        "txId": "a8639f3a796267e048d475b00fe7646a4524f1c20d71880e19708821177b7bdb",
        "status": 0,
        "createName": "test02@app000120200416102015291845 1",
        "timeSpanSec": 1587271285,
        "timeSpanNsec": 26436800
      }
    ]
  }
}
```


5.4.3.11 Get block data API

After the data is added to the chain, the off-BSN system will get the block information of the current transaction by calling this interface on the public city node gateway.

1. Interface address:

https://PCNGatewayAddress/api/fabric/v1/node/getBlockData

2. Call method: POST
3. Signature algorithm: required and refer to Section 5.4.3.1
4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
Header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
Body					
1	Block number	blockNumber	Int64	N	Can't be null at the same time
2	Block HASH	blockHash	String	N	Can't be null at the same time
3	Transaction Id	txId	String	N	Can't be null at the same time
Example:					
{"header": {"userCode": "USER000120200415195801087129 2","appCode": "app00012020041610201529184 51","tId": ""},"mac": "MEUCIQCrGthrAvNalUsWEdnDxZkNXF4nCpXOxIFQdp1YYhGvugIgKvYql9Ex6RCcOhqt6coufNPH/QhtKYNeThWJ2rEL+4g=","body": {"blockNumber": 6,"blockHash": "","txId": ""}}					

Response parameters

No.	Field name	Field	Type	Required	Remarks
1	header	header	Map	Y	
2	body	body	Map	Y	
3	signature value	mac	String	Y	
Header					
1	Response ID	code	int	Y	0: authentication successful -1: authentication failed
2	Response Message	msg	String	N	if code=0 then can be null
Body					
1	Block Hash	blockHash	String	Y	
2	Block Number	blockNumber	Long	Y	
3	Previous Block Hash	preBlockHash	String	Y	
4	Block Data	blockData	String	Y	String generated by base64 calculation
Example					

{
"header": {
"code": 0,					

```
    "msg": "success"
  },
  "mac":
"MEQCICAgU3G6o1Ky6UeYgqEgCee27TS2F8ScH+jaSj6w20OCAiB+/6z1a2jG5m4vvjz1ft
2LQdIsaG2BAXqcwxmSFyEIzg==",
  "body": {
    "blockHash":
"b8366a63ed32fddec720872d206802e670222f29d9a8a32983d26b59dbfd6971",
    "blockNumber": 3,
    "preBlockHash":
"6dcc69799682e2fc7ffa950c56031b807c54b7a098b4fd69db9cf8c97518bcea",
    "blockData": "CkYIAxIgbcxpeZa....."
  }
}}
```


5.4.3.12 Get the latest ledger information API

Use this interface to get the latest ledger information, including block hash, previous block hash, and the current block height, etc.

1. Interface address:

   https://PCNGatewayAddress/api/fabric/v1/node/getLedgerInfo

2. Call method: POST
3. Signature algorithm: required and refer to Section 5.4.3.1
4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
Header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
Example:					
{"header":{"userCode":"USER00012020041519580108712 92","appCode":"app00012020041610201529184 51","tId":""},"mac":"MEQCID7Z3J2PiRDOx7JasRamBZRTAHXj1XAG1K/DUkzJEwuiAiBIY5p3H2kArE7OuYLOgEqMHl15Xgj5Voi5zVPGhyU/+w==","body":{}}					

5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
Header					
1	Response ID	code	int	Y	0: authentication successful -1: authentication failed
2	Response Message	msg	String	N	if code=0 then can be null

Body					
1	Block Hash	blockHash	String	Y	
2	Block Height	height	Long	Y	
3	Previous Block Hash	preBlockHash	String	Y	
Example					


```
{
  "header": {
    "code": 0,
    "msg": "Transaction Successful"
  },
  "mac":
"MEUCIQC4PhYTBNyt1rSeBeZTdOly42CxILVgK1b/RlieA33G1gIgeodoEa5Ou0X4uW
c/VGp0n6NKByhXlBbo22FME4xQ8aw=",
  "body": {
    "blockHash":
"ab9366cf63881228863c884527fceefabc9ad2e375aa0bcbf71f17f75c7d3ff5",
    "height": 8,
    "preBlockHash":
"fc83c306677925efee540b4d7b7ca73e06f144cae34c706f1101d6b395ada2da"
  }
}
```


5.4.3.13 Chaincode event registration API

Chaincode event in a DApp can trigger the off-BSN system to process further transactions. This interface is used to register the chaincode event to be monitored.

1. Interface address:

   https://PCNGatewayAddress/api/fabric/v1/chainCode/event/register

2. Call method: POST
3. Signature algorithm: required and refer to Section 5.4.3.1
4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
Header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
Body					
1	ChainCode	chainCode	String	Y	
2	Chaincode event key	eventKey	String	Y	
3	Chaincode event notification URL	notifyUrl	String	Y	URL to receive the monitored chaincode event
4	Attached additional parameters	attachArgs	String	N	
Example:					

{"header":{"appCode":"CL20191107112252","userCode":"lessing"},"body":{"attachArgs":"name=TOM&age=20","chainCode":"cc_bsn_test_00","eventKey":"test01","notifyUrl":"http://192.168.6.128:8080/api/event/notifyUrl"},"mac":"MEUCIQCjzPr4KZVild2Vm5YgcunOXTh9mQK2QfWcRnYCk+jOzgIgDW6oHca7/249M43p2ElwiMNbuejdwAnyW5OwiMqiWCQ="}

5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
header					
1	Response ID	code	int	Y	0: successful -1: failed
2	Response Message	msg	String	Y	
Body					
1	Event ID	eventId	String	Y	
Example					
{ "header": { "code": 0, "msg": "Event Registration Successful" }, "body": { "eventId": "bd3391deedbe44a7ad5b7f80ce59abfa" }, "mac": "MEQCIENLpj2R9mRL100vcMXs0X5rwfSjB/U7kMg+76GjEPNJAiBlUo/Eyj49uXTPrzRW0m4rJ0NQIkZnDMPbyalxojXwrA=="}					

5.4.3.14 Block event registration API

Block event in a DApp can trigger the off-BSN system to process further transactions. This interface is used to register the block event to be monitored.

1. Interface address:

   https://PCNGatewayAddress/api/fabric/v1/chainCode/event/blockRegister

2. Call method: POST
3. Signature algorithm: required and refer to Section 5.4.3.1
4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
Header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
Body					
1	Chaincode event notification URL	notifyUrl	String	Y	URL to receive the monitored block event
2	Attached additional parameters	attachArgs	String	N	
Example:					
{"header":{"userCode":"USER0001202007101641243516163","appCode":"app00					

012021011914112384262 66","tId":""},"mac":"MEUCIQClsjKy/ee1qaYrItzCO1bMfjs0g0kPu8+YOCjbk3rPRAIgSfeyYvfeoh8QciZPG4fZQepaiyh7PmmWjYzFSqylT/c=","body":{"chainCode":"","eventKey":"","notifyUrl":"http://192.168.6.78:58011/v1/fabric/test","attachArgs":"a=1"}}

5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
header					
1	Response ID	code	int	Y	0: successful -1: failed
2	Response message	msg	String	Y	
Body					
1	Event ID	eventId	String	Y	
Example					


```
{
  "header": {
    "code": 0,
    "msg": "success"
  },
  "mac":
"MEUCIQC6PKsSqfkQGLrqi2vMpZzBP5beLhyP+fXVr8S5aqhaagIgaEtAnsuiubibYoYZzQ/8aGYErzm5rtU8Oj952OuHgCo=",
  "body": {
    "eventId": "002f0e1f0b0f4331ab541461547a38d6"
  }
}
```


5.4.3.15 Chaincode and block event query API

Use this API to query the list of monitored chaincode and block events that have been registered.

1. Interface address:

   https://PCNGatewayAddress/api/fabric/v1/chainCode/event/query

2. Call method: POST
3. Signature algorithm: required and refer to Section 5.4.3.1
4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	N	
3	Signature Value	mac	String	Y	
header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
Example:					
{"header":{"appCode":"CL20191107112252","userCode":"lessing"},"body":{},"mac":"MEQCIAnJxvuKVe0u/bG0VYCjM3g3ctxTYIWkejYp462okNlcAiBcOTGvAkF7xErL2w1PiwgfFjIu3Sszgyfzym/pEwRGxA==="}					

5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	[]body	Y	Event List
3	Signature Value	mac	String	Y	
Header					
1	Response ID	code	int	Y	0: Query successful -1: Query failed
2	Response Message	msg	String	Y	
body					
1	Event ID	eventId	String	Y	
2	Chaincode Event key	eventKey	String	N	Null if it's a block event
3	Chaincode Event Notification URL	notifyUrl	String	Y	
4	Attached additional parameters	attachArgs	String	N	
5	Creation Time	createTime	String	Y	
6	PCN ID	orgCode	String	Y	
7	user unique ID	userCode	String	Y	
8	DApp unique code	appCode	String	Y	
9	Chaincode ID	chainCode	String	N	Null if it's a block event
10	Event type	eventType	String	N	Returns "block" if it's a block event; Null if it's chaincode event
Example					
{ "header": { "code": 0, "msg": "Query Event Successful" }, "body": [{ "eventKey": "test001", "notifyUrl": "http://192.168.6.128:8080/api/event/notifyUrl", "attachArgs": "a=123\u0026b=456", "eventId": "945ee631d26140118963ad3104c81713", "createTime": "2019-11-18 14:22:59", "orgCode": "ORG1571365934172", "userCode": "lessing", "appCode": "CL20191107112252", "chainCode": "cc_bsn_test_00" }, { "eventKey": "test002", "notifyUrl": "http://192.168.6.128:8080/api/event/notifyUrl", "attachArgs": "hahahhahhahahahah", "eventId": "346617a493d84c6d8512b8dddad87811", "createTime": "2019-11-18					

14:29:28", "orgCode": "ORG1571365934172", "userCode": "lessing", "appCode": "CL20191107112252", "chainCode": "cc_bsn_test_00" }, { "eventKey": "test01", "notifyUrl": "http://192.168.6.128:8080/api/event/notifyUrl", "attachArgs": "name=Zhangsan\u0026age=20", "eventId": "bd3391deedbe44a7ad5b7f80ce59abfa", "createTime": "2019-11-19 10:52:15", "orgCode": "ORG1571365934172", "userCode": "lessing", "appCode": "CL20191107112252", "chainCode": "cc_bsn_test_00" }], "mac": "MEQCIEYXFMa8dfBrjy/s9H5JAoFIrjROJBiw+7/daELUbF5eAiA7a6HvqqbOpv6vlkunHGxCB1o5DoeuJFD0FM6kLoU34Q==" }

5.4.3.16 Remove chaincode and block event API

This interface is used to remove a chaincode event's registration from the event list.

1. Interface address:

   https://PCNGatewayAddress/api/fabric/v1/chainCode/event/remove

2. Call method: POST
3. Signature algorithm: required and refer to Section 5.4.3.1
4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	N	
3	Signature Value	mac	String	Y	
header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
Body					
1	Event ID	eventId	String	Y	
Example:					
{"header":{"appCode":"CL20191107112252","userCode":"lessing"},"body":{"eventId":"bd3391deedbe44a7ad5b7f80ce59abfa"},"mac":"MEQCIE3/CLG5LxZZN7En7LZvzthajwxHzpvDduXSsw4Tb1JFAiAXGJ4WVtyCKbtCasQGofCkge8NOgZDNPgJIdTCtCi2SQ==="}					

5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
header					
1	Response ID	code	int	Y	0: remove successful -1: remove failed
2	Response Message	msg	String	Y	
Example					
{ "header": { "code": 0, "msg": "Remove Event Successful" }, "body": null, "mac": "MEUCIQCaTFLliY7pPjkwcmSsLXOth7k9bQj9Sblq+1nMVjkFAAIgUsizFO+f1+dxU3/hPxjf/+na4qG6aQFftJIWGtMhlVI="}					

5.4.3.17 Chaincode and block event notification API

This interface is implemented on the off-BSN system side. When the PCN gateway receives the notification of a triggered event, it uses this interface to notify the off-BSN system about the execution result.

After receiving the notification successfully, the off-BSN system returns a string containing "success", otherwise, the gateway will send the notification again at 3, 12, 27, and 48 seconds respectively, for a total of five times.

1. Call method: POST
2. Signature algorithm: required and refer to Section 5.4.3.1
3. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	N	
3	Signature Value	mac	String	Y	
header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
body					
1	Chaincode ID	chainCode	String	N	Null when the block event notification
2	PCN ID	orgCode	String	Y	
3	Registered Event key	eventKey	String	N	
4	Registered Event ID	eventId	String	Y	
5	Registered Event parameters	attachArgs	String	N	Additional parameters entered during registration
6	Monitored event key	eventName	String	N	The event name in the chaincode, null when the block event notification
7	Current Chaincode transaction Id	txId	String	N	Null when the block event notification
8	Monitored event value	payload	String	N	
9	Current Block Height	blockNumber	Long	Y	
10	Response random string	nonceStr	String	Y	Off-BSN system uses this value to judge if the notification is already received. This string remains the same at the repeated notifications.

11	Previous hash	previousHash	String	N	Null when chaincode event notification

Example:

Chaincode event nofitication

{"header":{"userCode":"lessing","appCode":"CL20191107112252"},"body":{"chainCode":"cc_bsn_test_00","orgCode":"ORG1571365934172","eventKey":"test:\\S{32}","eventId":"2964a0f60b3e460f834618b3664af2da","attachArgs":"abc=123211","eventName":"test:12345678123456781234567812345678","txId":"32fc105681820fa556b8a460efc1e43a47daa864b959ea1753abb4640f2dce49","payload":"","blockNumber":74,"nonceStr":"522c8061b5e84837bad72ca08c6a353f"},"mac":"MEQCIDU4tROyjLtvD1b8TTbWWAlCPuUbmdPAEUXwRRgVn7kIAiA58je5u/7xDuRPcgeUWL3nB9mouUGQ6dGKJMmD7Jm08g=="}

Block event notification

{"header":{"userCode":"USER000120200710164124351616 3","appCode":"app0001202101191411238426266"},"body":{"orgCode":"ORG2020041114171692360","eventId":"8746bb9a1e854c9f8b3710f5a63f7c59","attachArgs":"a=1","previousHash":"022281f6089e3684501251775166b6b0afd18a176ec98a835cb5d09aff0d4950","blockNumber":12,"nonceStr":"79a7baa26c854caeb2e2e7abc0b7f07e"},"mac":"MEUCIQDiZrwf8fKG/3fuaVrsfTN3BKmLx+qnnEuuSaHfvIBbMQIgS+1qHKXeVR24WXwOGu3Nze/tLLziQ0LkjXaueYu0ctM="}

4. The payload parameter in the message is not passed in Fabric 1.4.3, please refer to https://github.com/hyperledger/fabric/blob/v1.4.3/core/peer/deliverevents.go#L251

   For the specific code, if you need to use the payload parameter, you can get it as follows:

   1) store the content to be passed through the event to the chain in the form of "key-value".

   2) pass the event name and the key splice in 1 as eventName, e.g.: eventkey_key.

   3) register the event with a regular registration, e.g. : eventkey_[\s\S]*.

   4) after receiving the event, parse the key according to the event name and call a query to get the value.

   5) if the amount of payload data to be passed is not large, it can be directly spliced to enevtName, which has no length limitation.

5.4.3.18 Transaction status description

Under both Key Trust Mode and Public Key Upload Mode, the description of the returned transaction status when the off-BSN system invokes the DApp chaincodes via PCN gateway APIs are shown as follows:

No.	Status Code	Remarks
	0	Successful
	-1	Block creation time out
	1	Submitted data empty
	2	Unusual response
	3	Error in the submitted information
	4	Error in the creator's signature
	5	Invalid "endorser" transaction

	6	Invalid transaction settings
	7	Unsupported transaction response
	8	Error in the transaction ID
	9	Duplicate transaction ID
	10	Failed endorsement
	13	Unknown transaction type
	14	Cannot locate target chaincode
	17	Expired chaincode
	18	Conflict in chaincode version
	254	Invalid transaction
	255	Invalid transaction for other reasons

5.4.4 PCN Gateway FISCO API

A PCN gateway is deployed on each public city node (PCN) to receive off-BSN system requests signed and verified by DApp access keys, then used to route the requests to the corresponding FISCO BCOS-based DApp smart contracts. Invoking the PCN gateway is realized by sending HTTP requests to each PCN gateway service. The gateway is responsible for verifying user and application identities, and then uses these identities and smart contract functions to process smart contract parameters then sends the smart contract transaction results back to the off-BSN systems.

5.4.4.1 DApp Access Signature Algorithm

Whenever an off-BSN system sends requests to the PCN gateway, the HTTP request message should be signed with the DApp participant's DApp access private key. When the PCN gateway receives the message with the digital signature, it will verify the authentication and message integrity with the corresponding hosted or uploaded DApp access public key. The gateway will only process the request message further after the verification is passed.

1. Assemble signature string

Convert the request parameters into a joined string according to the order of the parameter table, of which, the call parameter prioritises joining UserCode and AppCode of the Header and the response parameter prioritises joining code and msg. Then join the parameters in the Body according to the order of the parameter tables in the definition of APIs.

2. Different type conversion formats

Type	Rule	Example	Result
String	No conversion	abc	abc
Int/int64/long	Decimal conversion	-12	-12
Float	Decimal conversion; see notes for values after decimal point	1.23	1.23
Bool	Convert to "true" or "false"	true	true
Array	Join according to parameter sequence and type	{"abc","xyz"}	abcxyz
Map[key]value	Join key and value according to parameter sequence	{"a":1,"b":2}	a1b2
Object	Convert the attributes in the object one by one according to the document in the above-described format	{"name":"abc","secret":"123456"}	abc123456

3. Signature rules

1. FISCO BCOS framework DApp using ECDSA (secp256k1) secret key algorithm

- Getting the Hash value: The converted string to be signed is required to be computed with SHA256 algorithm with UTF-8 encoding.
- Sign the Hash value: The hash value and private key should be encrypted with ECDSA (secp256k1) algorithm. In the processing of some programming languages (C#, Java), if signed with SHA256WithECDSA, which includes hash value computation, therefore, the first step is not necessary.
- Encoding the signature result to Base64.

2. FISCO BCOS framework DApp using SM secret key algorithm

- Getting the Hash value: The converted string to be signed is required to be computed with SM3 algorithm with UTF-8 encoding.
- Sign the Hash value: The hash value and private key should be encrypted with SM2 algorithm.
- Encoding the signature result to Base64.

4. Example

Parameters:

{"header":{"userCode":"user01","appCode":"app01"},"mac":"","body":{“userId”:”abc”,”list”:[“abc”,”xyz”]}}

Result: user01app01abcabcxyz

5.4.4.2 Key and Certificate Modes

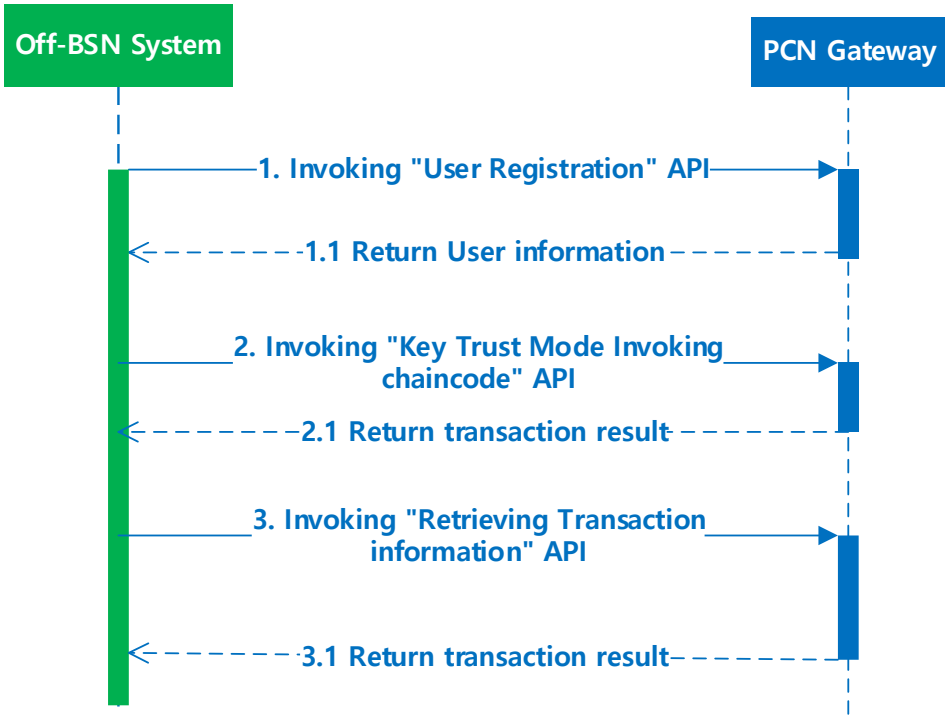
1. Key Trust Mode

As described in chapter 5, DApp participants require two sets of key pairs to access the DApp: DApp access key pair and user transaction key pair. Under the key trust mode, the pairs are generated and hosted by BSN. The participants only need to download the private key (DApp access key) from the BSN portal.

DApp Access Key Pair: After the participant has successfully joined the DApp, BSN will generate one key pair (private and public keys) that corresponds to the DApp’s framework algorithms under the Key Trust Mode. The participant can download the private key from “My Certificates” section of the BSN global portal and use it to sign the request message sent to the PCN gateway. The gateway will use the hosted public key from the generated key pair to validate the signature.

User Transaction Key Pair: This is the identity of a participant to invoke the chaincodes. Under the Key Trust Mode, after successfully joining the DApp, a participant’s user transaction key pair will be created automatically by BSN by default. The participant’s off-BSN system can use the participant’s UserCode to invoke the certificate generated by the key pair. If the participant’s off-BSN system has multiple sub-users, the off-BSN system can invoke the gateway’s “User Registration API” to register the sub-users and generate a separated user transaction key pair for each sub-user. The sub-users can use their own UserCode to connect to the DApp to execute smart contract transactions.

Transaction process:

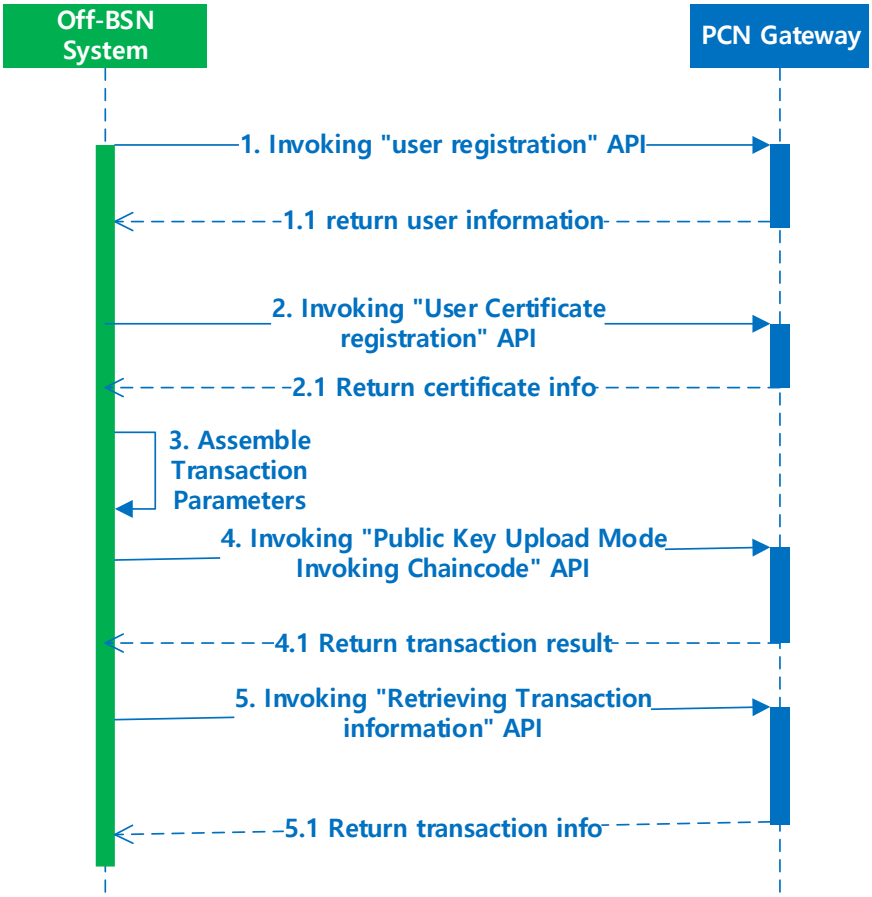


2. Public Key Upload Mode

As described in chapter 5, DApp participants require two sets of key pairs to fully access the DApp: DApp access key pair and user transaction key pair. With public-key upload mode, the key pairs are generated and stored locally by the participants. The participants only need to upload the public keys to BSN via the BSN portal or gateway APIs.

- DApp Access Key Pair: The DApp participant must generate the DApp access key pair locally according to the DApp framework algorithm after successfully joining the DApp. The participant stores the private key locally and uploads the public key to BSN via the BSN global portal. The participant's off-BSN system uses the private key to sign the transaction messages when invoking the PCN gateway. The PCN gateway will use the public key uploaded by the participant to verify the signature and validate the legality of the transaction.
- User Transaction Key Pair: This is the identity of a participant to invoke the chaincodes. Under the Key Trust Mode, the participant must generate the user transaction key pair locally and use the public key to generate the "public key registration application", then from the participant's off-BSN system to submit the registration application to BSN by invoking the "Public Key Upload Mode user certification registration" API on the PCN gateway to receive the public key certificate. If the off-BSN system has sub-users, it should first invoke the "User Registration" API to register the sub-users before sending their public key registration applications.

Transaction process:



5.4.4.3 Get DApp information API

Invoke this interface to get basic DApp information; this interface can be used by transactions in Public Key Upload Mode.

1. Interface address:

   https://PCNgatewayAddress/api/app/getAppInfo

2. Call Method: POST
3. Signature Algorithm: Not Required
4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Yes	
2	Body	body	Map	No	
3	Signature value	mac	String	Yes	
Header					
1	User unique ID	userCode	String	Yes	
2	DApp unique ID	appCode	String	Yes	
Body					
Example:					
{"header":{"userCode":"USER00012020041519580108712 92","appCode":"app00012020041610201529184 51","tId":""},"mac": "","body":{}}					

5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature value	mac	String	Y	
Header					
1	Response ID	code	int	Y	0: successful -1: failed
2	Response Message	msg	String	Y	
Body					
1	DApp name	appName	String	Y	
2	DApp type	appType	String	Y	
3	DApp encryption key type	caType	Int	Y	1: Key Trust Mode 2: Public Key Upload Mode
4	DApp algorithm Type	algorithmType	Int	Y	1: SM2 2: ECDSA(secp256r1)
5	City MSPID	mspId	String	Y	
6	DApp chain name	channelId	String	Y	Fabric corresponding channelId, fisco corresponding groupId

Example:


```
{
 "header": {
  "code": 0,
  "msg": "Transaction Successful"
 },
 "mac":
"MEUCIQDE9zv0E/w4V/ILG6wUCFP08a7NDCAtX/IoZOcCyY4gIQIgUTYWsFTA1
KE88gE6452jKnnVBrhznGVOV2HPMCbNh8A=",
 "body": {
  "appName": "sdktest",
  "appType": "fabric",
  "caType": 2,
  "algorithmType": 2,
  "mspId": "OrgbNodeMSP",
  "channelId": "app00012020041610201529184 51"
 }
}
```


5.4.4.4 User Registration API

After a participant has successfully joined in a FISCO BCOS (FISCO) DApp, his/her off-BSN system can invoke this interface to generate the user account and user address to execute smart contract transactions.

1. Interface address:

   https://PCNGatewayAddress/api/fiscobcos/v1/user/register

2. Call Method: POST
3. Signature algorithm: required and refer to Section 5.4.4.1

4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
body					
1	user name	userId	String	Y	Registered user name
Example:					
{ "header":{"appCode":"CL18810388732201909021143 14","userCode":"newuser"}, "body": { “userId”:”abc” }, "mac":"MEQCIBRhaM2szckWl9N9qcqnaYXOXGQw7SfII9DlRvxcI3YVAiBt4XeNs+EUjhBNSr3IjLRPZucsuGHxfjt9RiaNIQS8cA==”}					
signature value:					

5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
header					
1	Response ID	code	int	Y	0: authentication successful -1: authentication failed
2	Response Message	msg	String	N	if code=0 then can be null
body					
1	User information	data	[]string	N	If code is not 0, then leave blank
data					
1	User ID	userId	String	Y	
2	User Address	userAddress	String	Y	
Example					

{
"header": {
"code": 0,
"msg": "Transaction Successful"
},
"mac":
"MEQCIEI5VKMyJUXls2Hf8TLoPXjZLT4/L2wyXoddgTnZdqRsAiBxEBMeCOZ8M97OCRUAMZNMcL974vhzjOS/tk8/wbgbsA==",
"body": {
"userId": "100003",
"userAddress": "0x14647a48303b5e1c77934583883ebc327ba3b297"
}					

```
}
```

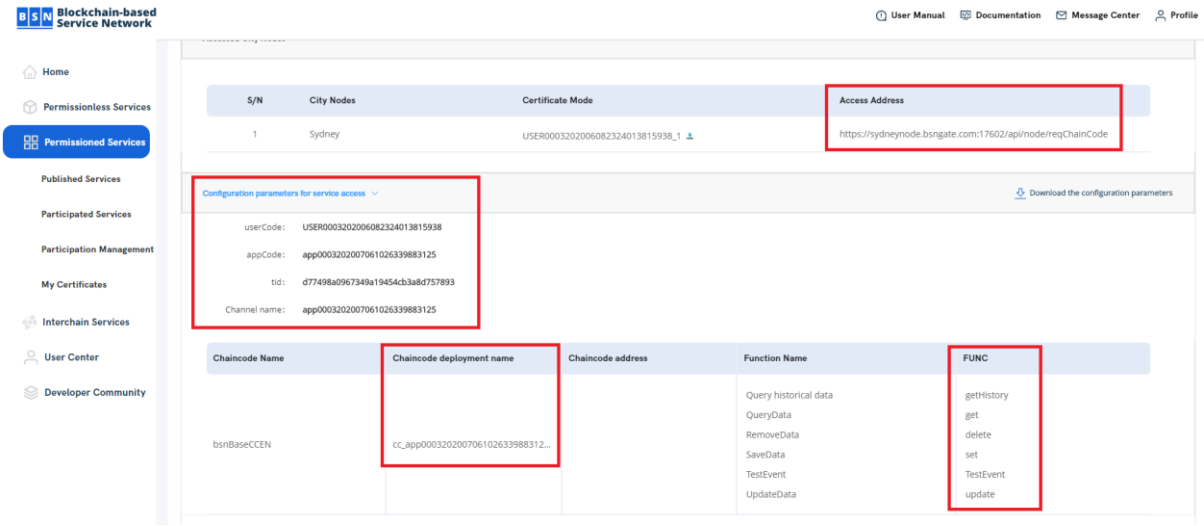
5.4.4.5 Invoke Smart Contract API in Key Trust Mode

For the FISCO DApps in Key Trust mode, when the off-BSN system invokes the smart contract via PCN gateway, it is required to include the parameters in the request. The gateway will return the response message from the chaincode.

1. Interface address:

   https://PCNGatewayAddress/api/fiscobcos/v1/node/reqChainCode

Note: After a participant has successfully joined in a FISCO DApp service, the participant can view and download the DApp's configuration parameters which are used for off-BSN systems to connect to this DApp's smart contracts, including the PCN gateway address and Dapp access keys, as shown below:



2. Call Method: POST
3. Signature algorithm: required and refer to Section 5.4.4.1
4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
Body					
1	User ID	userId	String	Y	Registered user ID via 7.3.1 API
2	Smart Contract Name	contractName	String	Y	
3	Function Name	funcName	String	Y	
4	Function Parameters	funcParam	string	N	convert array type to json string format

Example:
{"header":{"appCode":"cl00062020031819265736775 72","userCode":"USER00062020031819512818358 16"},"body":{"contractName":"HelloWorld","userId":"100003","funcName":"set","funcParam":[\"abc\"]},"mac":"MEUCIQDTFe2Gerdf7YJrG1a1Yt99M0ZQ3T1lGpsXdNmFV7WuTgIgSkZ19abUhAJbMrJMBoD8N7f26xhpQRuR4vNAfY7EEbs="}

5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
header					
1	Response ID	code	int	Y	0: authentication successful -1: authentication failed
2	Response Message	msg	String	N	if code=0 then can be null
Body					
1	Invoke Type	constant	Bool	N	
2	Query information	queryInfo	String	N	If Constant is true, this field has value.
3	Transaction hash	txId	string	N	If Constant is false, this field has value and is valid.
4	Block HASH	blockHash	String	N	If Constant is false, this field has value and is valid.
5	Block Number	blockNumber	Int	N	If Constant is false, this field has value and is valid.
6	Gas Used	gasUsed	Int	N	If Constant is false, this field has value and is valid.
7	Transaction Status	status	String	N	If Constant is false, this field has value and is valid. 0x0 means transaction successful, status value refer to transaction receipt status in 7.3.9
8	From account	from	String	N	If Constant is false, this field has value and is valid.
9	To account	to	String	N	If Constant is false, this field has value and is valid.
10	Input	input	String	N	If Constant is false, this field has value and is valid.
11	Ouput	output	String	N	If Constant is false, this field has value and is valid.

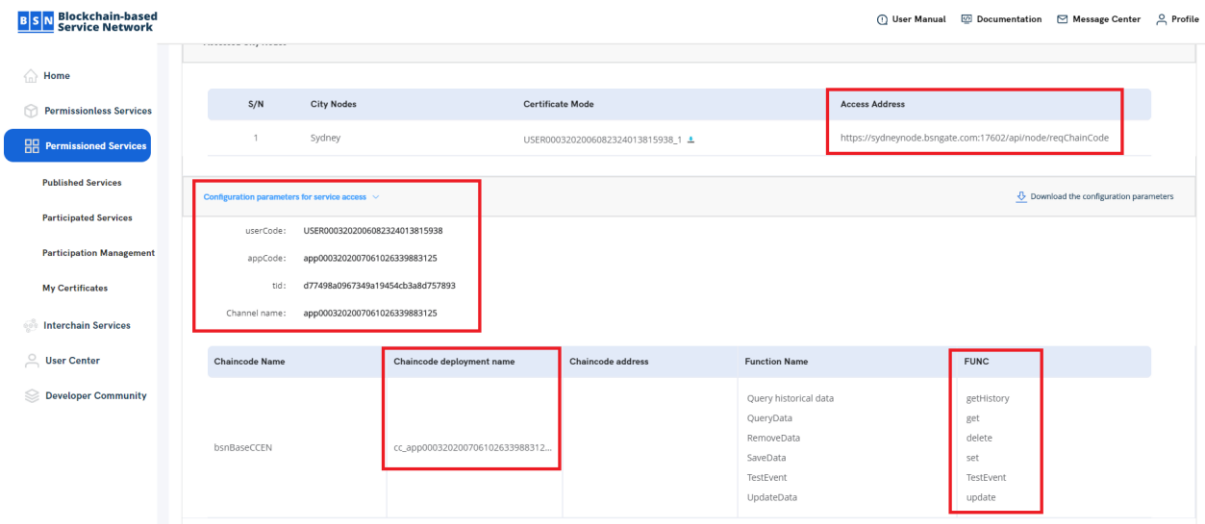
Example

5.4.4.6 Invoke Smart Contract API Public Key Upload Mode

When the off-BSN system invokes the node gateway, it should follow the API descriptions to add the corresponding parameters. After invoking the node gateway, the node gateway returns the execution result of the smart contract. In the transaction of Public Key Upload mode, the private key of the transaction on the chain is generated and saved by the user. Then the client performs the assembly and signature of the data locally. The signed data is uploaded to the node gateway, which forwards the data to the corresponding blockchain node to initiate the transaction request. Data assembly in this pattern requires information such as the contract ABI, which is compiled when developing the contract, and the contract address, which is available on the application details page. In the SDK of the gateway, the assembly method of the data on the link has been implemented, which can be directly called.

1. Interface address:

   https://PCNGatewayAddress/api/fiscobcos/v1/node/trans



Note: After a participant has successfully joined in a FISCO DApp service, the participant can view and download the DApp's configuration parameters which are used for off-BSN systems to connect to this DApp's smart contracts, including the PCN gateway address and Dapp access keys, as shown below:

2. Call Method: POST
3. Signature algorithm: required and refer to Section 5.4.4.1
4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
Body					
1	Smart Contract	contractName	String	Y	

	Name				
2	Transaction Data	transData	String	Y	
3	Contract address	contractAddress	String	N	
4	Contract ABI	contractAbi	String	N	

Example:

```
{"header":{"userCode":"USER0001202006042321579692440","appCode":"app0001202
006042323057101002","tId":""},"mac":"MEUCIQCrjIeRVSt1uwFFGkr37bVM8pF0Jg
AWb40mKEBc5HbpjgIgEzXRIgG+Q7obwuD2MY4EHo9sIsI1W71M+aQKOfAN3wU
=","body":{"contractName":"BsnBaseContractk1","transData":"0xf9016fa008d8ebcb4b
1f8205fd7883aa3ce9b9c844424070e55a3af6a5da5d7ee97d287385051f4d5c0083419ce0
7794866aefc204b8f8fdc3e45b908fd43d76667d7f7680b8e4ebf3b24f0000000000000000
00000000000000000000000000000000000000000000006000000000000000000000000
00000000000000000000000000000000000000005000000000000000000000000000000
00000000000000000000000000000000a00000000000000000000000000000000000000
0000000000000000000000000057330363034000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000000000000
00000000000026161000000000000000000000000000000000000000000000000000000
000000018187801ba0324efc9e17f1d31d95535c5103083560560f836931945d03fb69acb
6fd2046b5a05fa6f574f83b3b753c9fe40649a08c2a497af1cd804e08fed2b153af20267f23"
,
"contractAddress":"0xe2d0d414d436d8be9d52e2f40e6dd24a63faa638","contractAbi":"
Contract ABI"}}
```

5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
header					
1	Response ID	code	int	Y	0: authentication successful -1: authentication failed
2	Response Message	msg	String	N	if code=0 then can be null
Body					
1	Invoke Type	constant	Bool	N	
2	Query information	queryInfo	String	N	If Constant is true, this field has value.
3	Transaction hash	txId	string	N	If Constant is false, this field has value and is valid.
4	Block HASH	blockHash	String	N	If Constant is false, this field has value and is valid.
5	Block Number	blockNumber	Int	N	If Constant is false, this field has value and is valid.
6	Gas Used	gasUsed	Int	N	If Constant is false, this field has value and is valid.
7	Transaction Status	status	String	N	If Constant is false, this field has value

					and is valid. 0x0 means transaction successful, status value refers to transaction receipt status in 7.3.9
8	From account	from	String	N	If Constant is false, this field has value and is valid.
9	To account	to	String	N	If Constant is false, this field has value and is valid.
10	Input	input	String	N	If Constant is false, this field has value and is valid.
11	Output	output	String	N	If Constant is false, this field has value and is valid.
Example					

5.4.4.7 Get Transaction Receipt API

After the smart contract executes one transaction, this interface can be used to get the transaction receipt information according to the transaction hash value.

1. Interface address:

   https://PCNGatewayAddress/api/fiscobcos/v1/node/getTxReceiptByTxHash

2. Call Method: POST
3. Signature algorithm: required and refer to Section 5.4.4.1
4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
body					
2	Transaction Hash	txHash	string	Y	
Example:					
{"header":{"appCode":"cl0006202003181926573677572","userCode":"USER0006202003181951281835816"},"body":{"txHash":"0x755f3e7833778f674e1b025f513f05722ba7248be43a3c9168b880847814021a"},"mac":"MEYCIQCe6sI9zqspsy1bS6Ka9Q8O+pE7TEDWdsWj4UBSg6FM7AIhAJrud/EoxnURQcDc47iwTdh7OdxJEJPE+raK9UaHjNaJ"}					
signature value:					

5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	

2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
header					
1	Response ID	code	int	Y	0: authentication successful -1: authentication failed
2	Response Message	msg	String	N	if code=0 then can be null
Body					
1	Transaction Receipt Info	txId	string	N	If code is not 0, then leave blank
	Block HASH	blockHash			
	Block Number	blockNumber			
	Gas Used	gasUsed			
	From account	from			
	To account	to			
	Smart Contract Address	contractAddress			
Example					


```
{
  "header": {
    "code": 0,
    "msg": "Transaction successful"
  },
  "mac":
"MEUCIQCUlhnvH9a4HN/YITf4OWgTuHmmz6qMEO89I4effHdcIwIgStdeb/dVplhn3/FoCjeSc
VRyiEUhpkbze9bVm1gaXqs=",
  "body": {
    "blockHash":
"0x199eca276b60473dd65f8b36641684456694b419d89ef41b4953a9cdac848305",
    "gasUsed": 2154887,
    "blockNumber": 1,
    "txId": "0x8ee0c68e222742b5b70878265d3fdbd3a8e0d549da42a298a4ae872ca4fbfd89",
    "contractAddress": "0x20453db36c492fa49da9fab1b80db7fa5f46b01e",
    "from": "0x08ac3132a6c7e6ca5a7fbaf0521bb8b6f370ed35",
    "to": "0x0000000000000000000000000000000000000000"
  }
}
```


5.4.4.8 Get Transaction information API

After the smart contract executes one transaction, this interface can be used to get the transaction detailed information according to the transaction hash value.

1. Interface address:

   https://PCNGatewayAddress/api/fiscobcos/v1/node/getTxinfoByTxHash

2. Call Method: POST
3. Signature algorithm: required and refer to Section 5.4.4.1
4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
Body					
1	Transaction HASH	txHash	string	Y	
Example:					
{"header":{"appCode":"cl0006202003181926573677572","userCode":"USER0006202003181951281835816"},"body":{"txHash":"0x755f3e7833778f674e1b025f513f05722ba7248be43a3c9168b880847814021a"},"mac":"MEUCIQDDQudQBvHkI5tIpeTDGkQA+LPRMTA2k9u7hCZAYVobvQIgNseUfaVw8d/LxooPPWyQSo2O4EUt6wmEISgtnTcUO7k="}					

5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
header					
1	Response ID	code	int	Y	0: authentication successful -1: authentication failed
2	Response Message	msg	String	N	if code=0 then can be null
Body					
	Transaction HASH	txId	String		
	Block HASH	blockHash	String		
	Block Number	blockNumber	Int		
	Gas Used	gasUserd	Int		
	From account	from	String		
	To account	to	String		
		value	Int		
		input	String		
Example					

{
"header": {
"code": 0,
"msg": "Transaction Successful"
},
"mac":
"MEQCIBMqntmqQqZXkBbrLhmXEcuOqTG4YWvlfGJmebzEDbzcAiAKKHut9MBShqpSAEo8ts2MEQCIBMqntmqQqZXkBbrLhmXEcuOqTG4YWvlfGJmebzEDbzcAiAKKHut9MBShqpSAEo8ts2+OBIRmEEbedjihix5FZZvrw==",
"body": {
"blockHash":
"0x199eca276b60473dd65f8b36641684456694b419d89ef41b4953a9cdac848305",					

```
        "input":
"0x6080604052348015620000115760008 0fd5b50611001600080610100 0a81548173ffffffffffffffff
ffffffffffffffffffffff021916908373ffffffffffffffffffffffffffffffffffffffff160217905550600080905490 61
01000a900473ffffffffffffffffffffffffffffffffffff1673ffffffffffffffffffffffffffffffffffff1663c92a780
1604080519081016040528060068152602001 7f745f626173650000000000000000000000000000
0000000000000000000000081525060405182 63ffffffff167c0100000000000000000000000000000
0000000000000000000000000000281526004016200010191906200024a565b60206040518083038
1600087803b1580156200011c57600080fd5b505af115801562000131573d6000803e3d6000fd5b50
5050506040513d601f19601f820116820180604052506200015791908101906200017 4565b506200
02f4565b60006200016c8251620002a3565b905092915050565b6000602082840312156200018757
600080fd5b6000620001978482850162000 15e565b91505092915050565b6000620001ad82620002
98565b808452620001c381602086016020860162000 2ad565b620001ce81620002e3565b60208501
019150509291505056 5b6000601382527f626173655f6b65792c626173655f76616c7565000000000
0000000000000000060208301526040820190509190505 65b6000600782527f626173655f6964000
0000000000000000000000000000000000000000000000000060208301526040820190509190505 65b6
000606082019050818103600083015262000266818462000 1a0565b9050818103",
        "gasUsed": 100000000,
        "blockNumber": 1,
        "txId": "0x8ee0c68e222742b5b70878265d3fdbd3a8e0d549da42a298a4ae872ca4fbfd89",
        "from": "0x08ac3132a6c7e6ca5a7fbaf0521bb8b6f370ed35",
        "to": "0x0000000000000000000000000000000000000000",
        "value": 0
    }
}
```


5.4.4.9 Get Block Information API

Corresponding block information can be queried according to block number or the block hash. The block number and block hash cannot simultaneously be blank. When neither is blank, the block number will be invoked in priority.

1. Interface address:

   https://PCNGatewayAddress/api/fiscobcos/v1/node/getBlockInfo

2. Call Method: POST
3. Signature algorithm: required and refer to Section 5.4.4.1
4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
Body					
1	Block Height	blockNumber	string	N	When null, blockHash cannot be null
2	Block Hash	blockHash	String	N	When null, blockNumber

					cannot be null
Example:					
{ "header":{"appCode":"CL18810388732201909021143 14","userCode":"newuser"}, "body": { "blockNumber":22, "blockHash":"0xf27ff42d4be65329a1e7b11365e190086d92f9836168d0379e92642786db7ade" }, "mac":"MEQCIBRhaM2szckWl9N9qcqnaYXOXGQw7SfII9DlRvxcI3YVAiBt4XeNs+EUjhBNSr3IjLRPZucsuGHxfjt9RiaNIQS8cA==" }					
signature value:					

5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
header					
1	Response ID	code	int	Y	0: authentication successful -1: authentication failed
2	Response Message	msg	String	N	if code=0 then can be null
Body					
	Block HASH	blockHash	String	Y	
	Block Number	blockNumber	Int	Y	
	Parent Block HASH	parentBlockHash	String	Y	
	Block Size	blockSize	Int	Y	
	Block Time	blockTime	Int	Y	Timestamp in millisecond format
		author	String	Y	
	Transaction Information	transactions	[]Transaction Data	Y	
TransactionData					
	Transaction Id	txId	String	Y	
	Block HASH	blockHash	String	Y	
	Block Number	blockNumber	Int	Y	
	Gas Used	gasUsed	Int	Y	
		from	String	Y	
		to	String	Y	
		value	Int	Y	
		input	String	Y	
Example					

{
"header": {
"code": 0,
"msg": "Transaction successful"
},
"mac":					

```
"MEQCIHX8SuEn/sDiPscd5li3X1GdseyggAyC2o9L92FjhzrfAiBLyFW/rguLkqz/Lz62Vt
X3m7Y1nHqcFqcNdM7Wq0wGLQ==",
  "body": {
    "blockHash":
"0x199eca276b60473dd65f8b36641684456694b419d89ef41b4953a9cdac848305",
    "blockNumber": 1,
    "parentBlockHash":
"0xa6886f12ee91470e35546432413ed372615f8d4c23fa82e8381b3e5b31219d4c",
    "blockSize": 0,
    "blockTime": 1587125168039,
    "transactions": [
      {
        "txId":
"0x8ee0c68e222742b5b70878265d3fdbd3a8e0d549da42a298a4ae872ca4fbfd89",
        "blockHash":
"0x199eca276b60473dd65f8b36641684456694b419d89ef41b4953a9cdac848305",
        "blockNumber": 1,
        "gasUsed": 100000000,
        "from": "0x08ac3132a6c7e6ca5a7fbaf0521bb8b6f370ed35",
        "to": "",
        "value": 0,
        "input":
"0x6080604052348015620000115760008 0fd5b506110016000806101000a81548173ffffffff
ffffffffffffffffffffffffffffffffff021916908373ffffffffffffffffffffffffffffffffffffffff16021790555060
00809054906101000a900473ffffffffffffffffffffffffffffffffffffffff1673ffffffffffffffffffffffffffff
ffffffffff1663c92a7801604080519081016040528060068152602001 7f745f6261736500000
000000000000000000000000000000000000000000000000081525060405182 63ffffffff167c0
100000000000000000000000000000000000000000000000000000000000000281526004016200 0
10191906200024a565b602060405180830381600087803b1580156200011c57600080fd5b5
05af115801562000131573d6000803e3d6000fd5b505050506040513d601f19601f82011682
0180604052506200015791908101906200017 4565b50620002f4565b60006200016c825162
0002a3565b905092915050565b6000602082840312156200018757600080fd5b6000620001
97848285016200015e565b9150509291505056 5b6000620001ad8262000298565b80845262
0001c381602086016020860162000 2ad565b620001ce81620002e3565b6020850101915050
92915050565b6000601382527f626173655f6b65792c626173655f76616c756500000000000
000000000000000602083015260408201905091905056 5b6000600782527f626173655f696
400000000000000000000000000000000000000000000000000000602083015260408201905 09
19050565b600060608201905081810360008301526200026681846200001a0565b905081810
360208301526200027b8162000213565b905081810360408301520000 00"
      }
    ]
  }
}
```


5.4.4.10 Get DApp Block Height API

This interface is used to get block height in a DApp.

1. Interface address:

   https://PCNGatewayAddress/api/fiscobcos/v1/node/getBlockHeight

2. Call Method: POST
3. Signature algorithm: required and refer to Section 5.4.4.1

4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
body					
Example:					
{"header":{"appCode":"cl0006202003181926573677572","userCode":"USER000620200318195 1281835816"},"body":{},"mac":"MEQCIHb2o7hb0apDukOQBXkZftETsizDBaftnHxO9A9ux5 EtAiABuiFrVYPWT5FiU+Wd9HpXF/AJh0Yh2SXtL6h98m4eZw=="}					
signature value:					

5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
header					
1	Response ID	code	int	Y	0: authentication successful -1: authentication failed
2	Response message	msg	String	N	if code=0 then can be null
Body					
1	Block Height	data	string	N	If code not 0, then leave blank
Example					

{
"header": {
"code": 0,
"msg": "Transaction Successful"
},
"mac":
"MEQCICtCOdv4ZL72M3WoA9nAei2P0/PpKjlgI0Y5qeuzg61uAiA9D3TcB/+b2RMu NwVq+X0vgiglHfM5NBhoTJPR0gCPMA==",
"body": {
"data": "4"
}
}					

5.4.4.11 Get Total Number of DApp Transactions API

This interface is used to get the total number of transactions in a DApp.

1. Interface address:

   https://PCNGatewayAddress/api/fiscobcos/v1/node/getTxCount

2. Call Method: POST
3. Signature algorithm: required and refer to Section 5.4.4.1
4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
body					
Example:					
{"header":{"appCode":"cl00062020031819265736775 72","userCode":"USER0006202003181951281835816"},"body":{},"mac":"MEQCIBRhaM2szckWl9N9qcqnaYXOXGQw7SfII9DlRvxcI3YVAiBt4XeNs+EUjhBNSr3IjLRPZucsuGHxfjt9RiaNIQS8cA==" }					
signature value:					

5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
header					
1	Response ID	code	int	Y	0: authentication successful -1: authentication failed
2	Response Message	msg	String	N	if code=0 then can be null
Body					
1	Transaction Information	data	string	N	If code not 0, then leave blank
Example					


```
{
  "header": {
    "code": 0,
    "msg": "Transaction Successful"
  },
  "mac":
"MEQCIGgXINn3B9d/hC/ow0IJvi5eKDj59QbZRFdrCqcUeNCgAiApI4jkwhTY33qev1RwsJ3veDBKXokvIiSe3ck7SKlxmg==",
  "body": {
    "data":
"{\"txSum\":5,\"blockNumber\":5,\"txSumRaw\":\"0x5\",\"blockNumberRaw\":\"0x5\"}"
  }
}
```


5.4.4.12 Get Total Number of Block Transactions API

This interface is used to get the total number of transactions inside a block according the block number in a FISCO DApp. The block number cannot be null.

1. Interface address:

   https://PCNGatewayAddress/api/fiscobcos/v1/node/getTxCountByBlockNumber

2. Call Method: POST
3. Signature algorithm: required and refer to Section 5.4.4.1
4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
body					
2	Block number	blockNumber	string	Y	
Example:					
{ "header":{"appCode":"CL18810388732201909021143 14","userCode":"newuser"}, "body": { "grouId":1, "blockNumber":22, }, "mac":"MEQCIBRhaM2szckWl9N9qcqnaYXOXGQw7SfII9DlRvxcI3YVAiBt4XeNs+EUjhBNSr3IjLRPZucsuGHxfjt9RiaNIQS8cA==" }					

5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
header					
1	Response ID	code	int	Y	0: authentication successful -1: authentication failed
2	Response message	msg	String	N	if code=0 then can be null
Body					
1	Block total count of transactions info	data	string	N	If code not 0, then leave blank
data					
Example					

{
"header": {
"code": 0,
"msg": "Transaction Successful"
},
"mac":
"MEUCIQCMFbVhfH9X8pJ1mNI3YpzKIBcXCpfmf2AniF/42ak9EwIgTWDEF+xW5l39ZDUnDSSSc8Zv8J1glEf9izp16eW/Rn4=",					

```
  "body": {
    "data": "1"
  }
}
```

5.4.4.13 Smart Contract Event Registration API

Smart contract event in a DApp can trigger the off-BSN system to process further transactions. This interface is used to register the smart contract event to be monitored.

1. Interface address:

   https://PCNGatewayAddress/api/fiscobcos/v1/event/register

2. Call method: POST
3. Signature algorithm: required and refer to Section 5.4.4.1
4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
Header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
Body					
1	Event Type	eventType	String	Y	1.Block generation event 2.Contract event
2	Contract address	contractAddress	String	N	EventType is 1 then can be null; EventType is 2 then EventType and contract Name cannot be null at the same time
3	Contract name	contractName	String	N	EventType is 1 then can be null; EventType is 2 then EventType and contractName cannot be null at the same time
4	Notification URL	notifyUrl	String	Y	
5	Attached parameters	attachArgs	String	N	
Example:					
{"header":{"userCode":"USER000120200604232157969244 0","appCode":"app000120200604232 3057101002","tId":""},"mac":"MEUCIQCMP1ToZS5e8S94kYZ/8y5XfeyjRyUrPFpeIQMES3SGp QIgO8b6O8Kk/qpNTo1vbNTwyAYNaw6HBi9OkAH8Rp23j8s=","body":{"eventType":1,"contra ctAddress":"0x866aefc204b8f8fdc3e45b908fd43d76667d7f76","contractName":"BsnBaseContract k1","notifyUrl":"http://127.0.0.1:18080","attachArgs":"abc=123"}}					

5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
header					
1	Response ID	code	int	Y	0: successful -1: failed
2	Response Message	msg	String	Y	
Body					
1	Event ID	eventId	String	Y	Null when the code is not 0
Example					


```
{
 "header": {
  "code": 0,
  "msg": "Transaction successful"
 },
 "mac":
"MEUCIQDYSTwYhh6EDHT5Z7ukcqXW9LMjZW6WPnrv8Xt14RuH2AIgIwa5K7NK4/TThzs8
z6VfkpNNJU+dzAXeypFmfjkru88=",
 "body": {
  "eventId": "xxxxxxxxxxxxxxxxxxxxxxxxxxx"
 }
}
```


5.4.4.14 Smart Contract Event Query API

Use this API to query the list of monitored smart contract events that have been registered.

1. Interface address:

   https://PCNGatewayAddress/api/fiscobocs/v1 /event/query

2. Call method: POST
3. Signature algorithm: required and refer to Section 5.4.4.1
4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	N	
3	Signature Value	mac	String	Y	
header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
Example:					


```
{"header":{"userCode":"USER000120200604232157969244 0","appCode":"app000120200604232
3057101002","tId":""},"mac":"MEUCIQC2NTuUlsxQSWPpZwwhJK9zXEMaeYZC04Ar0P5Twy
p5AQIgFvZrskasuLiYfOGxd1F9TCetWHIfENg8BCiYfNS1xGk=" }
```


5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
Header					
1	Response ID	code	int	Y	0: Query successful -1: Query failed
2	Response Message	msg	String	Y	
body					
1	Block generation event	blockEvent	[]blockEvent	Y	Null when the code is not 0
2	Contract event	contractEvent	[]contractEvent	Y	
blockEvent					
1	block generation event	eventId	string	Y	Null when the code is not 0
2	App code	appcode	String	Y	
3	User code	userCode	String	Y	
4	Notification URL	notifyUrl	String	Y	
5	Attachment parameters	attachArgs	String	N	
6	Create time	createTime	String	Y	UTCtime
contractEvent					
1	block generation event	eventId	string	Y	
2	App code	appcode	String	Y	
3	User code	userCode	String	Y	
4	Notification URL	notifyUrl	String	Y	
5	Attachment parameters	attachArgs	String	N	
6	Create time	createTime	String	Y	UTCtime
7	Contract address	contractAddress	String	Y	

Example


```
{
  "header": {
    "code": 0,
    "msg": "Transaction succssful"
  },
  "mac":
"MEUCIQCQ/RjmlVkLKZw6jcLKBPh1BwK4EIQE001vUAKPVq1HTgIgXUQ7Bn+y8
D8xQxYUwtZOoh/bpteAPCUtKXZeAiN7cMU=",
  "body": {
    "blockEvent": [
      {
        "eventId": "ba537419953e4e219ceb0fe26ad5e125",
        "appCode": "app00012020060423230571010 02",
        "userCode": "USER00012020060423215796924 40",
        "notifyUrl": "http://127.0.0.1:18080",
        "attachArgs": "abc=123",
        "createTime": "0001-01-01 00:00:00.000 +0000 UTC"
```

```
      }
    ],
      "contractEvent": [
  {
      "eventId": "ba537419953e4e219ceb0fe26ad5e126",
      "appCode": "app00012020060423230571010 02",
      "userCode": "USER00012020060423215796924 40",
      "notifyUrl": "http://127.0.0.1:18080",
      "attachArgs": "abc=123",
      "createTime": "0001-01-01 00:00:00.000 +0000 UTC",
     “contractAddress”:” 0x866aefc204b8f8fdc3e45b908fd43d76667d7f76”
     }
      ]
  }
}
```


5.4.4.15 Remove Smart Contract Event API

This interface is used to remove a smart contract event’s registration information from the event list.

1. Interface address:

   https://PCNGatewayAddress/api/fabric/v1/chainCode/event/remove

2. Call method: POST
3. Signature algorithm: required and refer to Section 5.4.4.1
4. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	N	
3	Signature Value	mac	String	Y	
header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
Body					
1	Event ID	eventId	String	Y	
Example:					
{"header":{"appCode":"CL20191107112252","userCode":"lessing"},"body":{"eventId":"bd3391dedbe44a7ad5b7f80ce59abfa"},"mac":"MEQCIE3/CLG5LxZZN7En7LZvzthajwxHzpvDduXSsw4Tb1JFAiAXGJ4WVtyCKbtCasQGofCkge8NOgZDNPgJIdTCtCi2SQ=="					

5. Response parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	Y	
3	Signature Value	mac	String	Y	
header					
1	Response ID	code	int	Y	0: remove successful

					-1: remove failed
2	Response Message	msg	String	Y	
Example					
{"header": {"code": 0, "msg": "Remove Event Successful"}, "body": null, "mac": "MEUCIQCaTFLliY7pPjkwcmSsLXOth7k9bQj9Sblq+1nMVjkFAAIgUsizFO+f1+dxU3/hPxjf/+na4qG6aQFftJIWGtMhlVI="}					

5.4.4.16 Smart Contract Event Notification API

This interface is implemented on the off-BSN system side. When the PCN gateway receives the notification of a triggered event, it uses this interface to notify the off-BSN system about the execution result.

After receiving the notification successfully, the off-BSN system returns a string containing "success", otherwise, the gateway will send the notification again at 3, 12, 27, and 48 seconds respectively, for a total of five times.

1. Call method: POST
2. Signature algorithm: required and refer to Section 5.4.4.1
3. Call parameters

No.	Field name	Field	Type	Required	Remarks
1	Header	header	Map	Y	
2	Body	body	Map	N	
3	Signature Value	mac	String	Y	
header					
1	user unique ID	userCode	String	Y	
2	DApp unique ID	appCode	String	Y	
body					
1	Registered Event ID	eventId	String	Y	
2	PCN ID	orgCode	String	Y	
3	Registered Event parameters	attachArgs	String	N	Additional parameters entered during registration
4	Response random string	nonceStr	String	Y	Off-BSN system uses this value to judge if the notification is already received. This string remains the same at the repeated notifications.
5	Event type	eventType	String	Y	
6	Event data	eventData	String	Y	
Example:					
{"header":{"userCode":"USER000120200604232157969244 0","appCode":"app000120200604232 3057101002"},"body":{"eventId":"5b5b865f8dc94ae59d215cf26aa81d69","orgCode":"ORG20200 41114171692360","appCode":"app000120200604232305710100 2","attachArgs":"abc=123","nonc					

eStr":"52f080f27ff045eb87e21812d12cee40","eventType":1,"eventData":"{\"appId\":\"app000120200604232305710100 2\",\"blockNumber\":17,\"eventType\":1,\"groupId\":135}"},"mac":"MEUCIQD3Sp6xuI4DHy/GOb9z3nH6kQisEzfXvZ/Hn/mfZXIAOgIgYsISRfBKSJGt4FrmxETflfR4A8VenCZHvxthMFUWRkc="}

5.4.4.17 Transaction Receipt Status

Under Key Trust Mode, the description of the returned transaction status when the off-BSN system invokes the FISCO DApp smart contracts via PCN gateway APIs are shown as follows:

status(Decimal/ Hexadecimal)	message	Explanation
0(0x0)	None	No Error
1(0x1)	Unknown	Unknown Error
2(0x2)	BadRLP	Invalid RLP Error
3(0x3)	InvalidFormat	Invalid Format Error
4(0x4)	OutOfGasIntrinsic	The length of smart contract exceeds gas limit/smart contract invoking parameters exceed gas limit
5(0x5)	InvalidSignature	Invalid Signature Error
6(0x6)	InvalidNonce	Invalid nonce Error
7(0x7)	NotEnoughCash	Not enough cash Error
8(0x8)	OutOfGasBase	Parameters too long (RC version)
9(0x9)	BlockGasLimitReached	Gas limit reached Error
10(0xa)	BadInstruction	Bad Instruction Error
11(0xb)	BadJumpDestination	Bad Jump Destination Error
12(0xc)	OutOfGas	Out of gas to execute the smart contract/the length of smart contract exceeds the limit.
13(0xd)	OutOfStack	Out of Stack Error
14(0xe)	StackUnderflow	Stack Under Flow Error
15(0xf)	NonceCheckFail	Nonce check failed Error
16(0x10)	BlockLimitCheckFail	Block limit check failed Error
17(0x11)	FilterCheckFail	Filter check failed Error
18(0x12)	NoDeployPermission	No Deployment Permission Error
19(0x13)	NoCallPermission	Invalid call Error
20(0x14)	NoTxPermission	Invalid transaction Error
21(0x15)	PrecompiledError	Precompiled Error
22(0x16)	RevertInstruction	Revert Instruction Error
23(0x17)	InvalidZeroSignatureFormat	Invalid Signature Format
24(0x18)	AddressAlreadyUsed	Address Already Used Error
25(0x19)	PermissionDenied	Permission Denied
26(0x1a)	CallAddressError	Call Address does not exist Error

5.5 Development SDK and Examples

5.5.1 BSN Gateway SDK Example

Normally, if an off-BSN system wants to communicate with a permissioned DApp service on BSN, it has to call the public city nodes (PCN) gateway APIs. We provide a BSN Gateway SDK (Software Development Kit) which can help developers quickly implement an off-BSN system to call the PCN Gateway. Inside the SDK, we provide PCN gateway API encapsulation which you can use to implement the transaction querying, transaction interface calling,

generate public key and private key locally, register user certificate, generate certificate signature, encrypt and decrypt data, etc.

Download links:

https://github.com/BSNDA/PCNGateway-Go-SDK

https://github.com/BSNDA/PCNGateway-Java-SDK

https://github.com/BSNDA/PCNGateway-PY-SDK

https://github.com/BSNDA/PCNGateway-CSharp-SDK

5.5.2 Sample Smart Contract Packages

For your reference, the following is the sample source code of our preset chaincode/smart contract packages, including Golang, and solidity language examples.

- **Fabric example**

Download link:

https://github.com/BSNDA/FabricBaseChaincode

- **FISCO BCOS example**

Download link:

https://github.com/BSNDA/FISCOBaseContract

We invite experienced developers who are interested in BSN to work together to optimize the SDK and sample packages. If you'd like to participate, please contact us on GitHub.

5.6 BSN Testnet Services

5.6.1 Overview

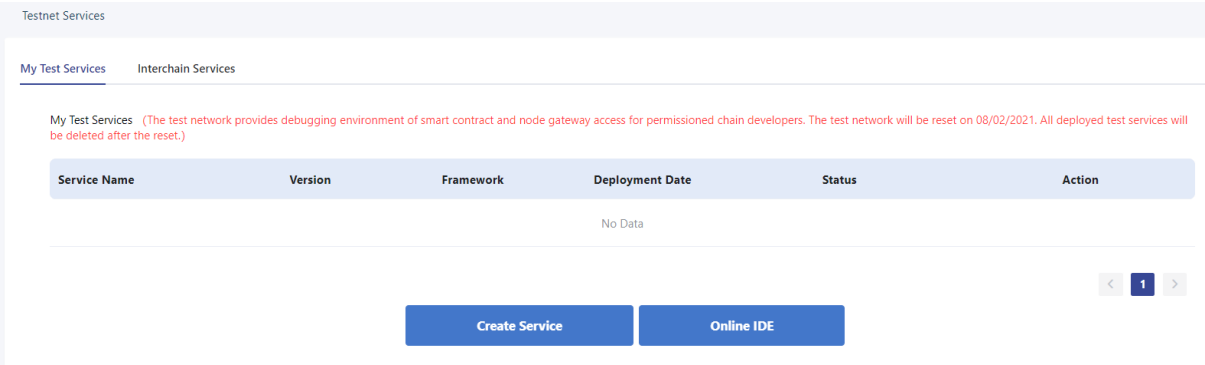
BSN Testnet is a free test environment for developers to test their permissioned DApp services. Developers can publish an unlimited number of permissioned DApp services on the testnet. Unlike the BSN production environment, it is not necessary to choose the public city nodes and configure the invocation authorities of smart contracts when publishing DApp services on the testnet. The Testnet supports Hyperledger Fabric and FISCO BCOS frameworks, and will continue to integrate all BSN-adapted permissioned frameworks. Like all testnets do, we will occasionally reset the Testnet and delete all smart contracts and ledger data. Therefore, please do not use the Testnet as a commercial or production environment. We welcome developers to try the service and provide us with feedback and suggestions as we continue to make improvements.

5.6.2 Permissioned DApp Service Publication

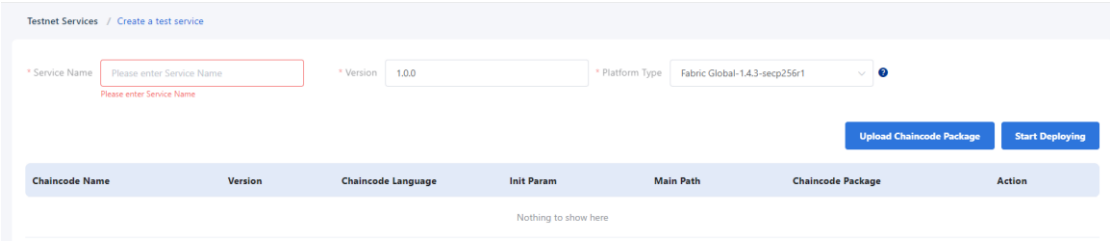
The steps to publish a permissioned DApp service for testing are as follows:

1. Create a new test service

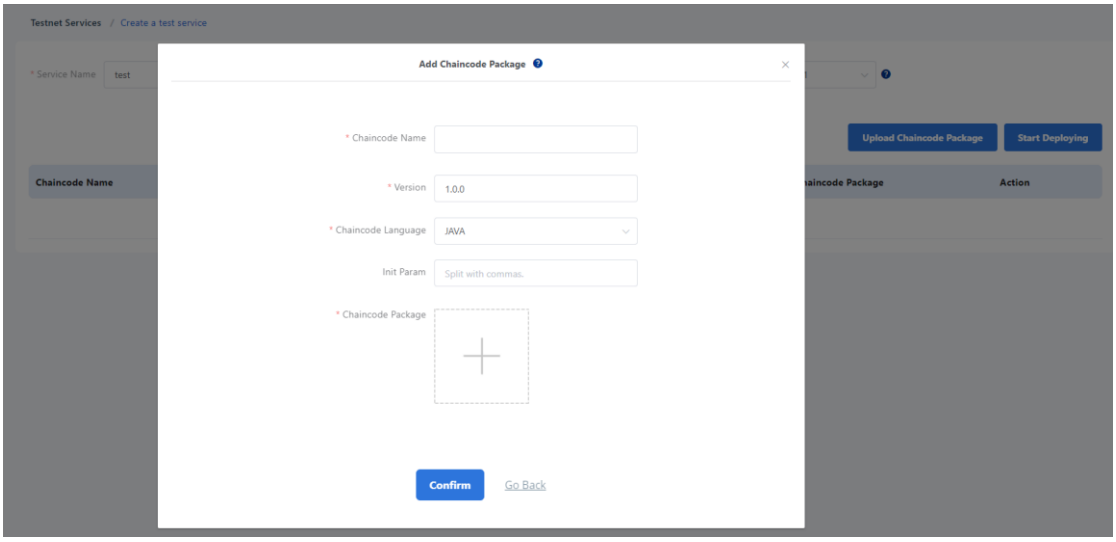
   Go to the **Permissioned Services > Testnet Services** page to publish the service.



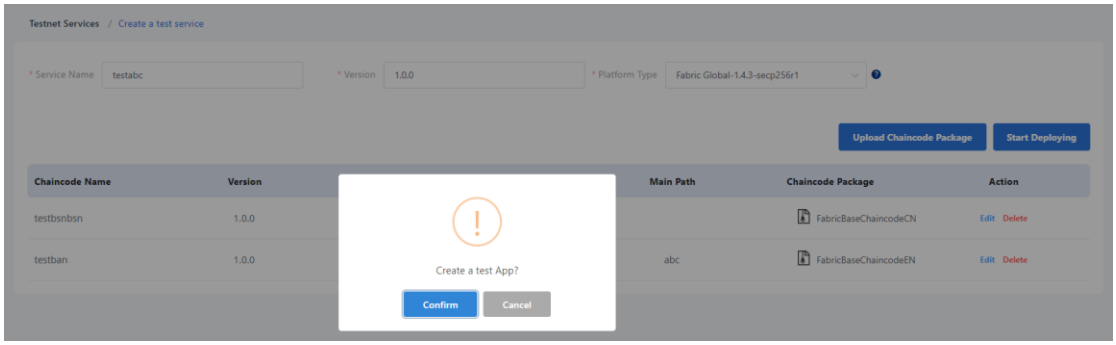
Click **Create a Test Service** and input the service name, version, and select a platform type.

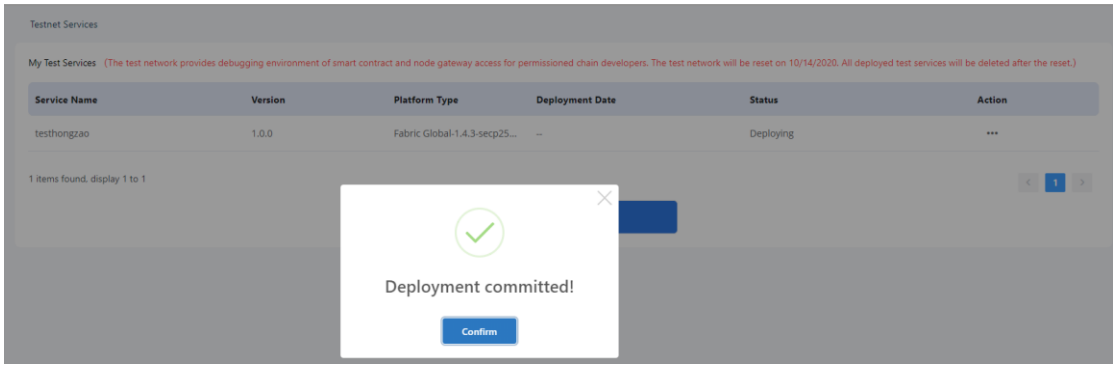


Click **Upload Chaincode Package** to upload the chaincode or smart contract package. You can upload multiple chaincode/smart contract packages in a permissioned DApp service. Input the information and click **Confirm** to upload the package.



2. Deploy the permissioned DApp service:
   Click **Start Deploying** to deploy the service.





After successfully deploying the chaincode/smart contract, developers can call it from their off-BSN systems so that they can configure and debug the functions easily.

Note: To keep the resources stable, DevOps will periodically clean up the chaincode/smart contract packages and ledger data on the Testnet.

5.6.3 Interchain Services on BSN Testnet

A demo version of Interchain Communications Hub (ICH) is now live on the Testnet, integrating the cross-chain solution based on the relay chain mechanism (Poly Enterprise developed by Onchain Tech). We welcome developers to try it out and provide feedback and suggestions, and we will continue to improve the functionality.

For detailed descriptions and examples of ICH services, please refer to chapter 8, "Interchain Services"

6 Dedicated Node Services

6.1 Overview

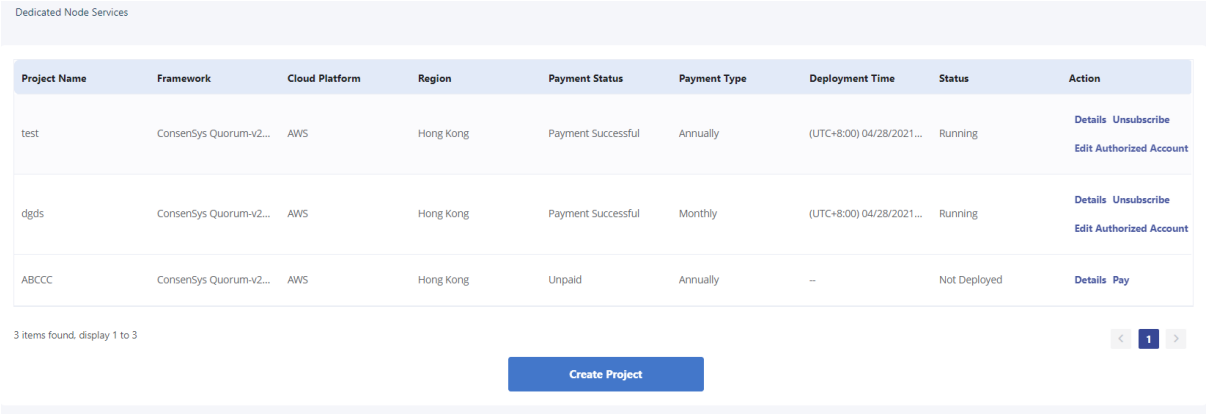
BSN dedicated node services apply BSN technologies including multi-layer framework adaptation, virtualized container, automated deployment and node gateway to provide users with "out-of-the-box" blockchain cloud services. Users can quickly create their own dedicated permissioned blockchain operating environment, configure node's CPU, memory, disk capacity and other parameters in the BSN portal; they can independently manage nodes, publish smart contracts, access node data and monitor blockchain operation status. The dedicated node does not restrict APIs of the framework, and all APIs can be called by developers after they access the dedicated node through the gateway.

Currently, dedicated node services allow users to build the permissioned chain services based on ConsenSys Quorum (an open source, free and enterprise-focused blockchain framework), Hyperledger Fabric, and Besu in the BSN public city node built on AWS cloud platform. The version of ConsenSys Quorum is v20.10.0, and its consensus mechanism supports Raft and IBFT mechanisms; the version of Hyperledger Fabric is v2.3.2, and its consensus mechanism is Raft; the version of Hyperledger Besu is v21.1.2, and its consensus mechanism is Clique and IBFT.

6.2 Project Management

6.2.1 Create Projects

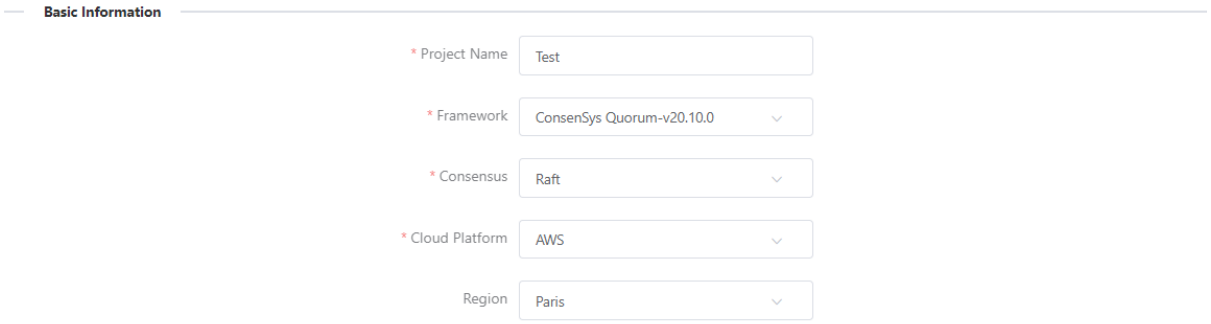
1. In the BSN menu, click the **Permissioned Service** dropdown, in the list, click **Dedicated Node Services** to open the page. The page lists the projects created by the user and shows the status information of each project.



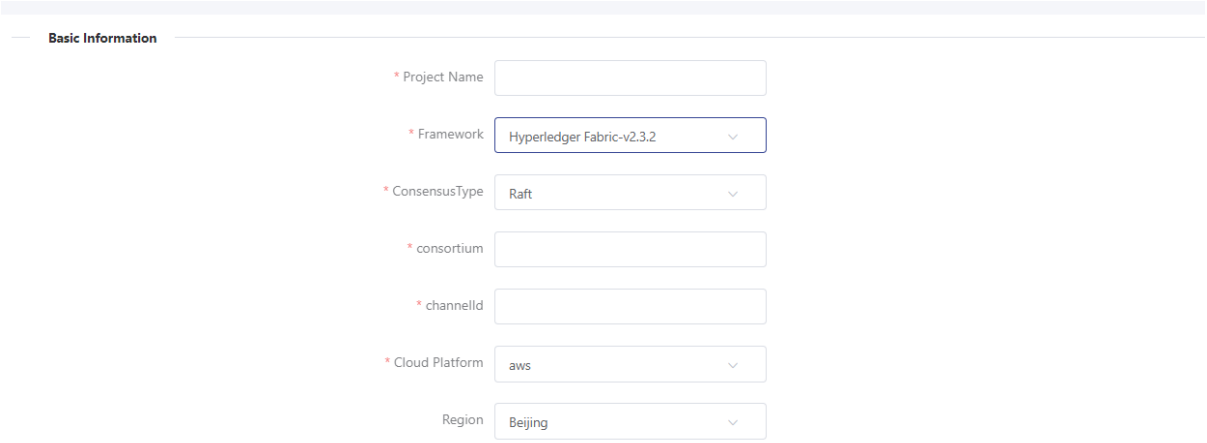
2. Click **Create Project** button and jump to the information page. This page contains 4 sections: **Basic Information**, **Node Information**, **Gateway Information** and **Data Usage Information**.

   1） **Basic Information**: This section shows the basic information of the service.

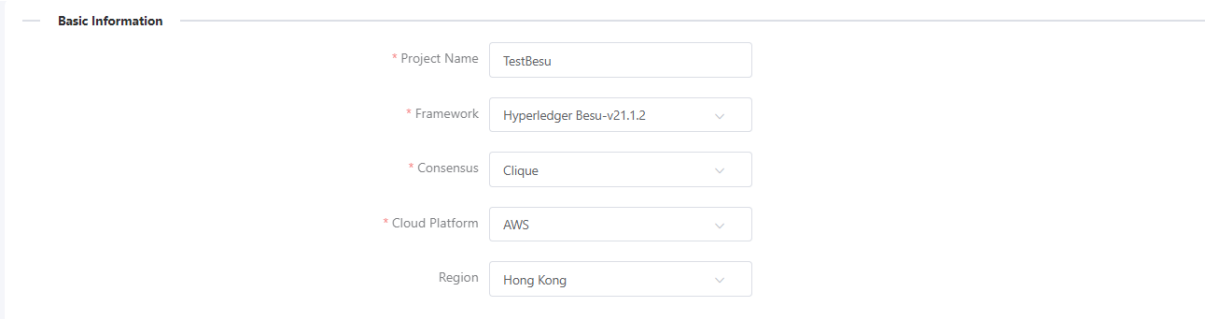
   - When the framework is ConsenSys Quorum-v20.10.0, the following basic information will be displayed, including project name, framework, consensus mechanism (options including: Raft, IBFT), cloud platform and region.



- When the framework is Hyperledger Fabric-v2.3.2, the following basic information will be displayed, including project name, framework, consensus mechanism (Raft), cloud platform, region, consortium name, and channel name.

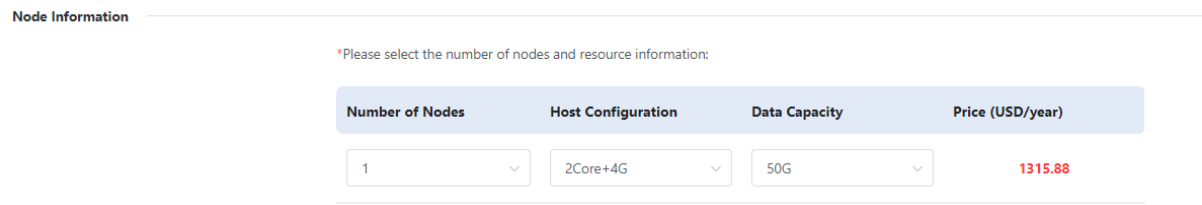


- When the framework is Hyperledger Besu-v21.1.2, the following basic information will be displayed, including project name, framework, consensus mechanism (Options including: Clique, IBFT), cloud platform and region.

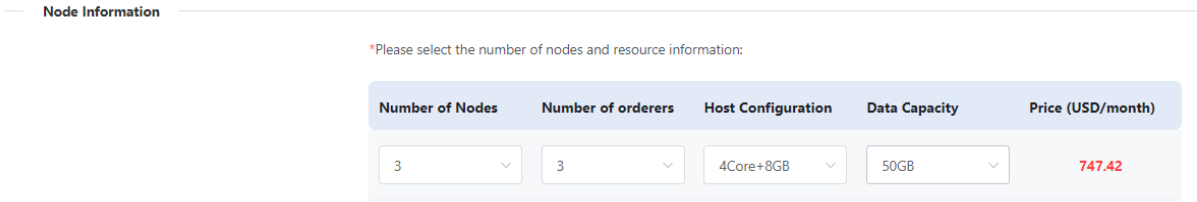


2）**Node Information**: The publisher can select the number of nodes and other resource information, including CPU, memory and data capacity. The price is automatically calculated based on the resources which publisher has selected.

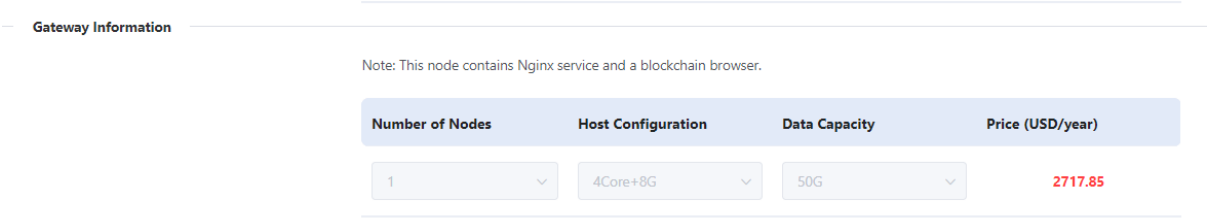
- When the framework is ConsenSys Quorum-v20.10.0 or Hyperledger Besu-v21.1.2, the node information includes: Number of Nodes, Host Configuration, Data Capacity and Price.



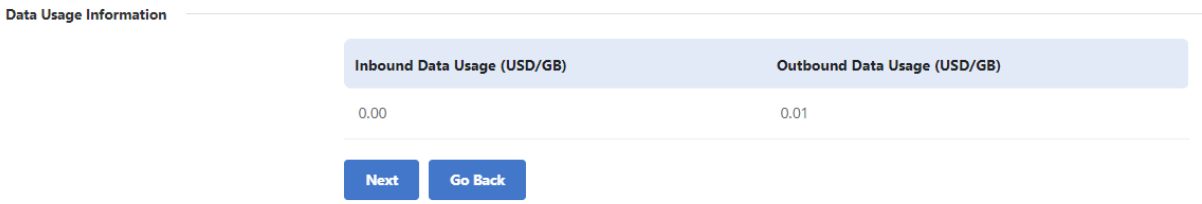
- When the framework is Hyperledger Fabric-v2.3.2, the node information includes: Number of Nodes, Number of Orderers, Host Configuration, Data Capacity and Price.



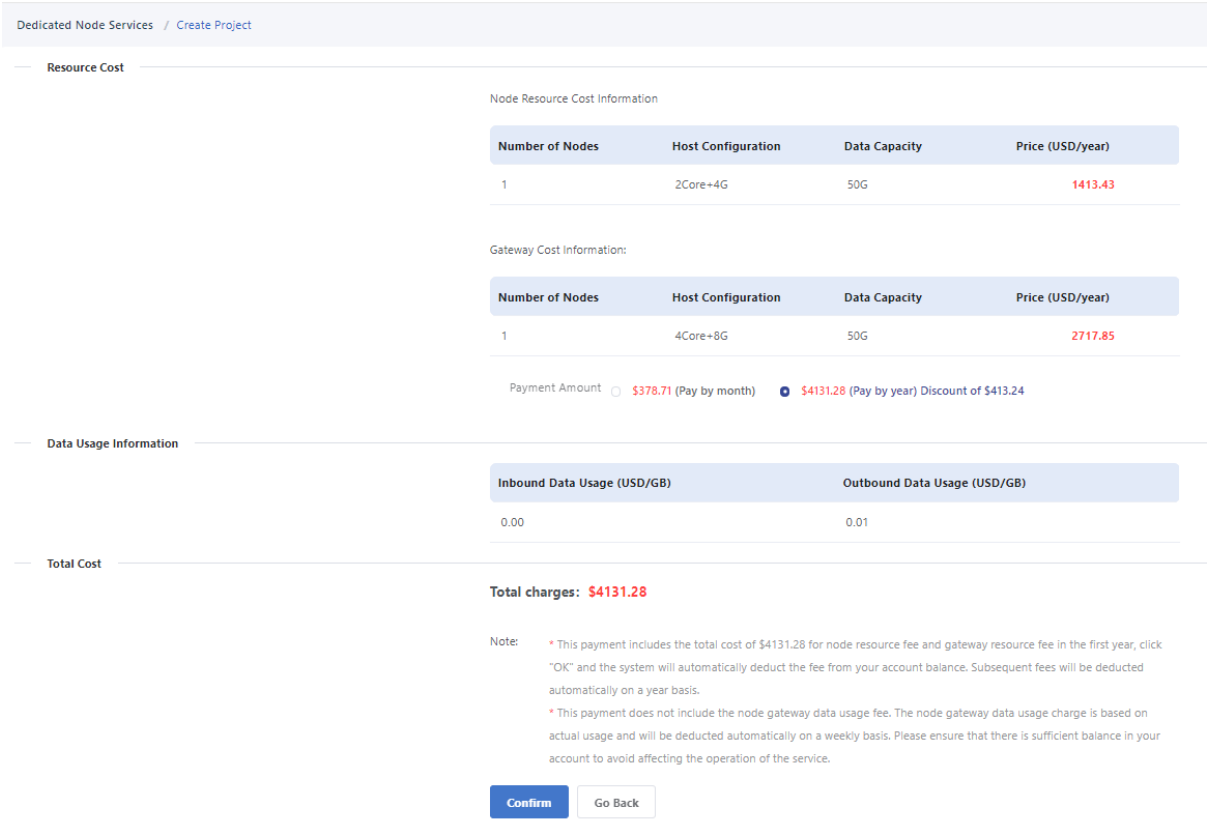
3）**Gateway Information**: This section shows the information of the gateway node, and this node contains Nginx service and a blockchain browser. Publisher does not need to select resources.



4）**Data Usage Information**: This section shows the unit data price for inbound gateway traffic and outbound gateway traffic.



3. Click Next button to jump to **Charge Details** page. This page has 3 sections: **Resource Cost**, **Data Usage Information** and **Total Cost**.



1) **Resource Cost:** Resource Cost section contains the cost of node resources and gateway resources. According to the resource cost information, the publisher can either pay by month or pay by year. A discount will be applied when paying annually.
   - When the framework is ConsenSys Quorum-v20.10.0 or Hyperledger Besu-v21.1.2, the node information section of the resource cost includes: number of nodes, host configuration, data capacity, and price.
   - When the framework is Hyperledger Fabric-v2.3.2, the node information section of the resource cost display includes: number of nodes, number of orderers, host configuration, data capacity, and price.
2) **Data Usage Information:** This section shows the unit data price for inbound gateway data usage and outbound gateway data usage.
3) **Total Cost:** The total charges that the publisher should pay for.

4. After the publisher confirms the Charge details, click "**Confirm**" button to make payment. The payment will be deducted from the user's personal (or corporate) account. If the deduction fails, the bill will be kept for 72 hours before expiration. If you still want to open a dedicated node service, you can resubmit or recreate the project by editing the current project.

Note: In terms of dedicated node services payment, developers can make payments for dedicated node services with the status of "not deployed" and pending payment, payment failed, and "running" but in arrears. The payment will be debited from the user's personal (or corporate) account. After the payment is successful, the developer should wait for the deployment of the dedicated node.

6.2.2 Edit Projects

1. Dedicated node services with the status of "not deployed" and billing invalid, pending payment, payment failed, and "deployment failed" and fully refunded can be edited. In the edit page, developer can edit the basic information and node information.

2. Once edited the information, developer can jump to the Charge Details page to pay the bill. After the payment is successfully made, developer can then wait for the deployment of the dedicated node.

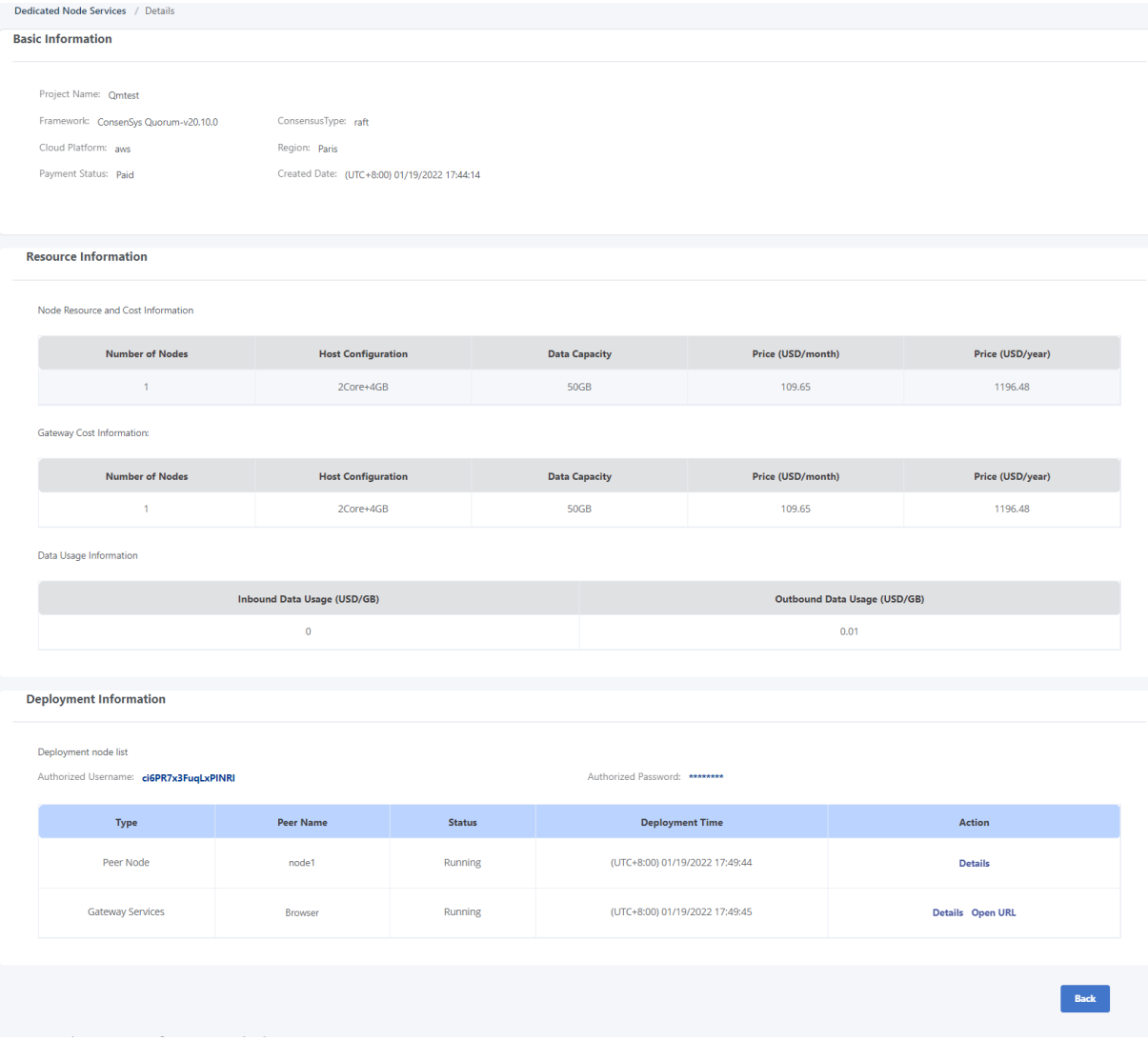
6.2.3 Delete Projects

Dedicated node services that are in the status of "not deployed" with expired billing and "deployment failed" with full refund can be deleted.

6.2.4 View Project Details

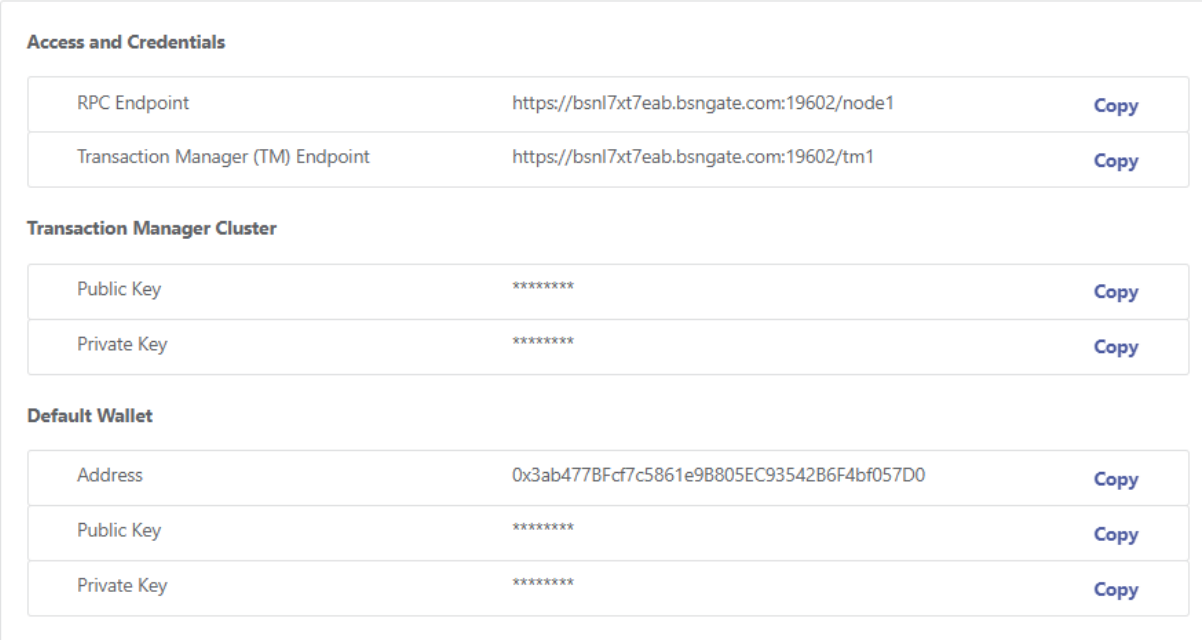
When the dedicated node has been deployed, the developer can view the detailed information of the project. Click **Details** button in **Action** column to jump to the project details page. There are 3 sections in this page: **Basic Information**, **Resource Information** and **Deployment Information**.

1. When the framework is ConsenSys Quorum-v20.10.0, the page is shown as below:

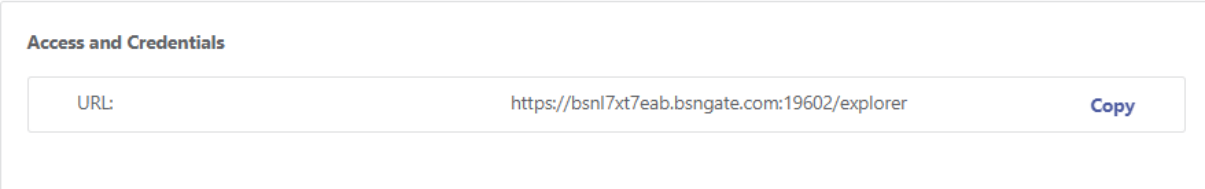


1) **Basic Information**: Project Name, Framework, Consensus, Cloud Platform, Region, Payment Status and Created Date.
2) **Resource Information**: Node resource and cost information, Gateway Cost Information and Data Usage Information.

3) **Deployment Information**: The developer can view node information and browser information. Clicking on the "**Details**" button corresponding to the peer node, developer can view the information of Access and Credentials, Transaction Manager cluster, and Default Wallet.



4) By clicking on the "**Details**" button corresponding to gateway services, the developer can obtain the URL address of the blockchain browser.



2. When the framework is Hyperledger Fabric-2.3.2, the page is shown as below:

Dedicated Node Services / Details

Basic Information

Project Name: hf232

Framework: Hyperledger Fabric-v2.3.2

ConsensusType: raft

consortium: test

channelId: hf

Cloud Platform: aws

Region: Beijing

Payment Status: Paid

Created Date: (UTC+8:00) 01/19/2022 17:20:33

Resource Information

Node Resource and Cost Information

Number of Nodes	Number of orderers	Host Configuration	Data Capacity	Price (USD/month)	Price (USD/year)
3	3	2Core+4GB	50GB	280.98	3066.32

Gateway Cost Information:

Number of Nodes	Host Configuration	Data Capacity	Price (USD/month)	Price (USD/year)
1	2Core+4GB	50GB	93.66	1022.1

Data Usage Information

Inbound Data Usage (USD/GB)	Outbound Data Usage (USD/GB)
0	0.2

Deployment Information

Deployment node list

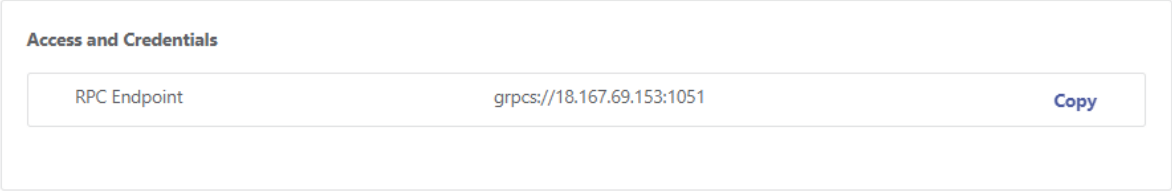
Access to Peer node, Orderer and CA certificate service requires downloading CA certificate and configuration information; the account/password for accessing the gateway service browser is: admin/adminpw

Click to download CA certificate and configuration information

Type	Peer Name	Status	Deployment Time	Action
Peer Node	peer1.org1.test.com	Running	(UTC+8:00) 01/19/2022 17:25:15	Details
Peer Node	peer3.org1.test.com	Running	(UTC+8:00) 01/19/2022 17:25:15	Details
Peer Node	peer2.org1.test.com	Running	(UTC+8:00) 01/19/2022 17:25:15	Details
Gateway Services	Browser	Running	(UTC+8:00) 01/19/2022 17:25:15	Details Open URL
Orderer	orderer1.orderer.test.com	Running	(UTC+8:00) 01/19/2022 17:25:15	Details
Orderer	orderer3.orderer.test.com	Running	(UTC+8:00) 01/19/2022 17:25:15	Details
Orderer	orderer2.orderer.test.com	Running	(UTC+8:00) 01/19/2022 17:25:15	Details
CA Certificate Service	ca.org1.test.com	Running	(UTC+8:00) 01/19/2022 17:25:15	Details

Back

1) **Basic Information**: Project Name, Framework, Consensus, Cloud Platform, Region, Consortium Name, Channel Name, Payment Status and Created Date.
2) **Resource Information**: Node resource and cost information, Gateway Cost Information and Data Usage Information.
3) **Deployment Information**: Click on the "**Click to download CA certificate information**" button to download the certificate. Clicking on the "**Details**" button corresponding to the peer node, developer can view the information of Access and Credentials.



4) Clicking on the "**Details**" button corresponding to the browser, developer can obtain the URL address of the blockchain explorer.

3. When the framework is Hyperledger Besu-v21.1.2, the page is shown as below:

Dedicated Node Services / Details

Basic Information

Project Name: TestBesu

Framework: Hyperledger Besu -v21.1.2

Consensus: Clique

Cloud Platform: AWS

Region: Hong Kong

Payment Status: Paid

Created Date: (UTC+8:00) 07/22/2021 14:26:06

Resource Information

Node Resource and Cost Information

Number of Nodes	Host Configuration	Data Capacity	Price (USD/month)	Price (USD/year)
4	4Core+8GB	50GB	996.56	10392.4

Gateway Cost Information:

Number of Nodes	Host Configuration	Data Capacity	Price (USD/month)	Price (USD/year)
1	4Core+8GB	50GB	249.14	2598.1

Data Usage Information

Inbound Data Usage (USD/GB)	Outbound Data Usage (USD/GB)
0	0.01

Deployment Information

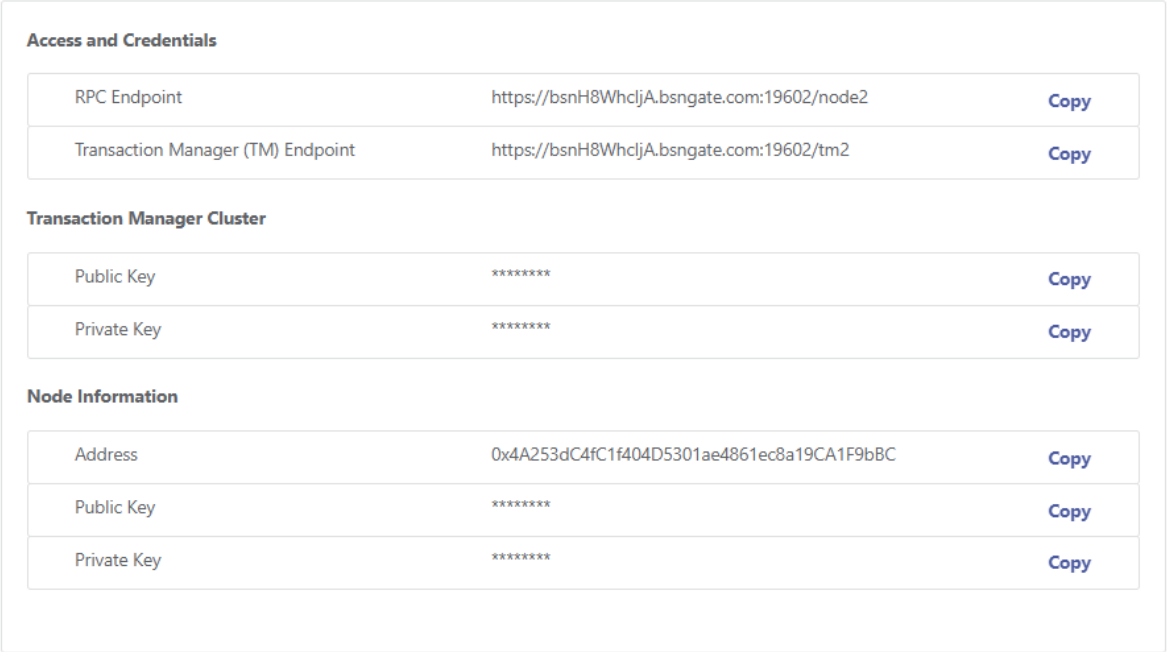
Deployment node list

Authorized Username: VVOigrhtgInDSqIfTR

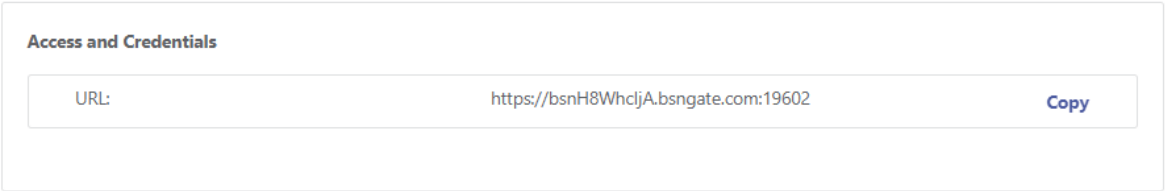
Authorized Password: ********

Type	Node Name	Status	Deployment Time	Action
Peer Node	node2	Running	(UTC+8:00) 07/22/2021 14:29:02	Details
Peer Node	node1	Running	(UTC+8:00) 07/22/2021 14:29:02	Details
Peer Node	node4	Running	(UTC+8:00) 07/22/2021 14:29:02	Details
Peer Node	node3	Running	(UTC+8:00) 07/22/2021 14:29:02	Details
Gateway Services	Browser	Running	(UTC+8:00) 07/22/2021 14:29:02	Details Open URL

1) **Basic Information**: Project Name, Framework, Consensus, Cloud Platform, Region, Payment Status and Created Date.
2) **Resource Information**: Node resource and cost information, Gateway Cost Information and Data Usage Information.
3) **Deployment Information**: The developer can view node information and browser information. Clicking on the "**Details**" button corresponding to the peer node, developer can view the information of Access and Credentials, Transaction Manager cluster, and no de information.

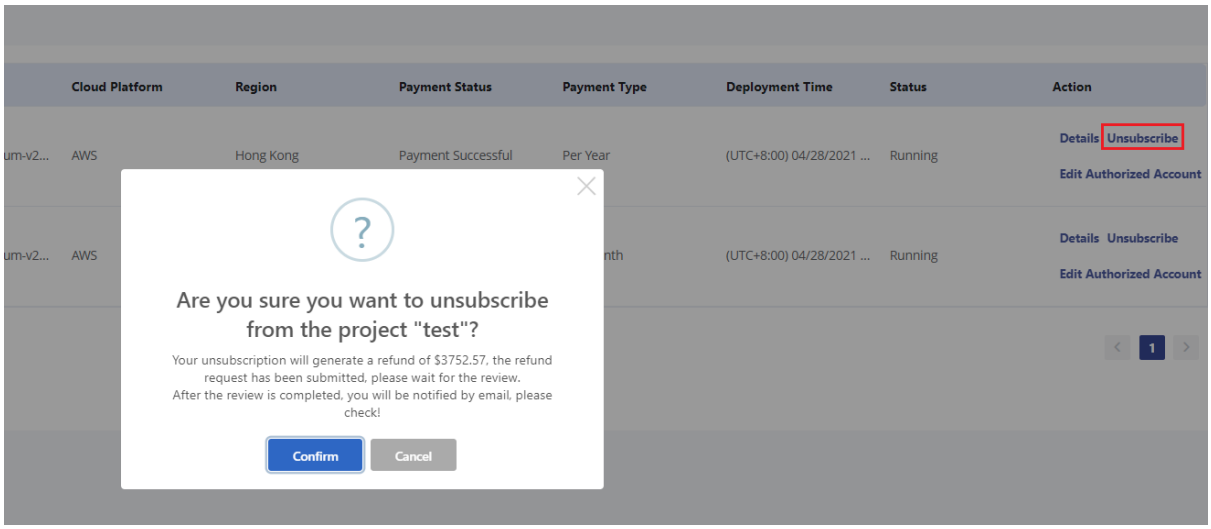


4) By clicking on the "**Details**" button corresponding to gateway services, the developer can obtain the URL address of the blockchain explorer.



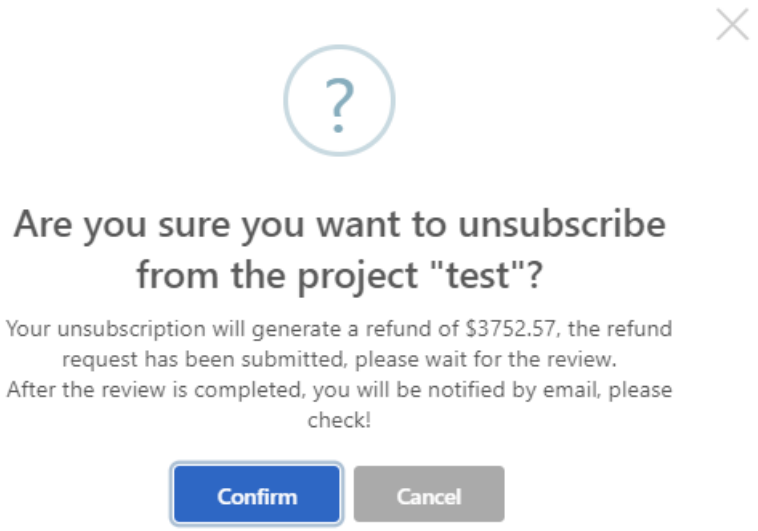
6.2.5 Unsubscribe Projects

For the dedicated node service in **Running** status, the publisher can unsubscribe that project:



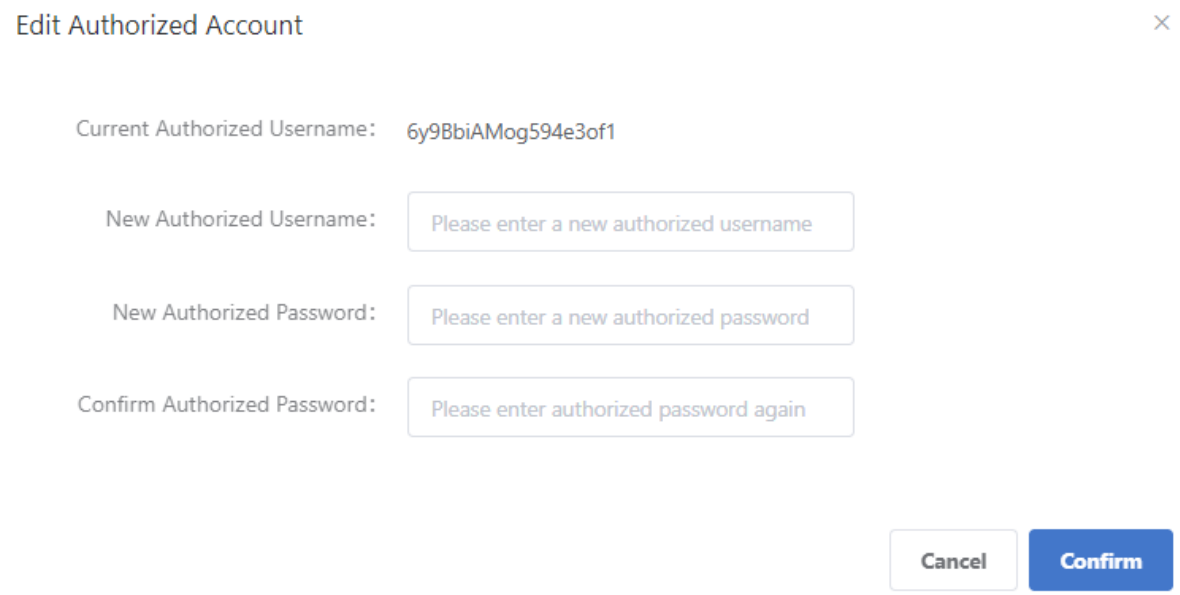
For users who pay monthly for node and gateway resources, no refund will be generated when unsubscribing; for users who pay annually for node and gateway resources, refunds will be

made at the point of time from the next month to the end of the billing cycle when unsubscribing. The discount policy for annual payment will be cancelled and the refund will be calculated by actual refundable months.



6.2.6 Edit Authorized Account

Authorized account is mainly used for the verification of connecting nodes or blockchain browsers to increase network security. Only the dedicated node with successful payment and running can edit the authorized account. Click "Edit Authorized Account" button in the dedicated node service list and jump to the page of editing the authorized account. Enter the new username, new password, confirm the new password, and click the "Confirm" button to edit the authorization account.



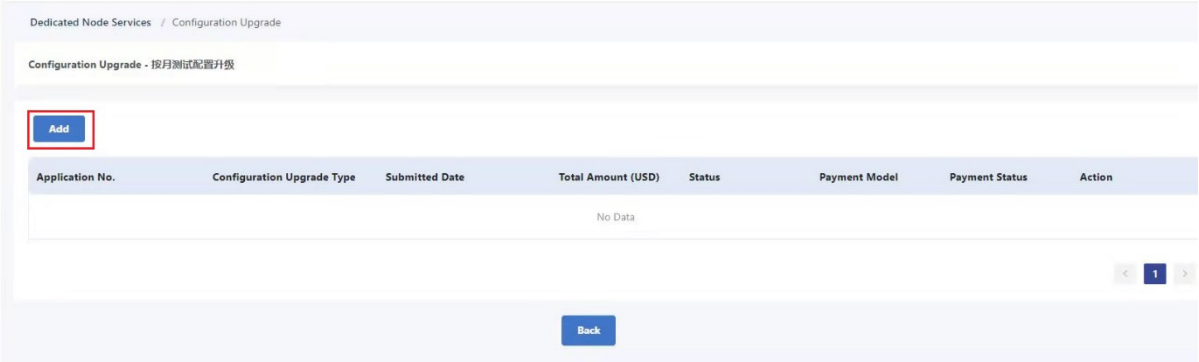
6.2.7 Configuration Upgrade

Publishers can upgrade the node information or resource information of the service by using the "**Configuration Upgrade**" function. They need to pay the corresponding resource upgrade fee when upgrading the configuration.

The configuration upgrade cannot delete the original node and downgrade the configuration of the original node. It can only upgrade on the basis of the current configuration.

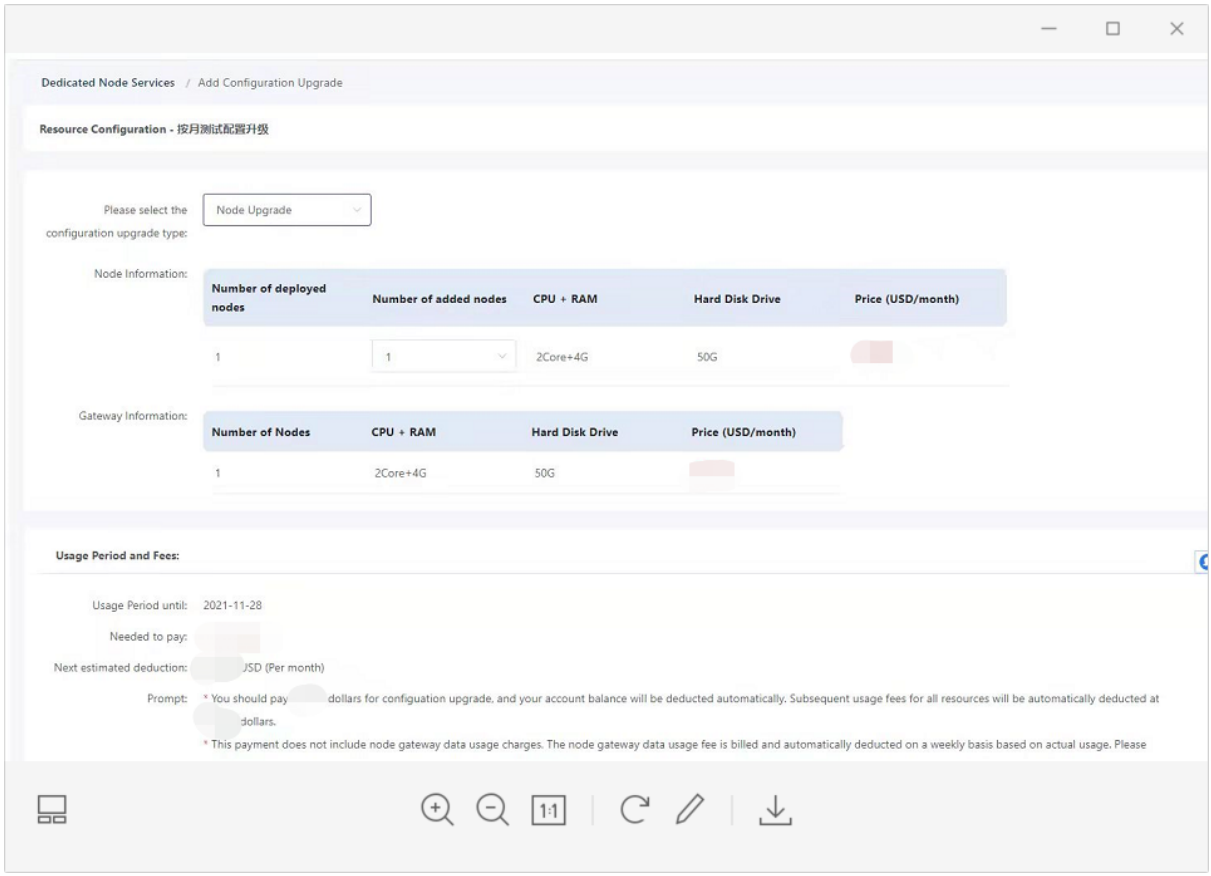
The operation steps of the configuration upgrade are as follows:

Go to "**Permissioned Services**" -> "**Dedicated Node Services**", select the running service, click "**Configuration Upgrade**" to enter the configuration upgrade list page as below:

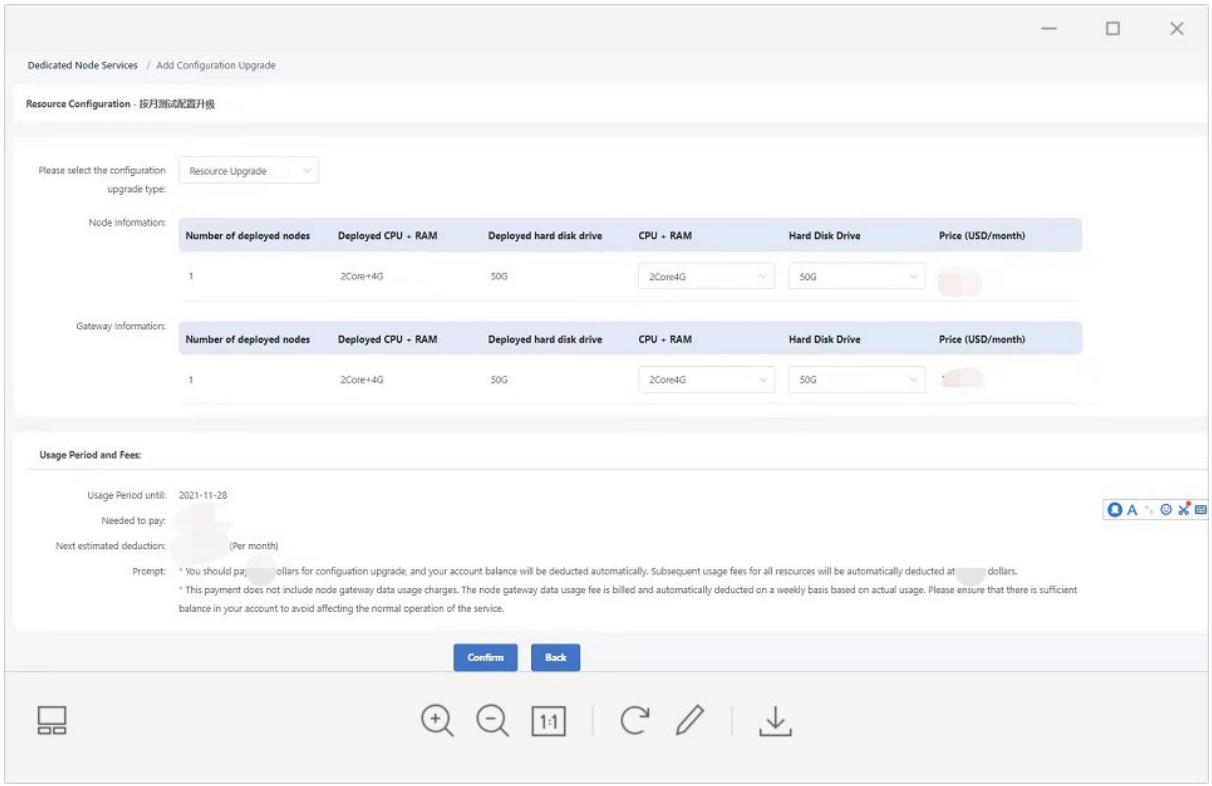


In the configuration upgrade list page, click "**Add**" to enter the configuration upgrade application page. The service configuration upgrade type is divided into node upgrade and resource upgrade.

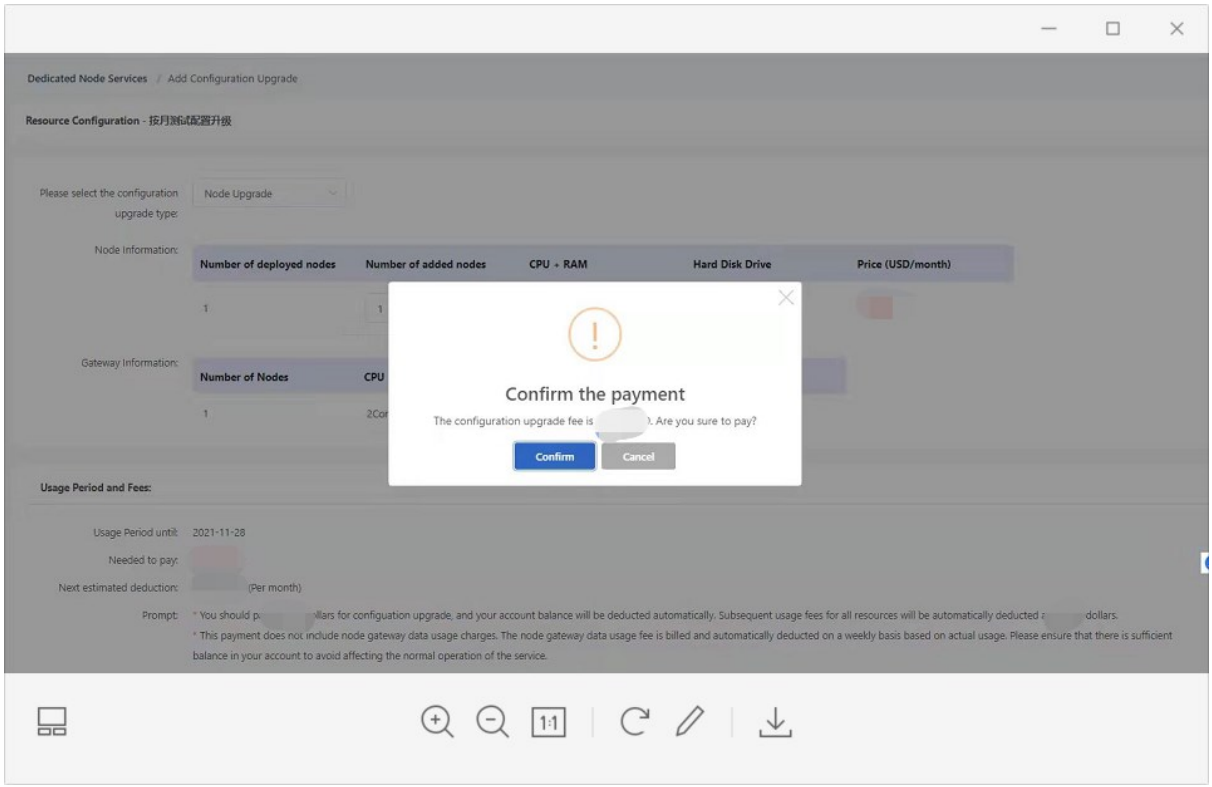
When the publisher is selecting the configuration type as node upgrade, he or she can select the number of new nodes to be added:



When the publisher is selecting the configuration type as resource upgrade, he or she can select the CPU, memory, and hard disk drive to be added in the node information and gateway information:



Click "**Confirm**" to submit the application of configuration upgrade. The system will ask for the payment of the corresponding configuration upgrade:



After the publisher clicks "**Confirm**", the system generates a configuration upgrade bill and debits the publisher's account. If the deduction is successful, the system will upgrade the configuration. If the deduction fails, the bill will be retained for 72 hours before expiration, if you still want to upgrade the configuration, you need to re-apply.

Note: The fee paid for the configuration upgrade is the upgrade fee, which is to make up the difference between the pre-upgrade configuration and the post-upgrade configuration in the billing cycle. After a successful upgrade, the next deduction cycle will be debited according to the cost of new configuration.

6.3 Access Instructions

Once the project is created, the system will allocate the access information to the project corresponding to the framework. The user will verify the access authorization when accessing the dedicated node and can access the blockchain after passing the verification.

6.3.1 ConsenSys Quorum Access Instruction

1. Use GoQuorum Client to interact with nodes

Example:

```
$   ./geth attach
https://VuF0h0y7pLwtvDqjuW:y2sYuiIciR6JFtHbmC@bsnmu7d0gNn.bsngate.com:19602/no
de1

INFO [05-08|16:05:52.534] Running with private transaction manager disabled -
quorum private transactions will not be supported

Welcome to the Geth JavaScript console!



instance: Geth/v1.9.7-stable-af752518(quorum-v20.10.0)/linux-amd64/go1.13.15

coinbase: 0xf957d0ae8a1c1b2cdcea0acb8fb0a2a750abadaa

at block: 109 (Sat May 08 2021 16:05:48 GMT+0800 (CST))

datadir: /root/quorum/data

modules: admin:1.0 debug:1.0 eth:1.0 istanbul:1.0 miner:1.0 net:1.0
personal:1.0 rpc:1.0 txpool:1.0 web3:1.0



> web3.eth.blockNumber

11
```

2. Use JSON-RPC API to interact with nodes

- Geth JSON-RPC documentation:

https://github.com/ethereum/wiki/wiki/JSON-RPC

- Quorum API documentation:

  https://docs.goquorum.consensys.net/en/latest/Reference/APIs/PrivacyAPI/

The API can be called by using CURL and Postman.

Example:

```
$ curl -H "Content-Type: application/json" -d
'{"jsonrpc":"2.0","method":"eth_blockNumber","params":[],"id":2}'
https://VuF0h0y7pLwtvDqjuW:y2sYuiIciR6JFtHbmC@bsnmu7d0gNn.bsngate.com:19602/no
de1

{"jsonrpc":"2.0","id":2,"result":"0x10"}
```

3. Use web3.js to interact with nodes

- Web3.js class library:

  https://github.com/ChainSafe/web3.js

Example:

```
const Web3 = require("web3");



const web3 = new Web3(

new
Web3.providers.HttpProvider("https://VuF0h0y7pLwtvDqjuW:y2sYuiIciR6JFtHbmC@bsn
mu7d0gNn.bsngate.com:19602/node1")

);



web3.eth.getBlockNumber().then(console.log);
```

6.3.2 Hyperledger Fabric Access Instruction

1. Use fabric-tools to interact with nodes

Example:

- Start cli:

```
➢  # docker-compose-cli.yaml file:

➢  $ cat docker-compose-cli.yaml

➢  version: '2'
```

```
➢  services:
➢  cli:
➢      container_name: fabric_peercli
➢      image: hyperledger/fabric-tools:2.3.2
➢      restart: always
➢      tty: true
➢      stdin_open: true
➢      environment:
➢      - FABRIC_LOGGING_SPEC=DEBUG
➢      - CORE_PEER_TLS_ENABLED=true
➢      - CORE_PEER_TLS_ROOTCERT_FILE=/etc/hyperledger/fabric/tls/ca.crt
➢      - CORE_PEER_ADDRESS=peer1.org1.example.com:1051
➢      - CORE_PEER_MSPCONFIGPATH=/etc/hyperledger/fabric/msp
➢      - CORE_PEER_LOCALMSPID=Org1MSP
➢      -
   ORDERER_CA=/etc/hyperledger/fabric/orderer/tlsca/tlsca.orderer.example.com
   -cert.pem
➢      - ORDERER_ADDRESS=orderer1.orderer.example.com:7050
➢      working_dir: /etc/hyperledger/fabric
➢      command: /bin/bash
➢      volumes:
➢      - /var/run/:/host/var/run/
➢
   - ./certs/ordererOrganizations/orderer.example.com:/etc/hyperledger/fabric
   /orderer
➢
   - ./certs/peerOrganizations/org1.example.com/users/Admin@org1.example.com/
   msp:/etc/hyperledger/fabric/msp
➢
   - ./certs/peerOrganizations/org1.example.com/peers/peer1.org1.example.com/
   tls:/etc/hyperledger/fabric/tls
➢      - ./sharedfiles/chaincode:/etc/hyperledger/fabric/src
➢      extra_hosts:
```

```
➢      - "orderer1.orderer.example.com:161.189.69.75"

➢      - "peer1.org1.example.com:161.189.69.75"
```

➢ Access to containers for chaincode deployment and invocation

```
➢  #Chaincode deployment

➢  // package

➢  peer lifecycle chaincode package basic414.tar.gz --path ./asset-transfer-
   basic/chaincode-javascript/ --lang node --label basic414

➢  // install

➢  peer lifecycle chaincode install basic414.tar.gz

➢  // queryinstalled

➢  peer lifecycle chaincode queryinstalled

➢  // approveformyorg

➢  peer lifecycle chaincode approveformyorg --name basic414 --package-id
   basic414:16bf72ced8451fc6fd94bd139de1532adfdd190af075c2e84a87513915a97365
   -o $ORDERER_ADDRESS --tls --tlsRootCertFiles $CORE_PEER_TLS_ROOTCERT_FILE
   --cafile $ORDERER_CA --version 1.0 --channelID netchannel --sequence 1 --
   connTimeout 30s

➢  // queryapproved

➢  peer lifecycle chaincode queryapproved --channelID netchannel -n basic414

➢  // checkcommitreadiness

➢  peer lifecycle chaincode checkcommitreadiness --channelID netchannel --
   name basic414 --version 1.0 --sequence 1 --output json

➢  // commit

➢  peer lifecycle chaincode commit -o $ORDERER_ADDRESS --cafile $ORDERER_CA -
   -channelID netchannel --name basic414 --version 1.0 --sequence 1  --
   peerAddresses $CORE_PEER_ADDRESS --tls --tlsRootCertFiles
   $CORE_PEER_TLS_ROOTCERT_FILE

➢  // querycommitted

➢  peer lifecycle chaincode querycommitted -o $ORDERER_ADDRESS --channelID
   netchannel --tls --tlsRootCertFiles $CORE_PEER_TLS_ROOTCERT_FILE --cafile
   $ORDERER_CA

➢

➢  #Invoke the chaincode

➢  // InitLedger
```

```
➢  peer chaincode invoke -o $ORDERER_ADDRESS --tls --cafile $ORDERER_CA   -C
   netchannel -n basic414 --peerAddresses $CORE_PEER_ADDRESS --
   tlsRootCertFiles $CORE_PEER_TLS_ROOTCERT_FILE -c '{"Args":["InitLedger"]}'

➢  // GetAllAssets

➢  peer chaincode query -C netchannel -n basic414 -c
   '{"Args":["GetAllAssets"]}'

➢  // CreateAsset

➢  peer chaincode invoke -o $ORDERER_ADDRESS --tls --cafile $ORDERER_CA   -C
   netchannel -n basic414 --peerAddresses $CORE_PEER_ADDRESS --
   tlsRootCertFiles $CORE_PEER_TLS_ROOTCERT_FILE -c
   '{"Args":["CreateAsset","asset7","white", "15", "zxl", "800"]}'

➢  //UpdateAsset

➢  peer chaincode invoke -o $ORDERER_ADDRESS --tls --cafile $ORDERER_CA   -C
   netchannel -n basic414 --peerAddresses $CORE_PEER_ADDRESS --
   tlsRootCertFiles $CORE_PEER_TLS_ROOTCERT_FILE -c
   '{"Args":["UpdateAsset","asset7","zxl", "1218", "zxl", "1218"]}'

➢  //ReadAsset

➢  peer chaincode query -C netchannel -n basic414 -c
   '{"Args":["ReadAsset","asset7"]}'
```

6.3.3 Hyperledger Besu Access Instruction

1. Interact with node by Geth console.

Example:

```
[root@localhost ~]# geth attach https://admin:123456@bsn91000001.bsngate.com:1
9602/node1

INFO [07-
15|13:41:24.391] Running with private transaction manager disabled - quorum pr
ivate transactions will not be supported

WARNING: call to admin.getNodeInfo() failed, unable to determine consensus mec
hanism

Welcome to the Geth JavaScript console!



instance: besu/v21.1.2/linux-x86_64/oracle_openjdk-java-11

coinbase: 0xfd0fdb96a3326c61756711d314bea0149088c3d9

at block: 195 (Thu Jul 15 2021 13:41:24 GMT+0800 (CST))

 modules: eea:1.0 eth:1.0 ibft:1.0 net:1.0 perm:1.0 priv:1.0 web3:1.0
```

```
> web3.eth.blockNumber

202

>
```

2. Interact with nodes by JSON-RPC.

```
[Geth JSON-RPC document](https://github.com/ethereum/wiki/wiki/JSON-RPC):



 [Quorum API document](https://besu.hyperledger.org/en/stable/Reference/API-Methods/):  You can use curl and Postman to call the API.



  - Example:



  ```shell

  [root@localhost ~]# curl -H "Content-Type: application/json" -d \

  >   '{"jsonrpc":"2.0","method":"eth_blockNumber","params":[],"id":2}' \

  >  https://admin:123456@bsn91000001.bsngate.com:19602/node1



  {

    "jsonrpc" : "2.0",

    "id" : 2,

    "result" : "0x365"

  }

  ```
```

3. Interact with node by Web3.js.

```
- [web3.js class base](https://github.com/ChainSafe/web3.js)

  - Example:
```

```shell

  const Web3 = require("web3");



  const web3 = new Web3(

  new Web3.providers.HttpProvider("https://VuF0h0y7pLwtvDqjuW:y2sYuiIciR6JFtHb
mC@bsnmu7d0gNn.bsngate.com:19602/node1")

  );



  web3.eth.getBlockNumber().then(console.log);

```

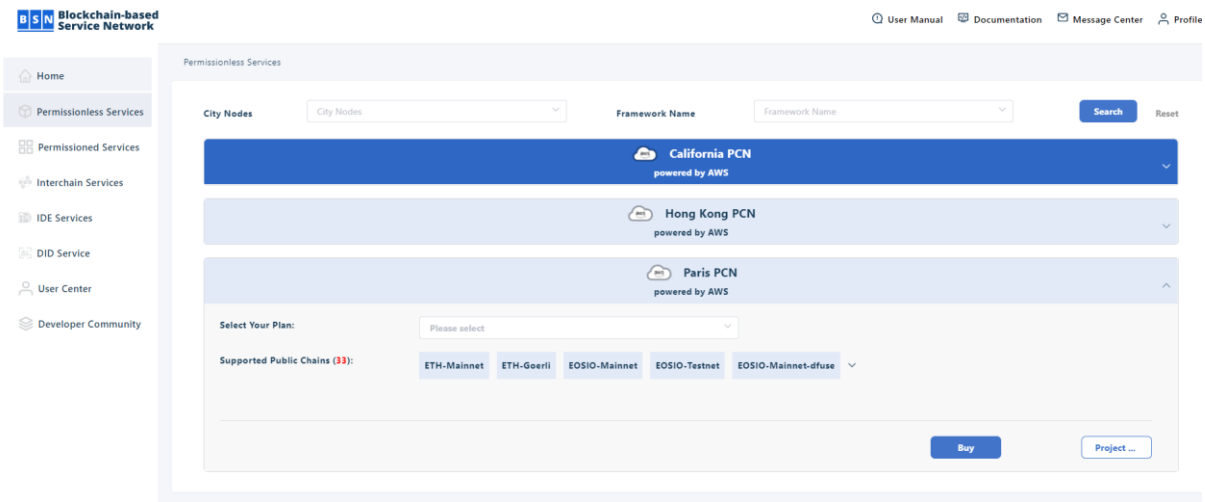
7 Permissionless Services

7.1 Overview

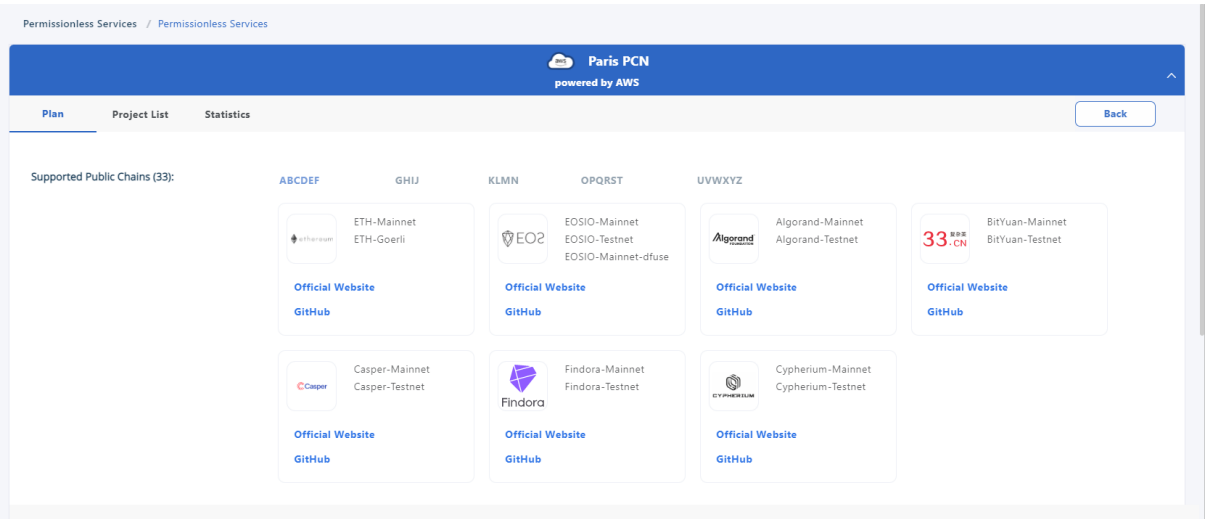
The Permissionless service allows the participant to select a public city node to access a plan that can be a free plan or a premium plan. When this is done, the participant can create a project, obtain the project ID, key and access parameters which can be used to access selected public chain node gateway. With the Permissionless service, the default plan is free for participants, however, it has limited daily requests and projects. BSN has created several other plans that can be upgraded to, for a certain fee, paid on a monthly basis.

7.2 Select Plans

On the page of Permissionless services, users can select different city nodes to participate in Permissionless services. The nodes in blue at the top of the list represent those activated for the free plan or premium plans on that city node. The nodes in grey at the bottom represent no plans are purchased or used on that city node.

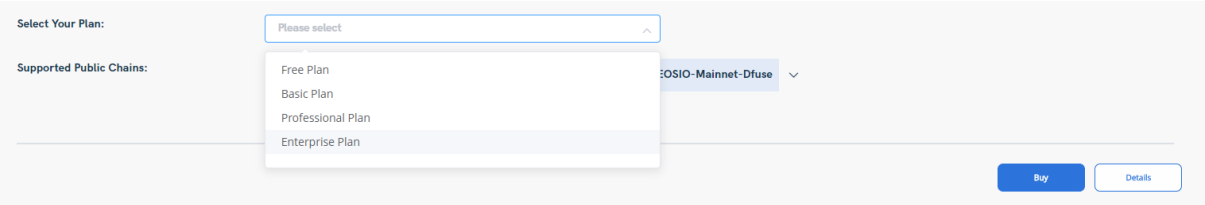


When you click and expand the public city node, you can see all public chain frameworks supported by the city node. Users can decide whether to choose this city node as the access entrance according to their needs. The public chain frameworks supported by different city nodes may be different. In general, we recommend that developers choose a city node that is close to them, so that the access speed will be relatively fast.

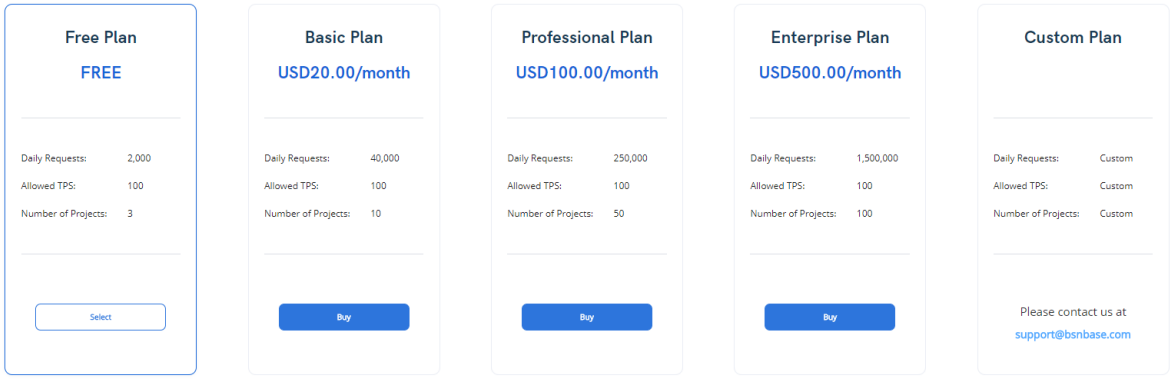


By default, participants on the Permissionless service have a **free** plan that is free to use up to 2000 daily requests, allowed TPS of 100 and maximum of 3 projects. However, a participant can upgrade to a higher plan available on the platform. To select plans, follow these steps

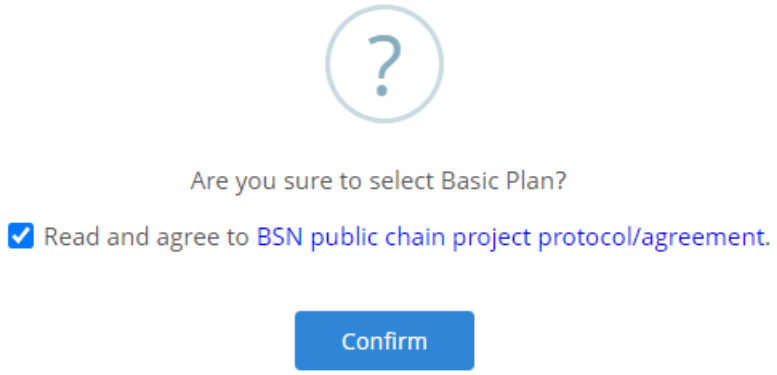
1. On the Permissionless page, click **Buy** in the **Select Your Plan** section.



2. In the **Details** page, locate the **Select or Update your plan** section and click **Buy** on the appropriate plan.

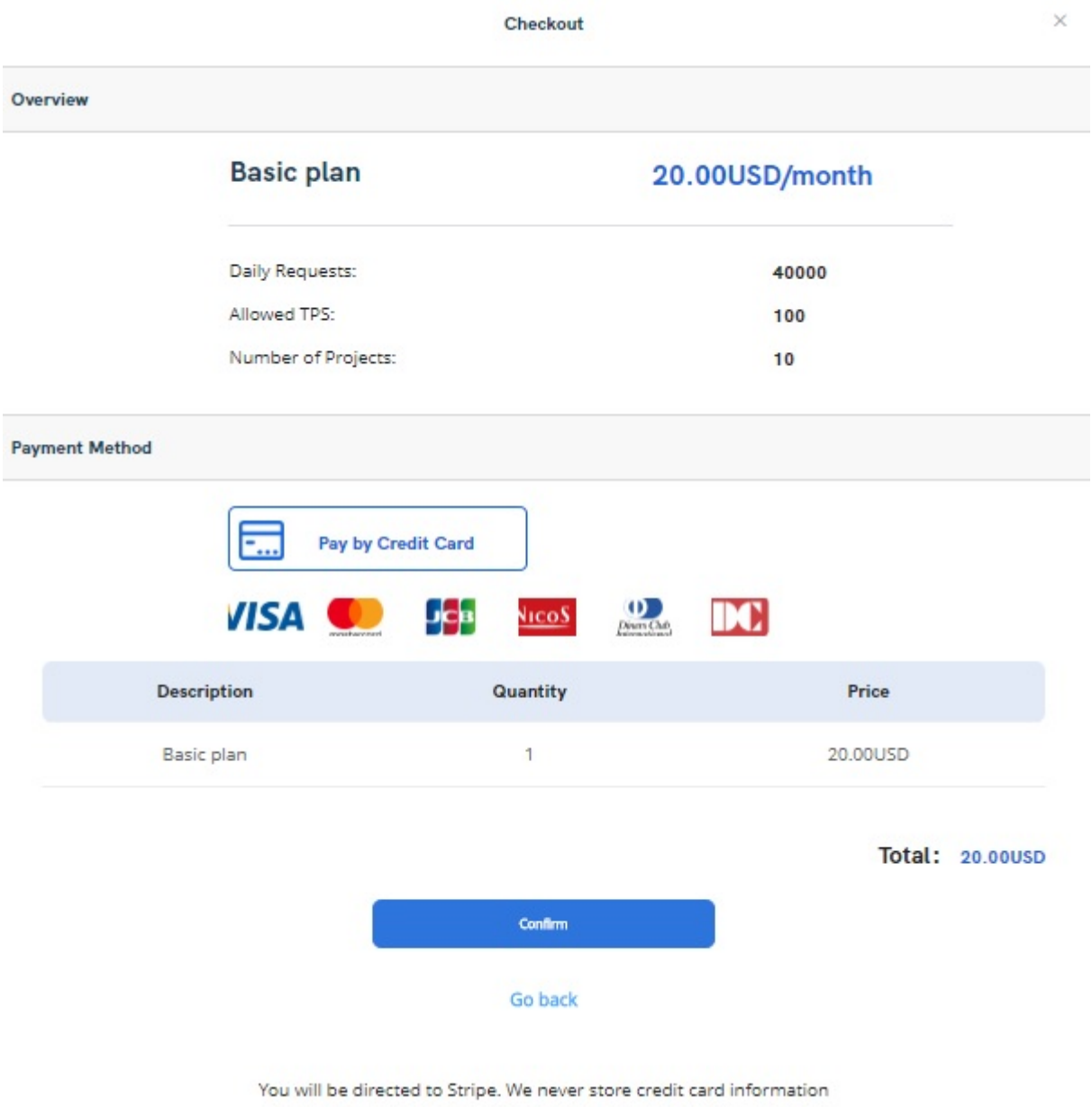


3. In the **Are you sure you want to buy package** window, click the project agreement and click **Confirm**.



4. In the **Select Payment Method** page, select the appropriate payment method and click **Next Step to be redirected to Stripe**.

The BSN portal never records and stores any credit card information.



5. On the **Stripe Payment** page, click **Pay** to display the **Receipt** and **Invoice**.

Invoice from RED DATE (HONG KONG) TECHNOLOGY LIMITED

Billed to billjackson5

Invoice #841DA2D2-0001

$20.00 USD due Aug 13, 2020

Card number MM / YY CVC

Pay invoice

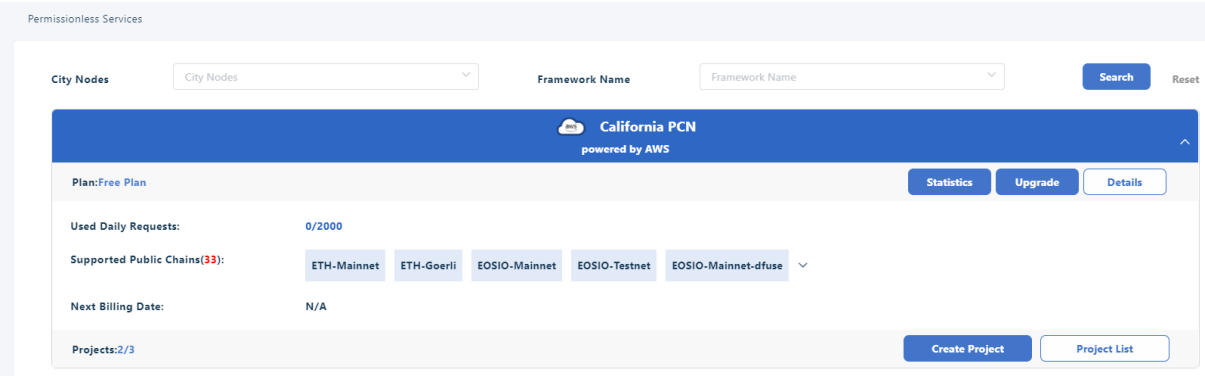
DESCRIPTION	QTY	PRICE	TOTAL
"Basic Plan" Permissionless service	1	$20.00	$20.00
↓ PDF		Amount due	$20.00

If you have any questions, contact RED DATE (HONG KONG) TECHNOLOGY LIMITED at support@bsnbase.com or call +86 10 8646 2811.

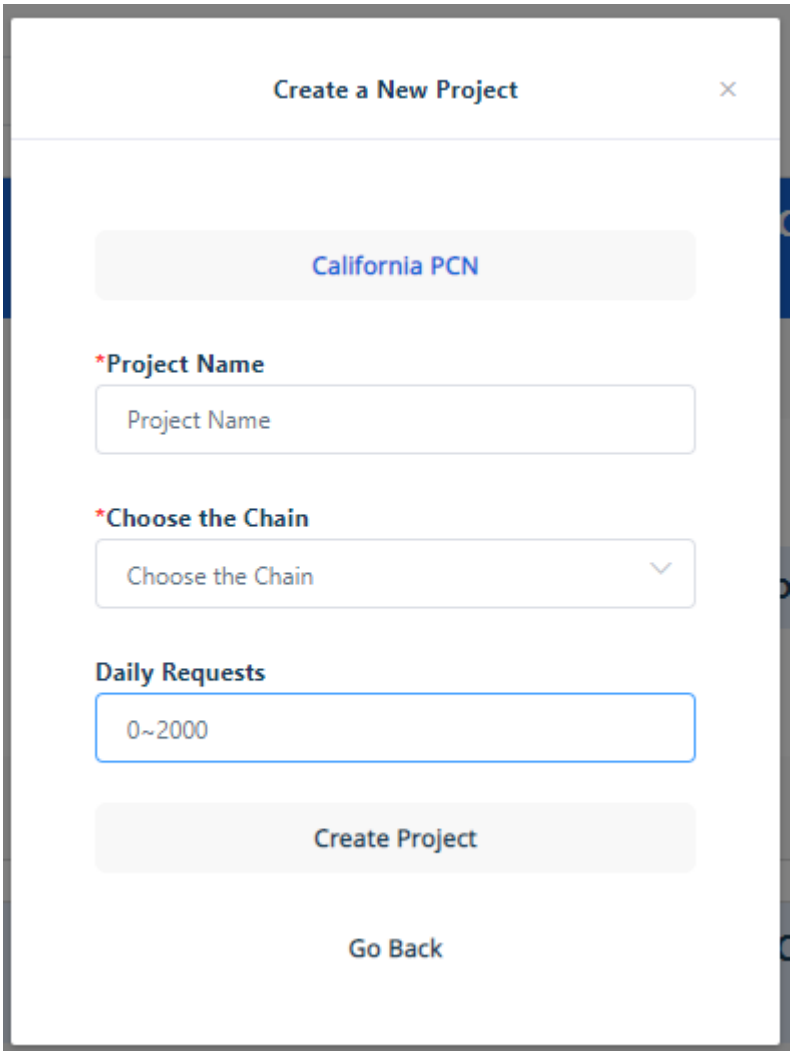
7.3 Create and Manage Projects

With the Permissionless service, projects can be created in a much simpler way when compared with Permissioned service as plans are embedded into the project, making it easier for participants to manage. To create and manage projects follow these steps:

1. In the Permissionless Service page, click **Create Project** in the development plan section.



2. In the **Create a new project** window, enter the **Project Name**, select the Public **Chain to access** from the dropdown list, input the **Daily Requests** number if needed. Then click **Create Project**. The Daily Requests number is optional, and it is used to control the TPD (transactions per day) for this project.

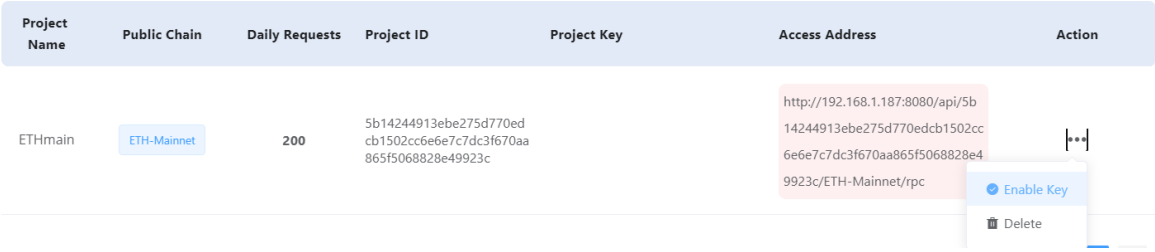


This will automatically create the project and list it in the **Project Information** tab.

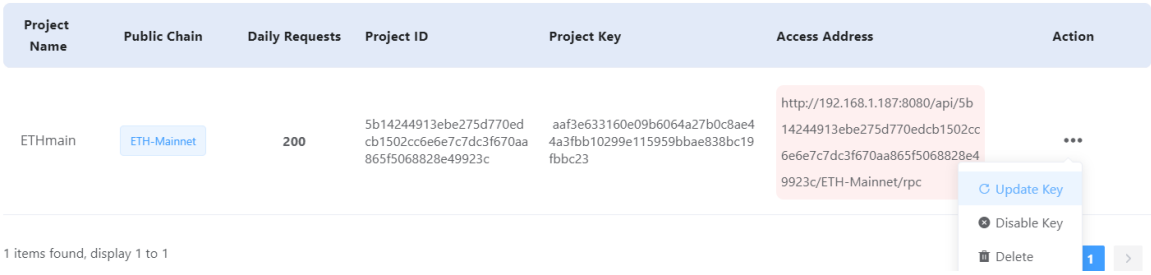
After a project has been created it can be managed using available tools for the project. To manage a project, follow these steps:

1. Locate the project to be managed, click **Upgrade** to display the **Plans** page.

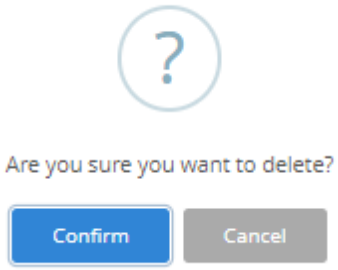
2. Select the appropriate plan to **Upgrade** to and click **confirm** to display the payment page.
3. To enable the project key, in the Permissionless Service page, click **Project list** to display the list of projects. In **Action**, click **Enable Key** to enable the project key. Then the information page on enabling the key will be displayed. Click **Confirm.**



4. To update a project key, click **Update Key**. Then the information page on updating the key will be displayed. Click **Confirm.**



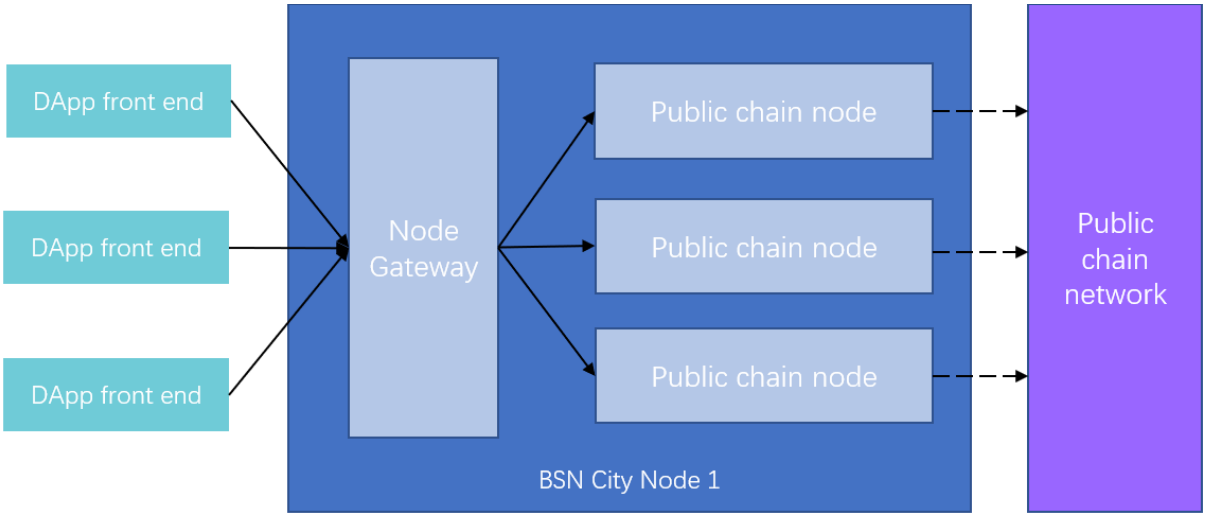
5. To delete a project, click **Delete**. A confirmation message will be displayed asking if you wanted to delete the project. Click **Confirm** to delete it.



7.4 Off-BSN system Access Guide

7.4.1 Overview

BSN provides shared or dedicated public chain nodes for public chain application developers. Developers can quickly access all public chain networks by accessing the gateway of the public city node.



After developers select the public chain framework (netcode) in the BSN portal to create the public chain project, they will get the gateway's domain name address (url), project number (id), project key (key), public chain supportive protocol {protocol} and public chain gateway API address.

The developer accessing the PCN gateway via HTTP should concatenate the request address in "https://{url}/api/{id}/{netcode}/{protocol}/{subUrl}" format. If project key is enabled, "x-APi-key:{key}"should be added to the request header. If the public chain nodes provide multiple components, they should add {subUrl}; If the Nervos CKB has an Indexer component service in addition to the RPC service, "{subUrl}" should fill the indexer value, {subUrl} is optional.

The developer accessing the node gateway via WebSocket, should concatenate the Key and SubUrl to the path address of the target machine and concatenate to the format of {url}/api/{id}/{key}/{netcode}/{subUrl}. If the project key is not enabled, then the {key} filed should be null. If there is no subUrl, this field can be null. That is, developers can think of the content after/API as the method name of a target machine.

7.4.2 Ethereum

Ethereum is a global, open-source platform for decentralized applications. On Ethereum, you can write code that controls digital value, runs exactly as programmed, and is accessible anywhere in the world.

For more resources, please visit: https://ethereum.org/en/developers/

The BSN public city node gateway is adapted to the Ethereum JSON RPC API, so developers can initiate transaction requests to the node gateway via HTTP JS-RPC. For detailed docking instructions please visit: https://eth.wiki/json-rpc/API

The following table shows additional error code definitions for public city node gateways:

Error code	Transaction error code	Error code description
500	-32099	Service internal exception
503		
429	-32098	TPS, TPD current limit

401	-32097	Authentication permission failed

7.4.3 EOS

EOSIO is a blockchain platform designed for the real world. Built for both public and private use cases, EOSIO is customizable to suit a wide range of business needs across industries with rich role-based security permissions, industry-leading speeds and secure application processing.

For more resources, please visit: https://developers.eos.io

The BSN city node gateway is adapted to EOSIO's JSON RPC API, so developers can initiate transaction requests to the node gateway via HTTP JSON-RPC. For detailed docking instructions please visit:

https://developers.eos.io/manuals/eos/latest/nodeos/plugins/chain_api_plugin/api-reference/index#operation/get_block

The following table shows additional error code definitions for public city node gateway:

Error code	Transaction error code	Error code description
401	3090000	Authentication permission failed
429	3210000	TPS, TPD current limit
500	3100000	Service internal exception
503		Service Unavailable

7.4.4 Tezos

Tezos is an open-source platform for assets and applications backed by a global community of validators, researchers, and builders. Tezos is designed to provide the safety and code correctness required for assets and other high value use cases. Its native smart contract language, Michelson, facilitates formal verification, a methodology commonly used in mission-critical environments such as the aerospace, nuclear, and semiconductor industries.

For more resources, please visit: https://developers.tezos.com

The BSN city node gateway is adapted to the Tezos JSON RPC API, so developers can initiate transaction requests to the node gateway via HTTP JSON-RPC. For detailed docking instructions please visit:

https://tezos.gitlab.io/api/rpc.html

The following table shows additional error code definitions for public city node gateway:

Error code	Transaction error code	Error code description
401	3090000	Authentication permission failed
429	3210000	TPS, TPD current limit
500	3100000	Service internal exception
503		Service Unavailable

7.4.5 Near

NEAR is a Proof-of-Stake Layer-1 public blockchain platform built with usability and developer accessibility in mind. With a novel sharding mechanism called Nightshade, NEAR can scale limitlessly and offers familiar user experiences just like the web today.

For more resources, please visit: https://near.org/

The BSN city node gateway is adapted to the Near JSON RPC API, so developers can initiate transaction requests to the node gateway via HTTP JSON-RPC. For detailed docking instructions please visit:

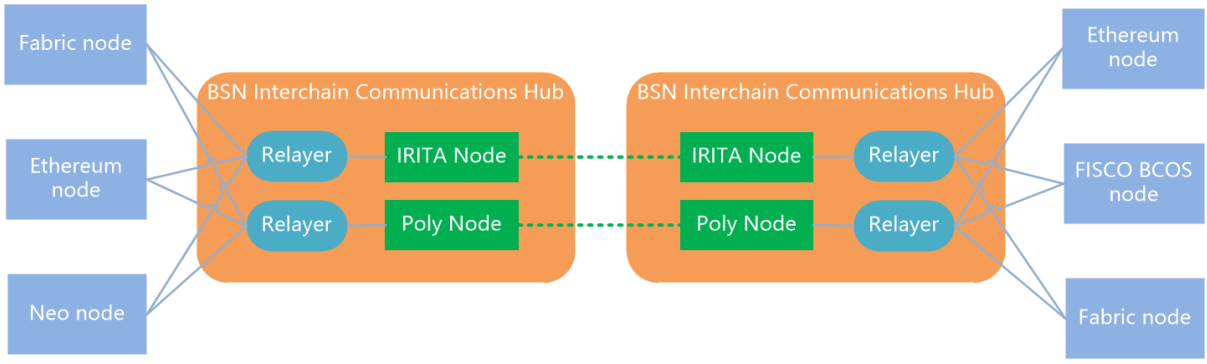
https://docs.near.org

The following table shows additional error code definitions for public city node gateway:

Error code	Transaction error code	Error code description
401	3090000	Authentication permission failed
429	3210000	TPS, TPD current limit
500	3100000	Service internal exception
503		Service Unavailable

8 Interchain Services

A cross-chain mechanism is the interoperability between two or more relatively independent blockchains, and it enables the swap and transfer of data, asset and information. On the BSN, every blockchain maintains its own transactions, consensus, and ledgers, carrying business data and information of different DApps. The cross-chain mechanism realizes data sharing and business collaboration among blockchains, and to break the silos between chains, allows data to flow securely and reliably across multiple chains. The main functions of the cross-chain system include cross-chain registration management mechanism, cross-chain contract functions, cross-chain transaction verification, cross-chain message routing protocol, cross-chain transaction atomicity guarantee, etc.



The BSN Interchain Communications Hub (ICH) adopts the cross-chain protocol of heterogeneous chains and the design of double-layer structure, using relay chains as cross-chain coordinators, multiple heterogeneous chains as cross-chain transaction executors, and acts as a relayer of cross-chain data. By solving validity, security, and transactional issues of cross-chain data, a secure, easy-to-use and efficient cross-chain system is implemented:

- Supports both isomorphic and heterogeneous chains.
- Supports any information to cross the chains.
- Very easy to access. Application chains do not need to do custom development adaptation, just deploy one smart contract per chain.
- Transactional support, supporting not only scenarios with the need for ultimate consistency of transactions, but also scenarios with the need for strong consistency of transactions, with support for any transaction, and scalable to any number of chains.
- Cross-chain protocols are secure and reliable, based on cryptography and consensus algorithms, and each application chain can verify the legitimacy of cross-chain transactions on its own, thus ensuring the security of cross-chain interactions.

The BSN's "Interchain Communications Hub" (ICH) is now commercially available and integrates with Onchain's Poly Enterprise cross-chain solution. It enables cross-chain interoperability between standard permissioned chains, open permissioned chains and public chains.

A demo version of ICH is also live on the BSN Testnet, integrating the cross-chain solution based on the relay chain mechanism (Poly Enterprise developed by Onchain). We welcome all developers to try it out and provide feedback and suggestions to us, and we will continue to improve the cross-chain functionality.

8.1 Interchain Service Management

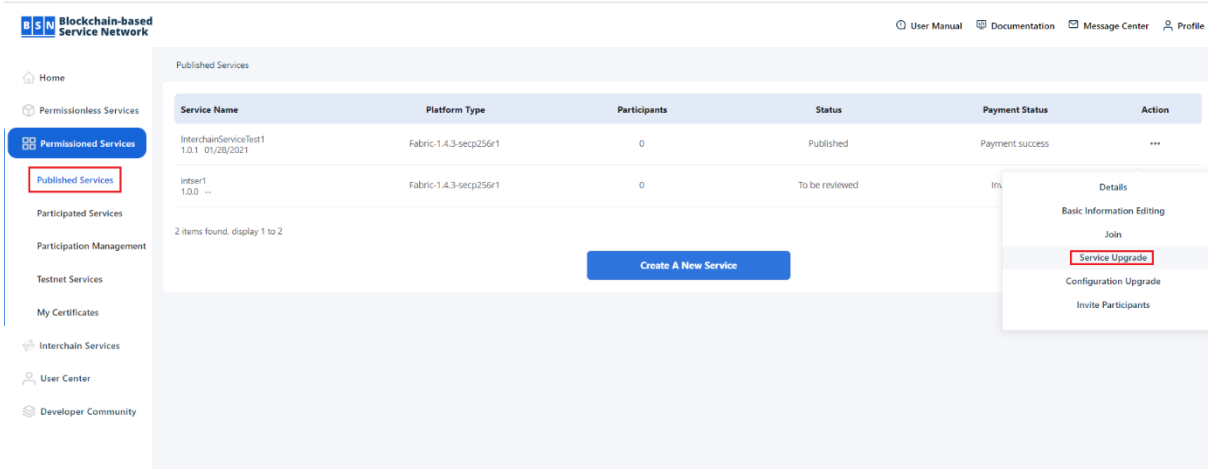
8.1.1 Open Interchain Services

There are two ways to open Interchain Services: permissioned DApp service publishers can either open it when upgrading their services, or they can open Interchain Services separately.

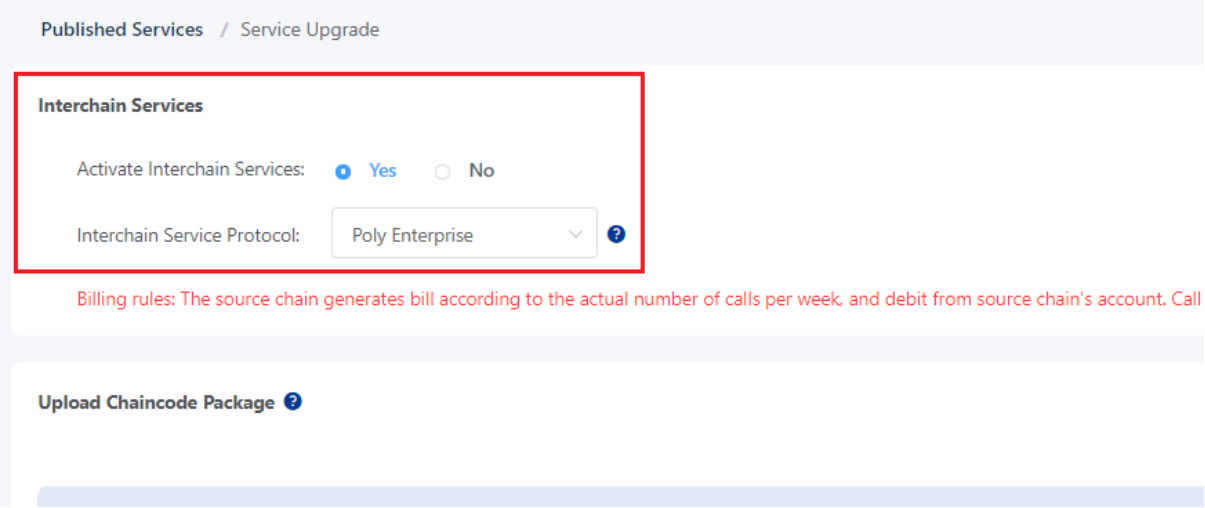
1) Open the Interchain Service when upgrading the permissioned service.

For published permissioned services, publishers can open Interchain Services through the **Service Upgrade** function:

On the home page, click **Permissioned Services** -> **Published Services**, click **Service Upgrade** in the **Action** column to enter the service upgrade page.



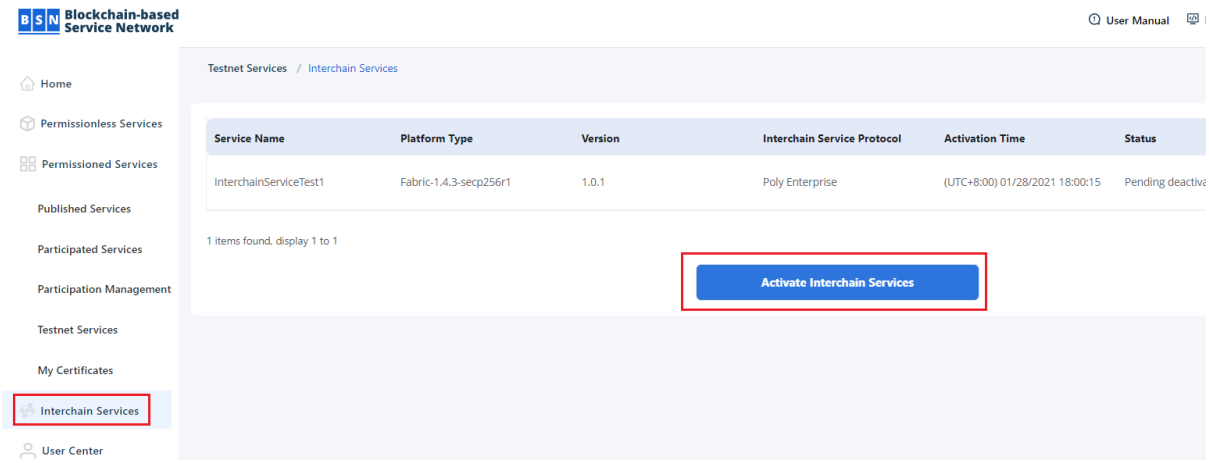
In the Interchain Services section, select **Yes** to activate Interchain Services, and choose the Interchain Service Protocol. Then, click **Confirm** to submit the service upgrade. After the system review and approval, the Interchain Service is successfully opened.



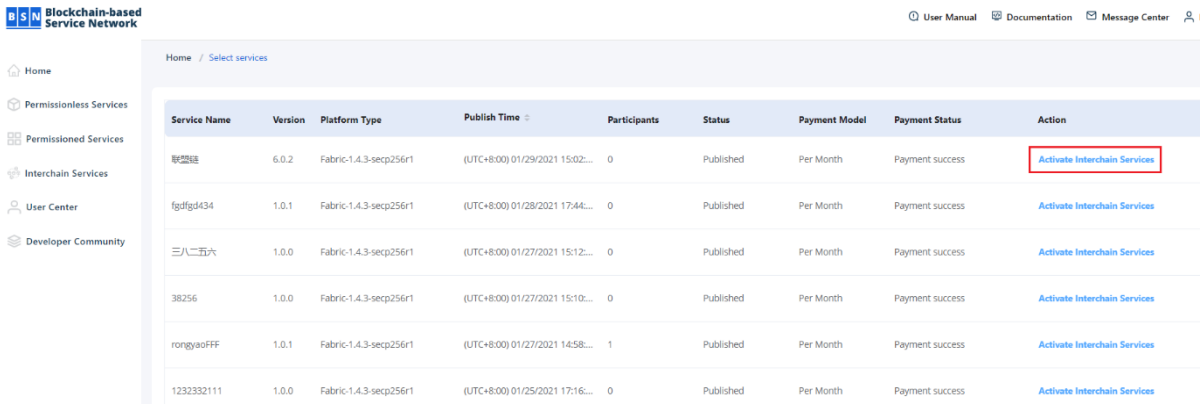
Note: If you open Interchain Services only, you don't need to upload new chaincode package; after opening the service, when calling across the chain, both source chain and target chain need to communicate off the BSN about cross-chain parameters, methods and specifications.

2) Directly open the service in Interchain Services

On the home page, click **Interchain Services**



Click **Activate Interchain Services** button to enter **Select services** page, click **Activate Interchain Services** in the **Action** column.

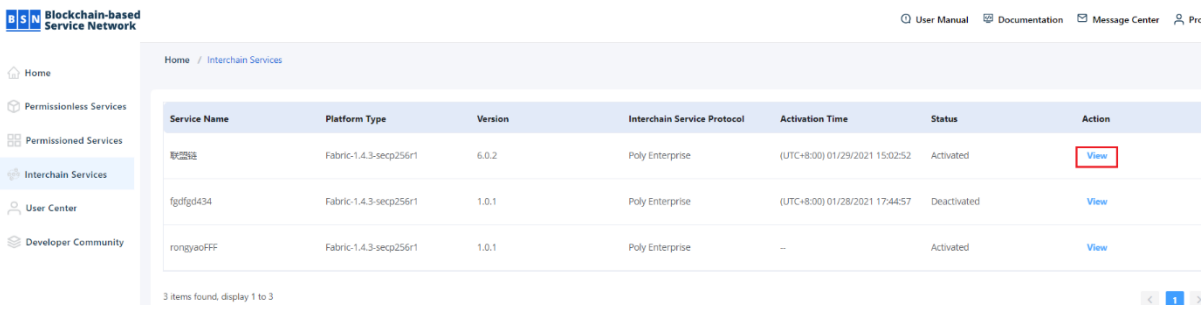


The following steps can refer to **Open the Interchain Service when upgrading the permissioned service**.

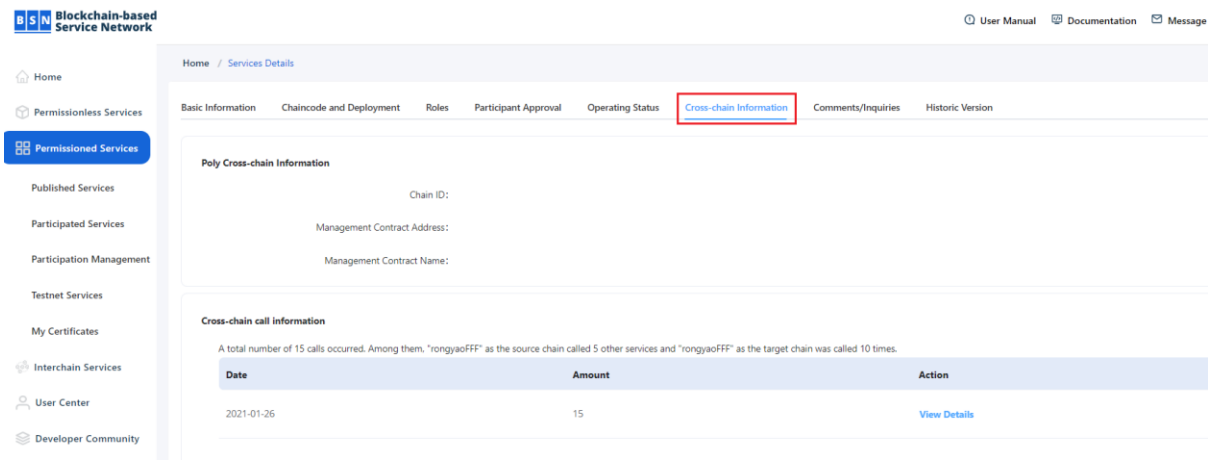
Note: For activated interchain services, users cannot change the interchain service protocols. The protocol can only be changed by re-opening the interchain services.

8.1.2 View Interchain Services

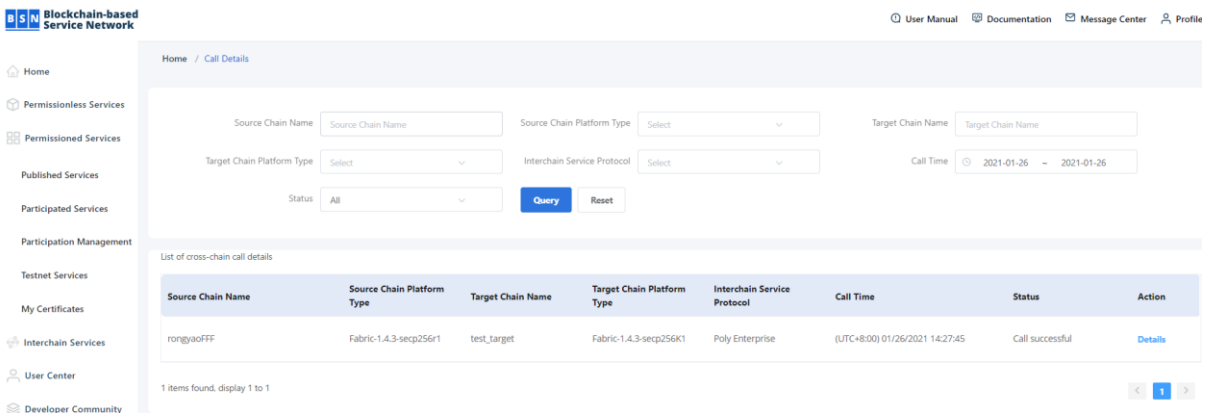
On the home page, click **Interchain Services**, users can find the service list of their activated interchain services.



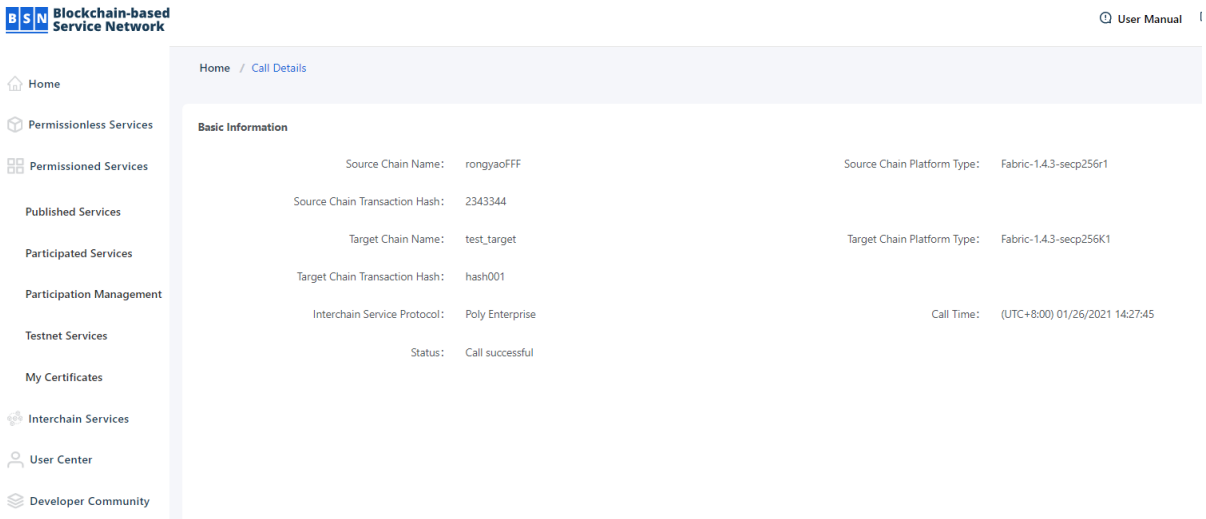
Select the service to be checked, click **View** in the **Action** column, select **Cross-chain Information**, users can check the chain ID, management contract address, management contract name and cross-chain information.



On the Cross-chain Information page, click **Details** button to jump to **Call Details** page. Select the parameter and click **Query** to retrieve the detailed cross-chain call information.



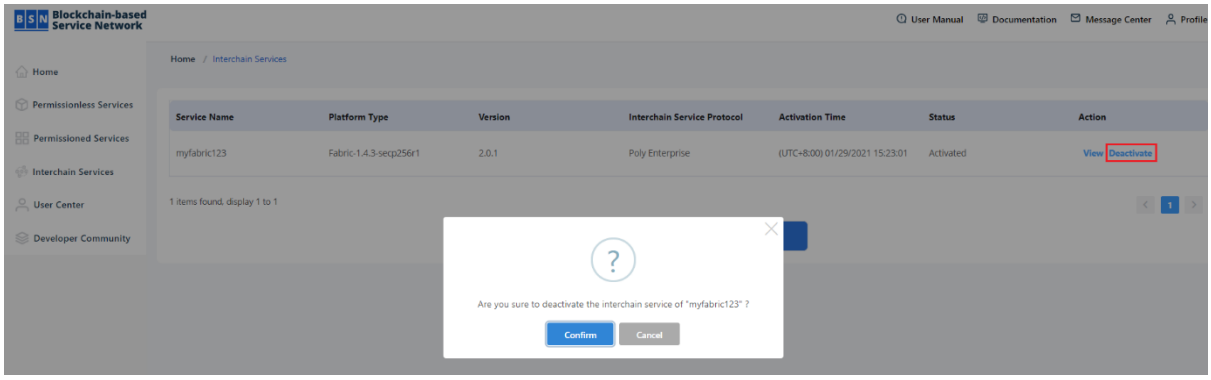
Go to **List of cross-chain call details** section, click **Details** button in **Action** column to enter the Basic Information page, you can view the basic information of the cross-chain call details, as shown in the figure:



8.1.3 Deactivation and Activation of Interchain Services

1) Deactivation of Interchain Services

On the home page, click **Interchain Services**, users can see a list of their activated interchain services. Select the service which needs to be deactivated and click **Deactivate** button in **Action** column.

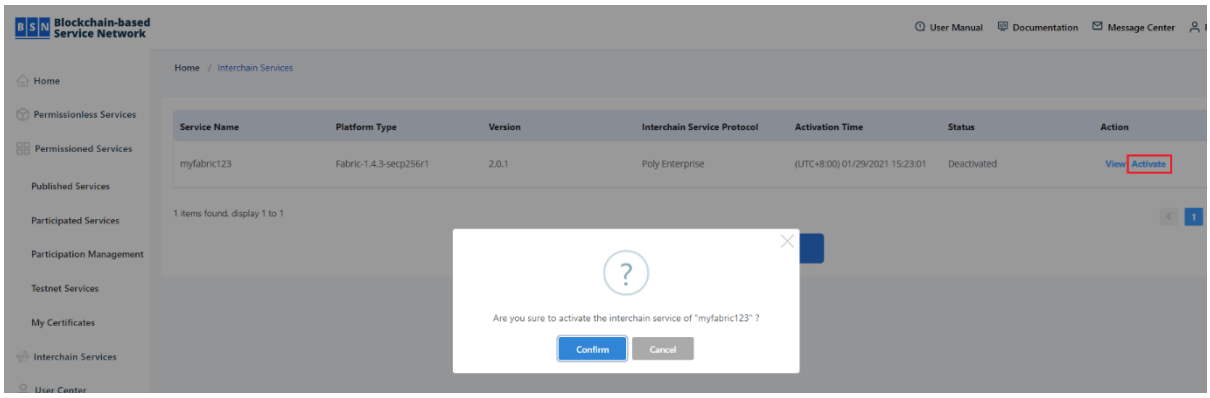


Click **Confirm** in the pop-up message to deactivate the interchain service.

Note: It takes a few minutes to deactivate the interchain service, please be patient.

2) Activation of Interchain Services

On the home page, click **Interchain Services**, users can see a list of their activated interchain services. Select the service which needs to be activated and click **Activate** button in **Action** column.



Click **Confirm** in the pop-up message to activate the interchain service.

8.2 Interchain Services based on Poly Enterprise

8.2.1 Overview

A complete cross-chain transaction requires application contracts for multiple chains. For example, there is an application contract on the Ethereum Ropsten and a FISCO BCOS application contract on the BSN. These two contracts can interact across chains through the cross-chain protocol to ensure the correctness of the information. The cross-chain contract includes a management contract and an application contract. The management contract implements the core logic of the cross-chain protocol, developed by the BSN development team and is deployed in each chain; the application contract needs to be implemented by blockchain application publishers according to the cross-chain protocol and deployed in the blockchain network.

Management contracts include the following implementations.

1. ETH and FISCO BCOS

- EthCrossChainManager: contains logic of management.
- EthCrossChainData: used to save and manipulate data.
- EthCrossChainManagerProxy: used to implement logical contract upgrades.

2. Neo

- CCMC: contains the logic of management.

3. Fabric

- CCMC: contains the logic of management.

4. BSN Testnet Cross-chain management contract address

The following table shows the framework names, chain IDs, and cross-chain contract names or addresses for Poly Enterprise-based cross-chain services.

Testnet	Framework	Chain ID	Cross-chain contract names/addresses	Application Example Contract
China	Fabric	88	ccm	myhellopoly
	FISCO BCOS	98	0x8f866dE652d34308De82E7DaF504D1af4B4b05E9	0x2e98f68147887288f1eb2ebd065ccc46be9bc4f9
International	Fabric	89	ccm	myhellopoly
	FISCO BCOS	99	0xaF92fAe702C24CF5B214645AdFE25821b5664667	0xd8e0013aa9b41bb946aee1a848b5665c17951200
Ropsten	Ethereum	2	0x1a9C1FE6cba599598d7F45150C2FD16F7338e2b0	0x7210c828d9455C5319f50d206C9EdD603CE1F999
Testnet	Neo	4	0x10b6edbb6e44188d0ff39065442081b13bbd109b	0x73090f73056cfc40895799c2a061da7904d8b53d

The application cross-chain contains the following functions:

1. Outbound: The source chain's application contract initiates a cross-chain transaction request and transfers this request from the source chain to the target chain. The user can call a self-defined method in the source chain's application contract which calls the 'crossChain' method of the management contract. This will send the cross-chain data through events.
2. Inbound: The target chain application contract receives the cross-chain transaction request. This request information sent from the source chain is passed to the target chain application contract. The cross-chain management contract receives and verifies the cross-chain information. The cross-chain protocol requires the target chain application contract and function name to be included in the cross-chain information. Then the management

contract invokes the specified method for the specified contract address and passes the information to the target chain application contract.

8.2.2 Interchain Services based on Hyperledger Fabric

8.2.2.1 Application Contract Development Guide in BSN production environment

The development of Fabric application contract is based on its own business scenario. The main implementation includes two parts: if the source chain initiates a cross-chain transaction, its application contract needs to get outbound to access the target chain; if the target chain receives a cross-chain transaction, its application contract needs to get inbound. Fabric's chain ID and cross-chain management contract's name are automatically assigned and generated through the BSN operations and maintenance system when users open interchain services, and can be viewed in the BSN portal.

An example of a specific cross-chain transaction call can be found in 7.2.2.3 Demo Contract Example.

8.2.2.2 Application Contract Development Guide in BSN Testnet

Fabric's chain ID in the BSN China Testnet is 88 and in the BSN International Testnet is 89. This chain ID is registered in Poly Enterprise, not the channel ID corresponding to Fabric itself. The name of Fabric cross-chain contract is ccm.

An example of a specific cross-chain transaction call can be found in 7.2.2.3 Demo Contract Example.

8.2.2.3 Demo Contract Example

BSN production environment and BSN Testnet:

https://github.com/BSNDA/ICH/tree/main/sample/polychain/fabric-contract/online/hellopoly

8.2.3 Interchain Services based on FISCO BCOS

8.2.3.1 Application Contract Development Guide in BSN production environment

The development of FISCO BCOS application contract is based on its own business scenario. The main implementation includes two parts: if the source chain initiates a cross-chain transaction, its application contract needs to get outbound to access the target chain; if the target chain receives a cross-chain transaction, its application contract needs to get inbound.

An example of a specific cross-chain transaction call can be found in 7.2.3.3 Demo Contract Example.

8.2.3.2 Application Contract Development Guide in BSN Testnet

FISCO's chain ID in the BSN China Testnet is 98 and in the BSN International Testnet is 99. This chain ID is registered in Poly Enterprise, not the group ID corresponding to FISCO itself.

The application contract example in BSN test network is the same as the production environment, please visit 7.2.3.1 Application Contract Development Guide in BSN Production Environment for details.

An example of a specific cross-chain transaction call can be found in 7.2.3.3 Demo Contract Example.

8.2.3.3 Demo Contract Example

BSN Production Environment and Testnet:
https://github.com/BSNDA/ICH/tree/main/sample/polychain/fisco_contracts/hellopoly

8.2.4 Interchain Services based on Ethereum Ropsten

Application Contract Development Guide

The development of the ETH application contract is based on its own business scenario. The main implementation includes two parts: if the source chain initiates a cross-chain transaction, its application contract needs to get outbound to access the target chain; if the target chain receives a cross-chain transaction, its application contract needs to get inbound. ETH's chain ID in the BSN Testnet is 2. This chain ID is registered in Poly Enterprise and the configuration is applicable to both BSN Production Environment and Testnet.

Below is an example of a source chain initiating a cross-chain transaction call:

```
/**

* @dev: Implements a cross-chain call by invoking the "say" method

 * @param _toChainId: The chain ID corresponding to the target chain being called in the
Poly network

*@param _functionName：  The method of the called contract

 * @param _somethingWoW: Parameters passed across the chain

* @return bool

 **/

function say(uint64 _toChainId, string memory _functionName, string memory
_somethingWoW) public returns (bool){

   // Get the cross-chain management contract interface

    IEthCrossChainManagerProxy eccmp =
IEthCrossChainManagerProxy(managerProxyContract);

   // Get the cross-chain management contract address

   address eccmAddr = eccmp.getEthCrossChainManager();

   // Get the cross-chain management contract object

   IEthCrossChainManager eccm = IEthCrossChainManager(eccmAddr);

   // Get the target chain application contract address

   bytes memory toProxyHash = proxyHashMap[_toChainId];

   // Call across the chain
```

```
    require(eccm.crossChain(_toChainId, toProxyHash, bytes(_functionName),
bytes(_somethingWoW)),"EthCrossChainManager crossChain executed error!");
    emit Say(_toChainId,toProxyHash, bytes(_somethingWoW));    return true;
}
```

Below is an example of a target chain call when receiving a cross-chain transaction:

```
/**

* @param _somethingWoW: Parameters passed across the chain

 * @param _fromContractAddr: The address of the application contract being invoked

 * @param _toChainId: Contract framework chainId being called

 * @return bool

 **/

function hear(bytes _somethingWoW, bytes _fromContractAddr, uint64 _toChainId) public
returns (bool){

    hearSomeThing = _somethingWoW;

    emit Hear(_somethingWoW, _fromContractAddr);

    return true;

}
```

Demo Contract Example

GitHub: https://github.com/BSNDA/ICH/tree/main/sample/polychain/eth_contracts/hellopoly

8.2.5 Interchain Services based on Neo Testnet

Application Contract Development Guide

The development of Neo application contract is based on its own business scenario. The main implementation includes two parts: if the source chain initiates a cross-chain transaction, its application contract needs to get outbound to access the target chain; if the target chain receives a cross-chain transaction, its application contract needs to get inbound. Neo's chain ID in the

BSN Testnet is 4. This chain ID is registered in Poly Enterprise the configuration is applicable to both BSN Production Environment and Testnet.

Below is an example of a source chain initiating a cross-chain transaction call:

```
/// <summary>

    /// This method is used to make cross-chain calls to other target chains (this method is self-defining)

    /// </summary>

    /// <param name="toChainId">The chain ID of the target chain in the Poly network</param>

    /// <param name="msg">The cross-chain information that the target chain needs to pass to apply the contract</param>

    /// <returns></returns>

    [DisplayName("say")]

    public static bool Say(BigInteger toChainId, string method ,byte[] msg)

    {

        // Get the application contract on the target chain

        var toProxyHash = HelloPoly.GetProxyHash(toChainId);

        // Get the CCMC contract address

        var ccmcScriptHash = HelloPoly.GetProxyHash(neoChainID);

        // Call across the chains

        bool success = (bool)((DynCall)ccmcScriptHash.ToDelegate())("CrossChain", new object[] { toChainId, toProxyHash, method, msg });

        HelloPoly.Notify(success, "[HelloPoly]-Say: Failed to call CCMC.");

        // Event notification

        HelloPoly.SayEvent(toChainId, toProxyHash);

        return true;

    }
```

Below is an example of a target chain call when receiving a cross-chain transaction:

```
/// <summary>
```

```
    /// This method is used to make cross-chain calls to other target chains (this method is self-defining)

    /// </summary>

    /// <param name="fromChainId">The chain ID of the source chain in a Poly network</param>

    /// <param name="toChainId">The chain ID of the target chain in the Poly network</param>

    /// <param name="msg">Receive a cross-chain message sent by the source chain</param>

    /// <param name="callingScriptHash">Callback script hash</param>

    /// <returns></returns>

    [DisplayName("hear")]

    public static bool Hear(byte[] inputBytes, byte[] fromProxyContract, BigInteger fromChainId, byte[] callingScriptHash)

        //commit into ledger

        Storage.Put(fromProxyContract, inputBytes);

        // Event notification

        HearEvent(fromChainId, fromProxyContract, inputBytes);

        return true;

    }
```

Demo Contract Example

GitHub: https://github.com/BSNDA/ICH/tree/main/sample/polychain/neo-contract

9 IDE Services

9.1 Overview

An integrated development environment (IDE) is a software application that provides comprehensive facilities to computer programmers for software development. It enhances the development experience and efficiency by integrating tools such as compiler, editor, interpreter, debugger, project manager, etc.

BSN IDE Services customize and integrate the third-party IDEs corresponding to the frameworks adapted in BSN to form a development tool suite. When users create, publish and upgrade DApp services in the BSN portal, if the framework used in the current DApp service has already integrated with the IDE, they can create and modify smart contracts by calling the

IDE website with one click from the DApp service page. After finishing programming, developers can debug the code and deploy the smart contract in the BSN production environment or BSN Testnet. Developers do not need to install their own development tools and set up debugging environment, all edited smart contract packages can be synchronized and saved in the BSN portal and IDE.

Currently, the BSN International portal provides IDE services for permissioned frameworks including Hyperledger Fabric and FISCO BCOS, as well as public chains including Ethereum, Algorand and Nervos.

This iteration of IDE services is only available on the web. In the future, BSN will continue to integrate more frameworks and launch the BSN IDE client version.

9.2 Access Instructions

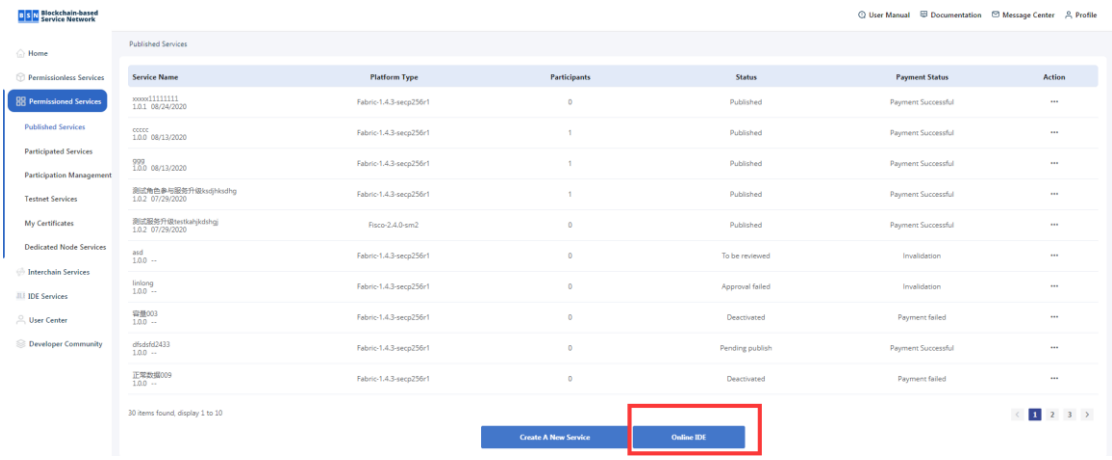
Users can access to the IDE from BSN portal, or directly log in to the IDE web page with BSN username and password.

If users jump from BSN portal to the IDE, the chaincode package will be automatically synchronized, and after IDE finishes the operation of chaincode package and jumps back to the portal, the chaincode package will be automatically synchronized to the corresponding service in the portal.

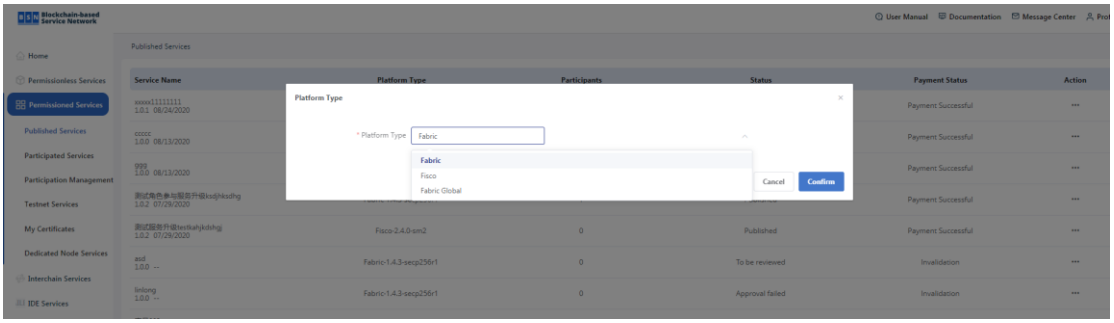
BSN's IDE is mainly applicable to the following services: service publication of permissioned chains, service editing and upgrading of permissioned chains, permissionless services and BSN testnet services.

9.2.1 Service publication of permissioned chains

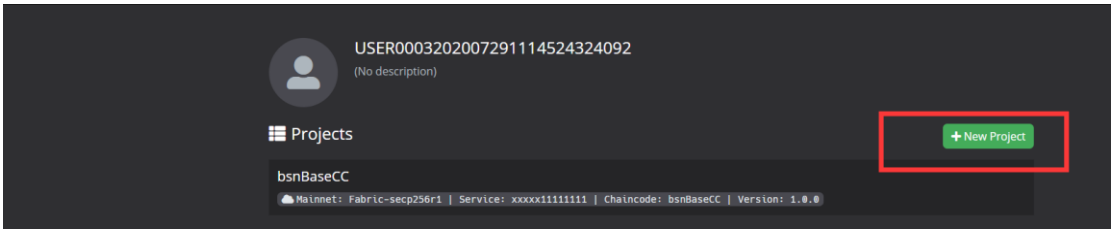
1. Log in to BSN portal, go to 【Permissioned Services】->【Published Services】, select “Online IDE”;



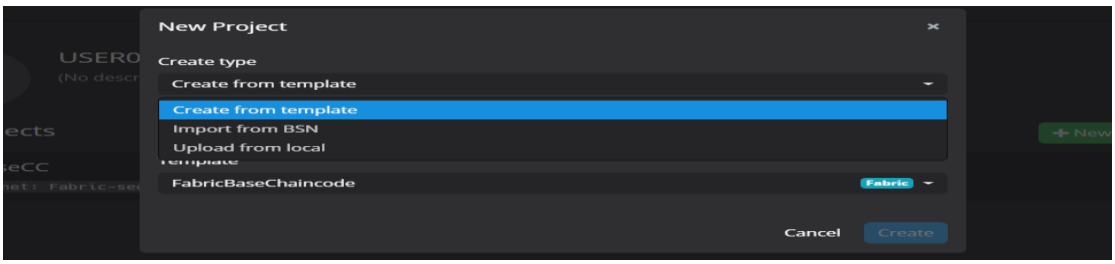
2. Choose the platform type, click “Confirm” button to jump to the IDE web page;



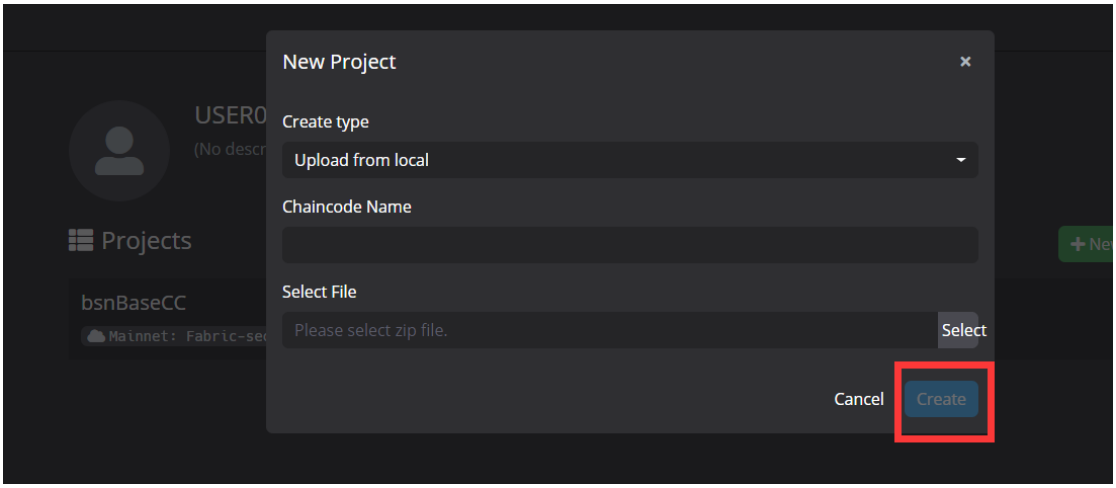
3. Create, edit and deploy the chaincode package in the IDE, and select "Create a new service";
   - Create chaincode package:
     Go to IDE, and click "New Project" button



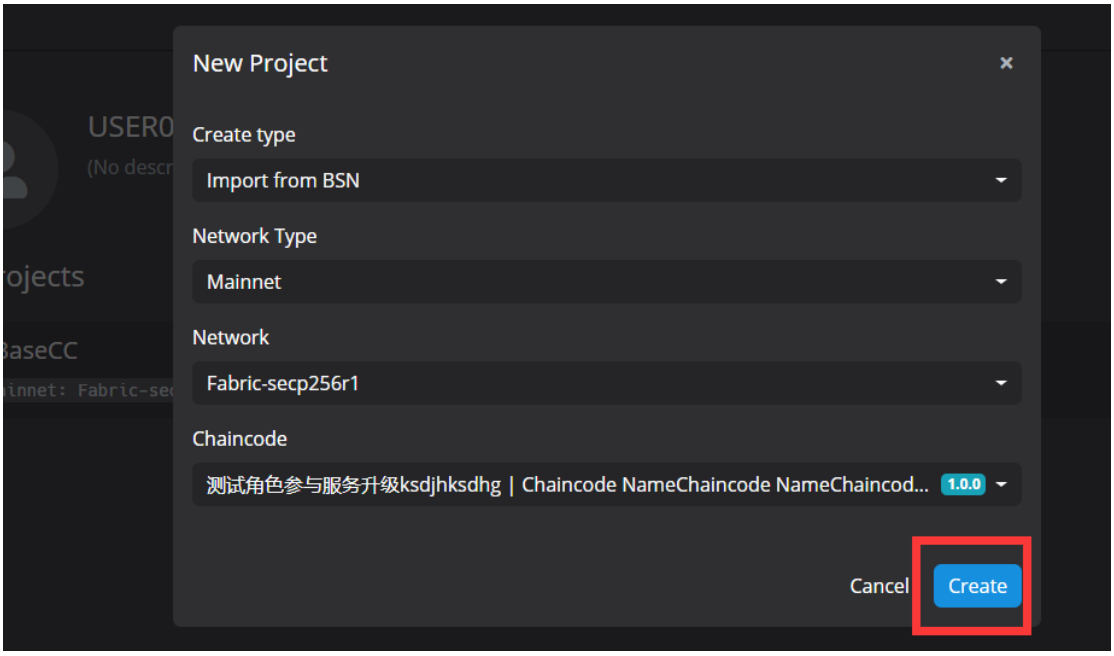
When creating the chaincode package, the IDE supports to import the chaincode package from BSN portal, or developer can create from template or upload from local disk drive.



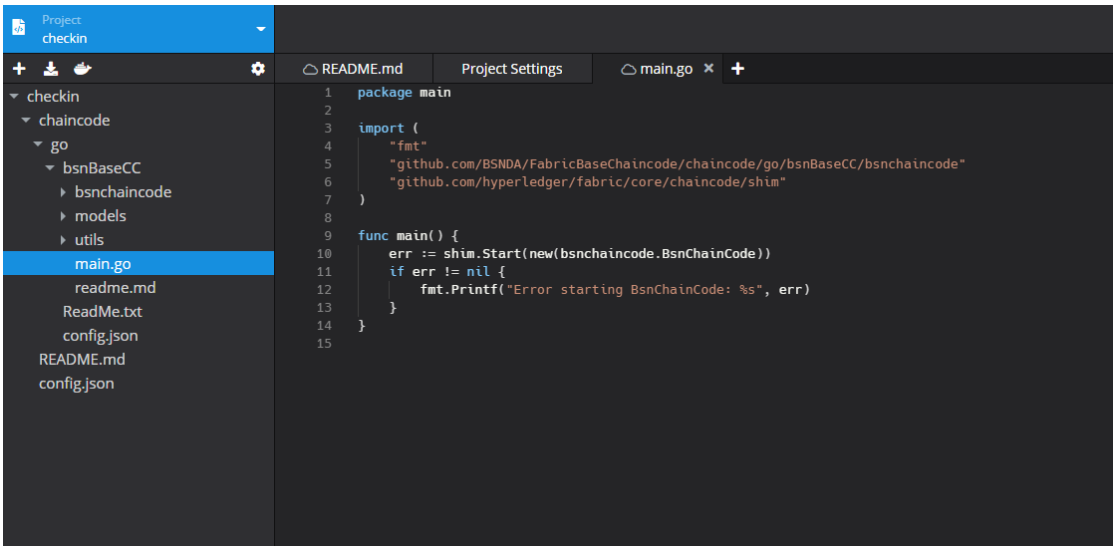
If "Create Type" is selected as "Upload from local", developer should input chaincode name, upload the chaincode package, and click "Create" button. Note that the file in the chaincode package cannot contain Chinese characters.



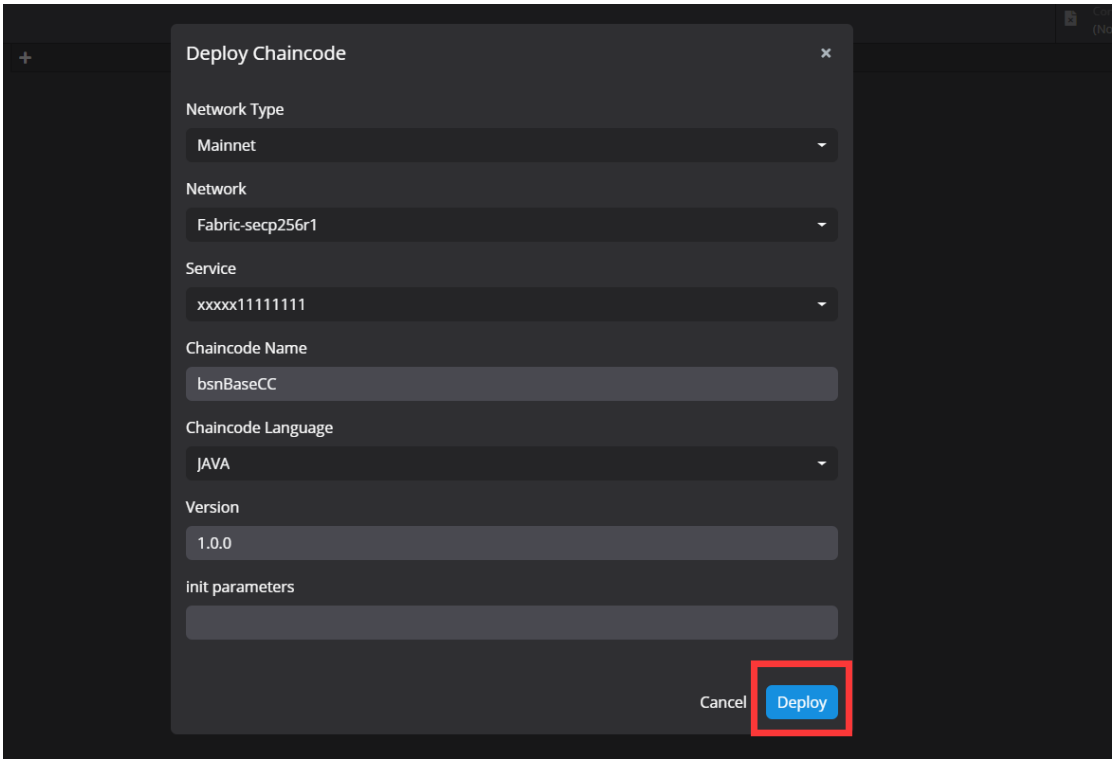
If “Create Type” is selected as “Import from BSN”, developer should select the network type, framework and chaincode package, and then click “Create” button to finish creating the project.



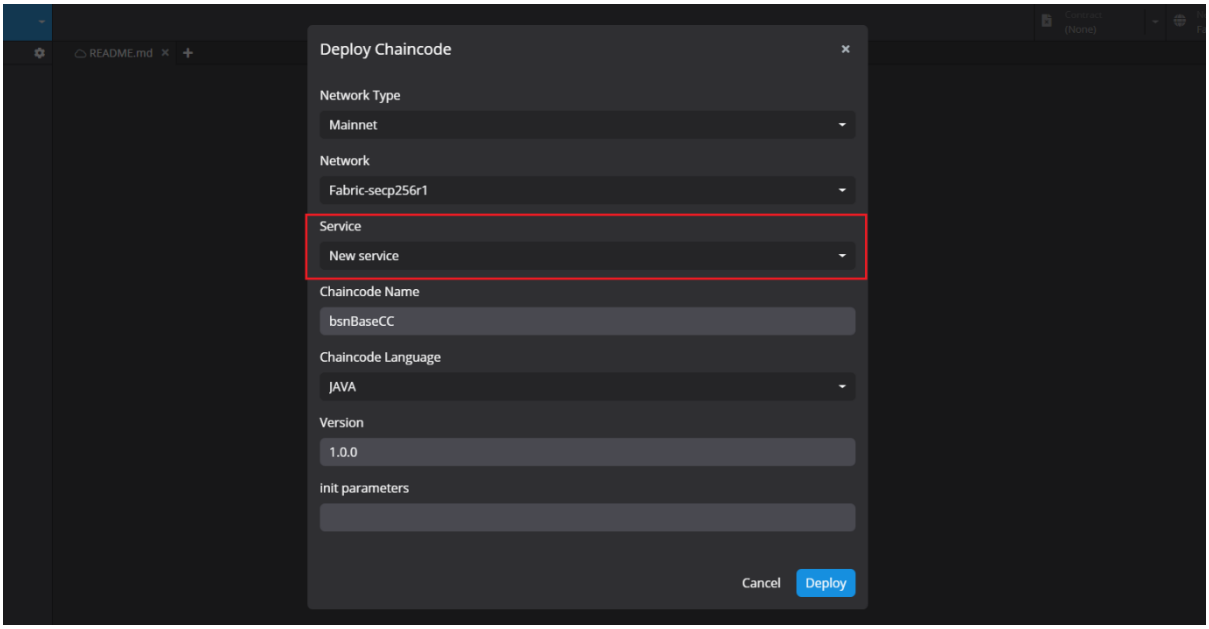
- Edit chaincode package:
  Click and expand the chaincode package in the IDE, and edit the chaincode in the editing page.



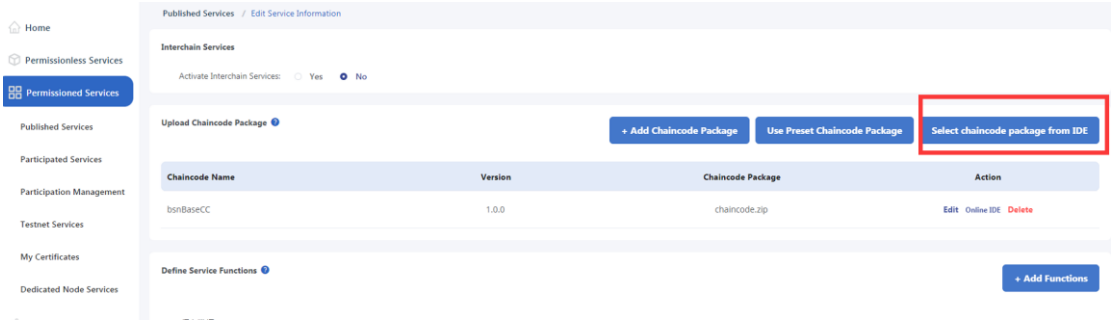
- Deploy chaincode package:
  On the editing page, click on “Deploy” button and go to the “Deploy Chaincode” page. Complete the from and click on “Deploy” button to deploy the chaincode package. Note that the chaincode name cannot contain Chinese characters.



- Create a new service
  On the chaincode deployment page, select “New service” in the Service part, it will navigate to BSN portal, Create a New Service page.

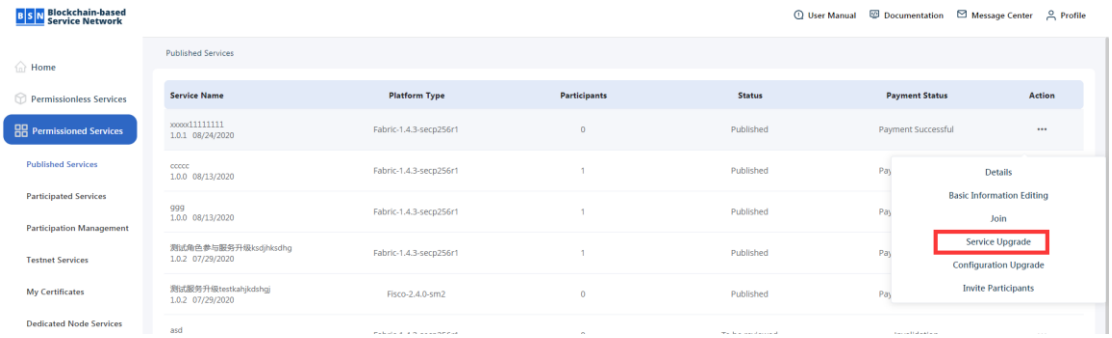


4. Jump back to the BSN portal, “Create a New Service” page, and continue the following process to publish the service. The chaincode package now has been synchronized to the portal.

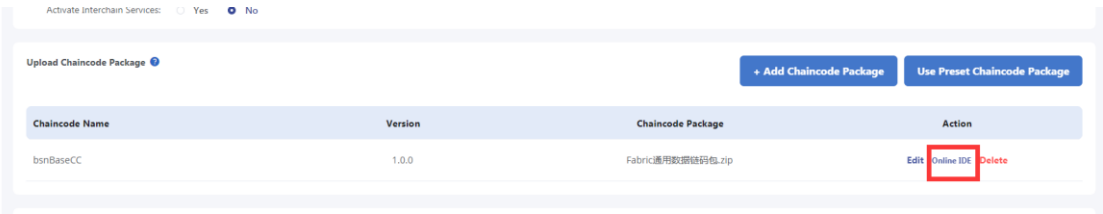


9.2.2 Service editing and upgrading of permissioned chains

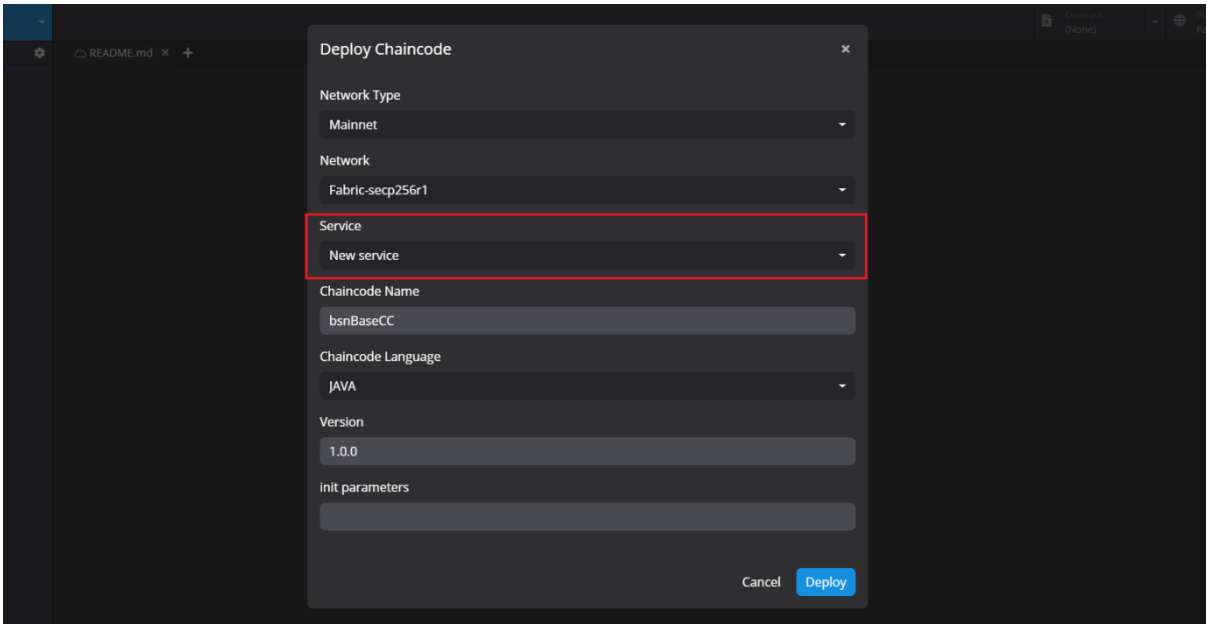
1. Log in to BSN portal, go to 【Permissioned Services】->【Published Services】, select "Service Upgrade";



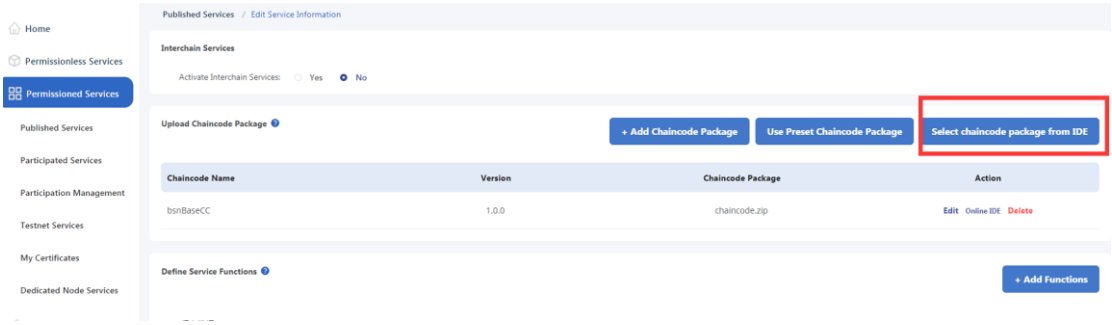
2. Select the chaincode package to be edited, and click on "Online IDE" button to jump to the IDE web page.



3. Edit and deploy the chaincode package in the IDE;
   The steps of editing and deploying the chaincode is the same as they are in 9.2.1.
4. Select the service to edit or upgrade;
   On "Chaincode deployment" page, select the service which needs to be upgraded, and jump back to the BSN portal Service Upgrade page.



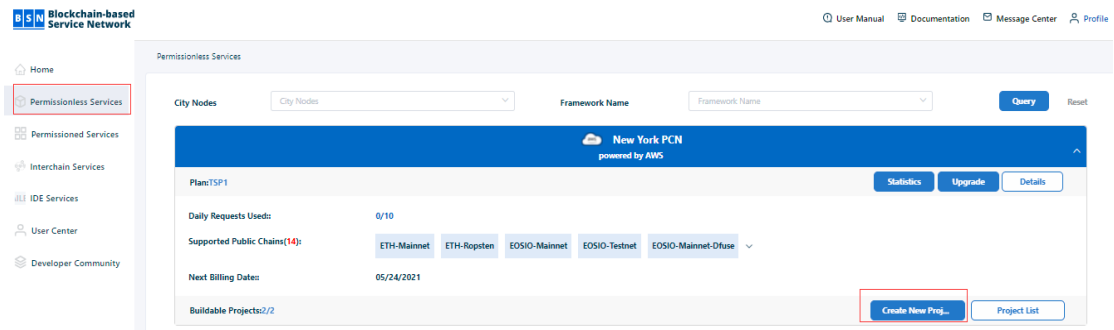
5. Navigate to the BSN portal and continue the following service upgrade process. In the "Upload chaincode package" section, click on "Select chaincode package from IDE" button to select the chaincode package from the IDE and replace the current one.



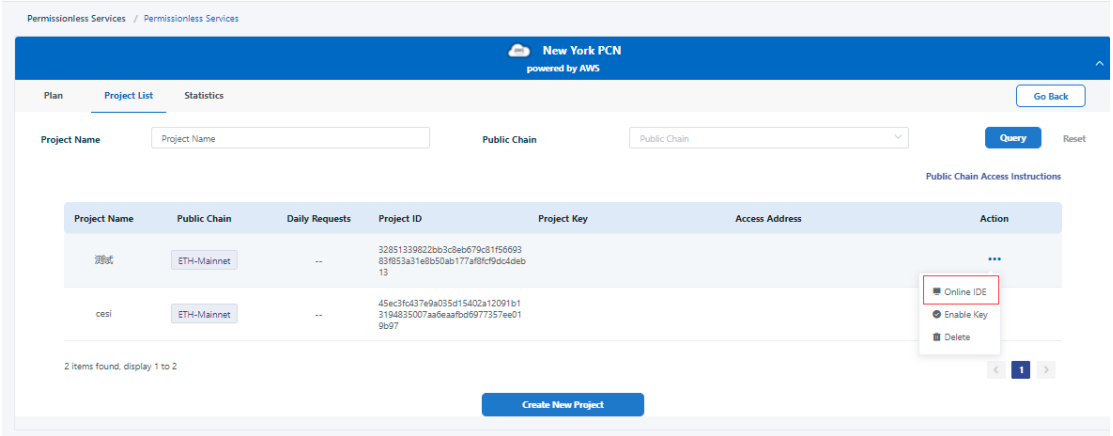
9.2.3 Access to permissionless services

Developers can access to the IDE to create, edit and deploy the chaincode package after creating the project in the BSN permissionless services.

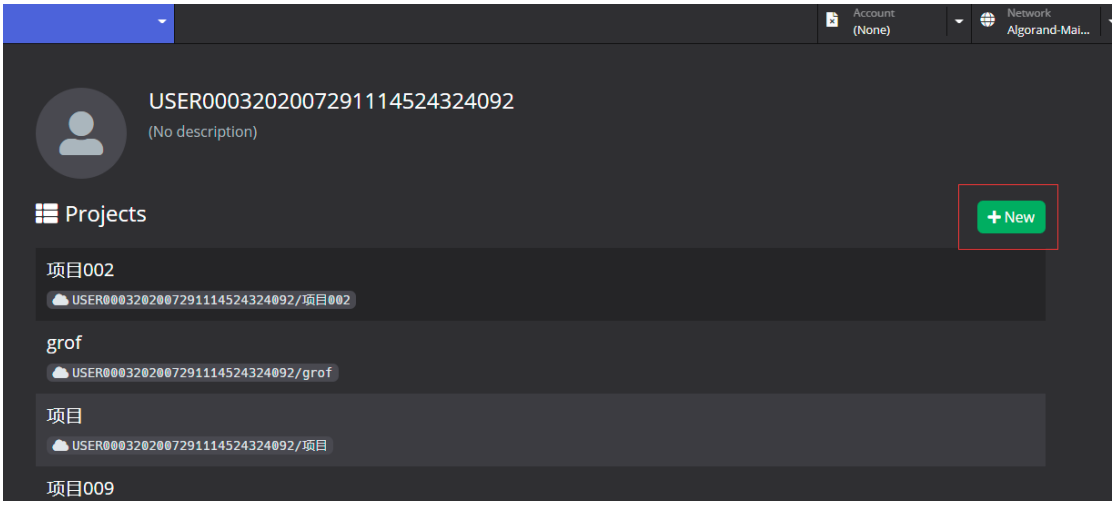
1. Log in to the BSN portal, "Permissionless Services", select the public city node and buy a plan and create a project (for example on Ethereum-Mainnet);



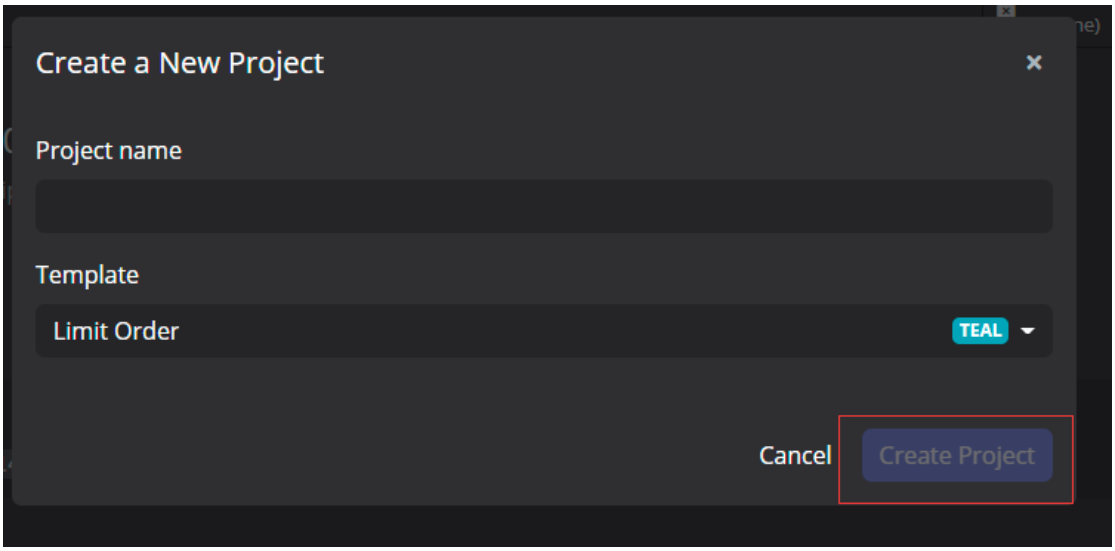
2. On the project list, click on "Online IDE" button in the created project to jump to the IDE;



3. Create, edit, test and deploy the chaincode package in the IDE;
   - Chaincode package creation:
     Go to IDE, and click “New” button.

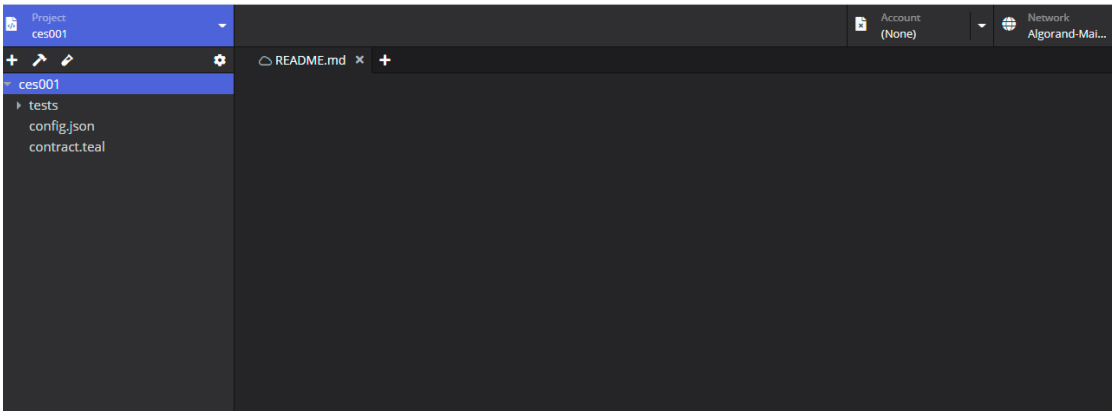


On “Create a New Project” page, input the project name, select the template and click “Create Project” button to create the chaincode package.

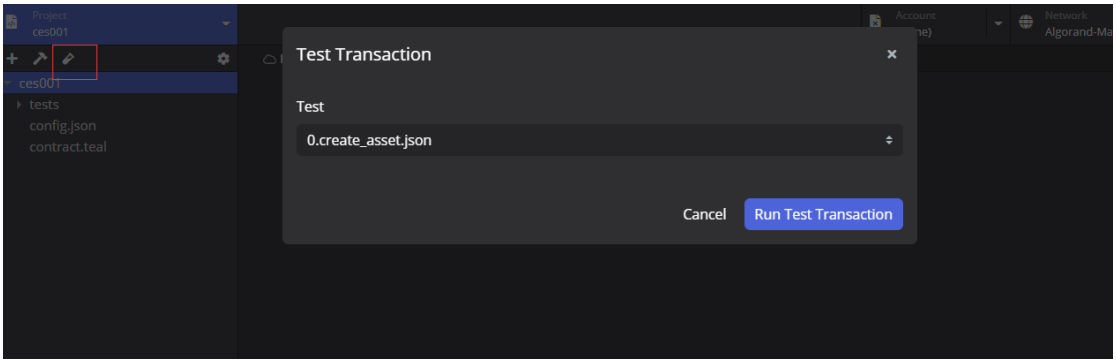


   - Edit chaincode package:

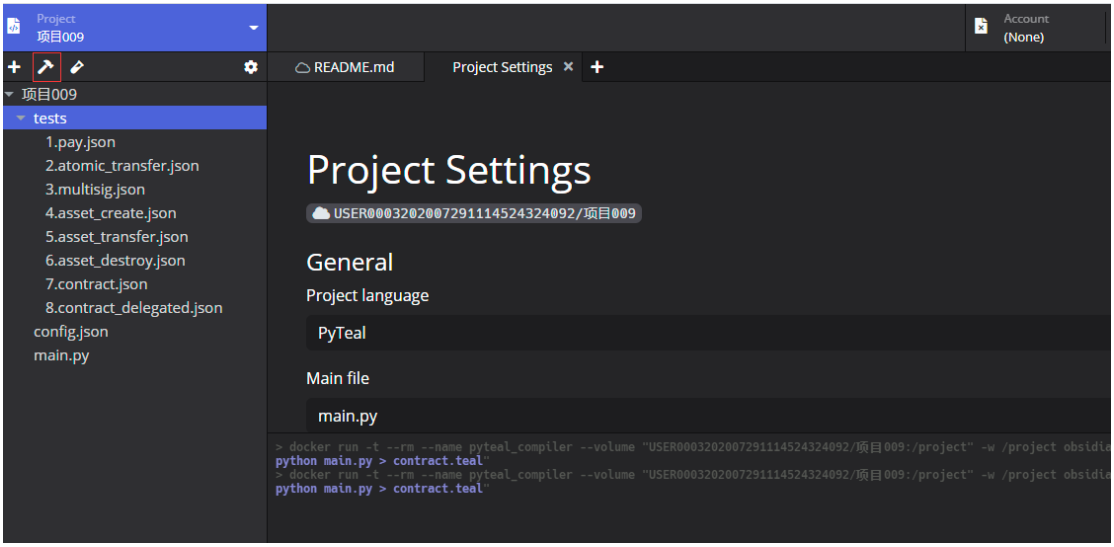
Click and expand the chaincode package in the IDE, and edit the chaincode in the editing page.



- Test chaincode package:
  In the editing page, click on “Run Test Transaction” to test the chaincode package.



- Deploy chaincode package:
  In the editing page, after passing the test, click on “Deploy” button to complete the deployment of the chaincode package.



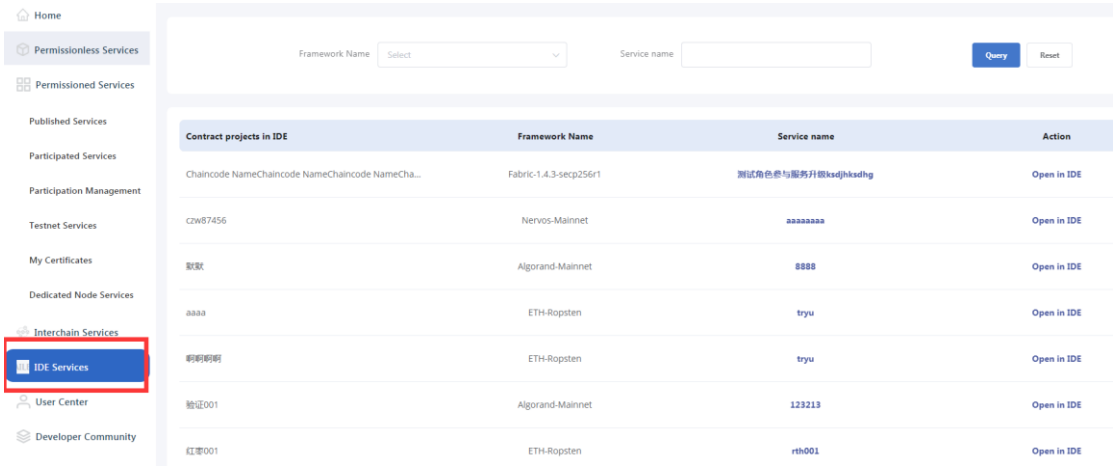
4. Chaincode package deployment. Developers can select the access information of the project in the BSN portal.

9.2.4 BSN Testnet Services

BSN testnet services has integrated the IDE, and the specific steps are consistent with the production environment.

9.3 My IDE

Login to the BSN portal and go to home page, click 【IDE Services】, and enter the service inquiry page.



BSN International portal supports developers to view the edited chaincode packages in IDE service query page, developers can query by framework name or service name.

If a chaincode package is used in multiple services or projects, it will be associated with multiple services or projects in the service name column, click the service name to jump to the service to view the service/project details; click "Open in IDE" to jump to the IDE for chaincode package editing.

10 DID Services

10.1Overview

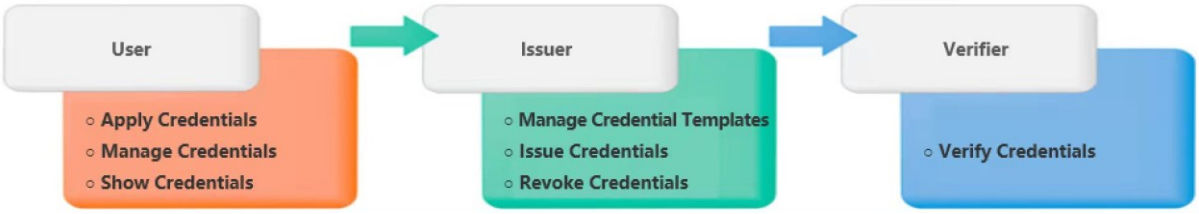
With blockchain technology as the cornerstone and W3C DID as the specification, BSN DID Services achieve decentralized on-chain mapping of real entity, thus achieving the ability to provide digital identity and digital credential interaction for individuals/organizations.

Roles

In the DID ecosystem, there are three roles: User, Issuer and Verifier.

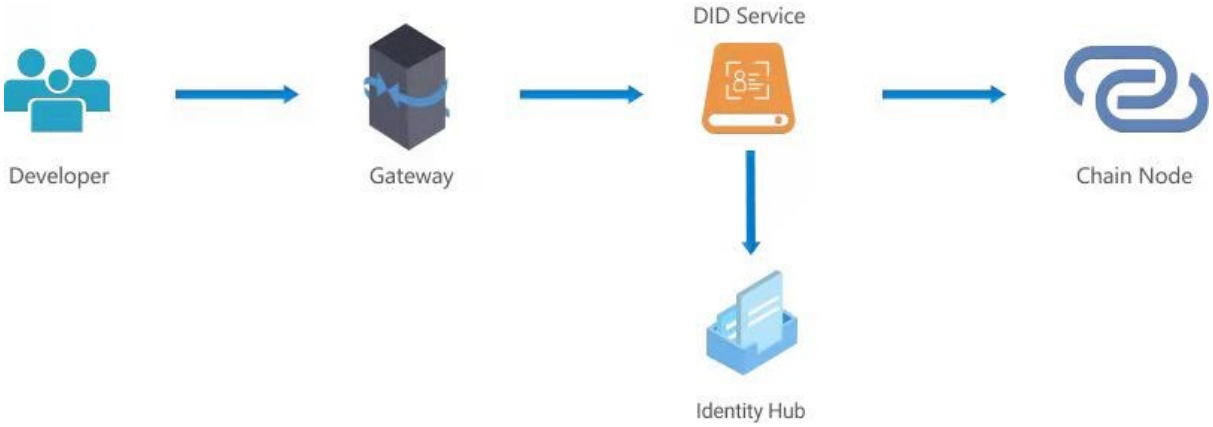
- User: Any individual/organization/entity that has a digital identity on the chain. Any entity object can create and manage its DID through the developer's project.
- Issuer: The individual or organization that can issue the digital credentials For example, if a university can issue a digital diploma to a student, then the university is an issuer.
- Verifier: Also known as a business party, is an individual or organization that uses digital credentials. After being authorized by the user, the verifier can verify the identity of the

user or their digital credentials. For example, when a company hires someone, it needs to verify his college diploma, then the company is a verifier.



Components

The DID system consists of three components: SDK, Service and Smart Contract. The SDK can be integrated in the developer's project; Service handles the business logic and connects the private data storage area (Identity Hub) to the chain node; the smart contract is deployed on the chain, and the methods in the contract is called by the Service.



Functions and features

- Deployed on the BSN, the DID Service builds a decentralized digital identity management system, which facilitates autonomous participation and affirmative collaboration among users, issuers and verifiers.
- Provide a unified decentralized digital identity management, including identifier creation, update and verification functions.
- Provide mechanisms for issuance, authorization, verification and revocation of user data credentials.
- Provide a private data storage area (Identity Hub) where credentials are fully controlled by users, and is stored and transmitted in encryption.
- Provide unified access to API services and SDKs, integrate object encapsulation, signature, verification and other methods for easy docking by developers.

10.2 HTTP API

1. Access parameters

No.	Parameter	Description	Value
1	url	Gateway URL	https://did.bsngate.com:18602
2	projectId	Project ID	8320935187
3	token	Project Key	3wxYHXwAm57grc9JUr2zrPHt9HC

2. Public parameters

Public request header parameters				
No.	**Parameter**	**Value**		
1	token	3wxYHXwAm57grc9JUr2zrPHt9HC		
2	projectId	8320935187		
3	Content-Type	application/json		
Public request parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		RequestParam<T>	Y	Public parameter
RequestParam				
1	projectId	String	Y	Project ID
2	did	String	Y	DID
3	data	T	Y	Any type of data
4	sign	String	Y	Secp256k1 signature
Public Response Parameter				
No.	**Parameter**	**Type**	**Description**	
1		ResultData<T>	Public response data	
ResultData				
1	code	Integer	Returned code	
2	msg	String	Message	
3	data	T	Any type of data	

3. DID Creation

The process of creating DID generates public and private key pair. In order to avoid the transmission of private keys, BSN DID Services do not provide the process of creating DIDs. Developers can generate them locally as described below, or they can use or refer to the SDK to complete the generation.

1) Generate two public and private key pairs through the elliptic curve algorithm Secp256k1.

2) Save the private key and specify the primary and recovery public keys to assemble the Base DID Document, the contents of which are shown below:

```
{
  "@context":"https://w3id.org/did/v1",
  "authentication":
  {
    "type":"Secp256k1",
    "publicKey":
```

```
"28986472722394106073871327423452879123214061743224210681401278929598807211
1400012745075303242219237958654476808367423489633373435102298806699684997 3
5858"
  }
  "recovery":
  {
    "type":"Secp256k1",
    "publicKey":
"92519711680429159415515746419877215039845427616418520648539645411813788327
4695934015129790831261659697162557396755667636769606793717160176658170984 3
378481"
  }
}
```


3) The DID identifier is generated by the base58(ripemd160(sha256(<Base DID Document>)) algorithm in the following example format:

did:bsn:3wxYHXwAm57grc9JUr2zrPHt9HC

4) Assemble the contents of the DID Document, as the following example:


```
{
  "did":"did:bsn:3wxYHXwAm57grc9JUr2zrPHt9HC",
  "version":1,
  "created":"2021-05-20T16:02:20Z",
  "updated":"2021-05-20T16:02:20Z",
  "authentication":
  {
    "type":"Secp256k1",
    "publicKey":
"28986472722394106073871327423452879123214061743224210681401278929598807211
1400012745075303242219237958654476808367423489633373435102298806699684997 3
5858"
  }
  "recovery":
  {
    "type":"Secp256k1",
    "publicKey":
"92519711680429159415515746419877215039845427616418520648539645411813788327
4695934015129790831261659697162557396755667636769606793717160176658170984 3
378481"
  }
}
```


5) Use the primary private key to sign the DID Document content with Secp256k1, and finally form the DID Document with the signature attribute, as following:


```
{
  "did":"did:bsn:3wxYHXwAm57grc9JUr2zrPHt9HC",
  "version":                                                    1,
  "created":"2021-05-20T16:02:20Z",
  "updated":"2021-05-20T16:02:20Z",
  "authentication":
```

```
  {
    "type":"Secp256k1",
    "publicKey":
"2898647272239410607387132742345287912321406174322421068140127892959880721114000127450753032422192379586544768083674234896333734351022988066996849973
5858"
  }
  "recovery":
  {
    "type":"Secp256k1",
    "publicKey":
"9251971168042915941551574641987721503984542761641852064853964541181378832746959340151297908312616596971625573967556676367696067937171601766581709843
378481"
  }
  "proof":
  {
    "type":"Secp256k1",
    "creator":"did:bsn:3wxYHXwAm57grc9JUr2zrPHt9HC",
    "signatureValue":
"zD5nt+P/Ga/CRG2hJU/SMRXy210CLdvATsxQdPxTEy9Mc9Y0OSFpE3Yu5k2+OjQKV
Otu5of9VFbgO3Zljw/vQxs="
  }
}
```


10.2.1 DID API

The creation of DID is done offline, so the following API is used to upload the DID to the chain and query the DID Document information on the chain.

10.2.1.1 Verify DID Document

Interface Address		**/did/verifyDoc**		
Description		Verify the content format and signature value of the offline generated DID Document.		
Interface request parameter				
No.	Parameter	Type	Required	Description
1		VerifyDocumentReq	Y	Wrapper class
VerifyDocumentReq				
1	didDoc	DidDocument	Y	DID Document
DidDocument				
1	did	String	Y	DID
2	version	String	Y	Version
3	created	String	Y	Created date
4	updated	String	Y	Updated date
5	authentication	PublicKey	Y	Primary public key
6	recovery	PublicKey	Y	Recovery public key
7	proof	Proof	Y	Signature
PublicKey				

1	publicKey	String	Y	Public key
2	type	String	Y	Algorithm type
Proof				
1	creator	String	Y	DIDs involved in the calculation of signature values
2	type	String	Y	Algorithm type
3	signatureValue	String	Y	Signature value
Interface response parameter				
No.	**Parameter**	**Type**	**Description**	
1		Boolean	Return true if success, return false if failed	

10.2.1.2 Add DID Document to the chain

Interface Address	**/did/putDoc**			
Description	The DID Document is stored in the chain. The verification will be executed internally, so if you want to upload the DID Document to the chain, you can directly call this interface.			
Interface request parameter				
No.	**Parameter**	**Type**	**Required**	**Description**
1		DidDocSotreReq	Y	Wrapper class
DidDocSotreReq				
1	didDoc	Document	Y	DID Document
Document				
1	did	String	Y	DID
2	version	String	Y	Version
3	created	String	Y	Created date
4	updated	String	Y	Updated date
5	authentication	PublicKey	Y	Primary public key
6	recovery	PublicKey	Y	Recovery public key
7	proof	Proof	Y	Signature
PublicKey				
1	publicKey	String	Y	Public key
2	type	String	Y	Algorithm type
Proof				
1	creator	String	Y	DID involved in the calculation of the Signature value
2	type	String	Y	Algorithm type
3	signatureValue	String	Y	Signature value
Interface response parameter				
No.	**Parameter**	**Type**	**Description**	
1		Boolean	Return true if success, return false if failed	

10.2.1.3 Get DID Document

Interface Address	/did/getDoc			
Description	The information in the DID Document is a record and description of the DID, so anyone can query the corresponding DID Document on the chain by the DID. It can be used to verify the DID and obtain the DID public key.			
Interface request parameter				
No.	**Parameter**	**Type**	**Required**	**Description**
1		DidDocumentReq	Y	Wrapper class
DidDocumentReq				
1	did	String	Y	DID
Interface response parameter				
No.	**Parameter**	**Type**	**Description**	
1		DidDocument	DID Document	
DidDocument				
1	did	String	DID	
2	version	String	Version	
3	created	String	Created date	
4	updated	String	Updated date	
5	authentication	PublicKey	Primary public key	
6	recovery	PublicKey	Recovery public key	
7	proof	Proof	Signature	
PublicKey				
1	publicKey	String	Public key	
2	type	String	Algorithm type	
Proof				
1	creator	String	DID involved in the calculation of the Signature value	
2	type	String	Algorithm type	
3	signatureValue	String	Signature value	

10.2.1.4 Verify DID Signature

Interface Address	/did/verifyDidSign			
Description	Verify the signature value of the DID to ensure the authenticity and validity of the current DID.			
Interface request parameter				
No.	**Parameter**	**Type**	**Required**	**Description**
1		VerifyDidReq	Y	Wrapper class
`VerifyDidReq`				
1	did	String	Y	DID
2	didSign	String	Y	DID signature value
Interface response parameter				
No.	**Parameter**	**Type**	**Description**	
1		Boolean	Return true if success, return false if failed	

10.2.1.5 Update Key

Interface Address	/did/resetDidAuth			
Description	The generation of the new authentication public-private key pair from the recovery public-private key information is done by the DID SDK. The interface receives new DID Document content from the user for on-chain update.			
Interface request parameter				
No.	**Parameter**	**Type**	**Required**	**Description**
1		RestDocAuth	Y	Wrapper class
RestDocAuth				
1	didDoc	Document	Y	DID Document
2	authPubKeySign	String	Y	The recovery private key performs k1 signature on the recovery public key
Document				
1	did	String	Y	DID
2	version	String	Y	Version
3	created	String	Y	Created date
4	updated	String	Y	Updated date
5	authentication	PublicKey	N	Primary public key
6	recovery	PublicKey	Y	Recovery public key
7	proof	Proof	Y	Signature
PublicKey				
1	publicKey	String	Y	Public key
2	type	String	Y	Algorithm type
Proof				
1	creator	String	Y	DID involved in the calculation of the Signature value
2	type	String	Y	Algorithm type
3	signatureValue	String	Y	Signature value
Interface response parameter				
No.	**Parameter**	**Type**	**Description**	
1		KeyInfo	New authentication public key information	
PublicKey				
1	publicKey	String	Public key	
2	type	String	Algorithm type	

10.2.2 Issuer

The issuer and user are two roles, and the following APIs are the pre-constraints for issuing credentials. The process of changing the DID user to the issuer does not change the DID Identifier or DID Document, but only the status.

To issue a credential, a DID user needs to register as an issuer and then define a template for registering the credential they want to issue. The credential template will be stored on the chain and everyone can query.

10.2.2.1 Issuer Registration

Interface Address	/did/registerAuthIssuer			
Description	The DID user becomes the issuer and the issuer information is uploaded if the registration is successful.			
Interface request parameter				
No.	**Parameter**	**Type**	**Required**	**Description**
1		RegisterAuthorityIssuerWrapper	Y	Wrapper class
RegisterAuthorityIssuerWrapper				
1	did	String	Y	DID
2	name	String	Y	Issuer's name
3	publicKeySign	String	Y	Public key
Interface response parameter				
No.	**Parameter**	**Type**	**Description**	
1		Boolean	Return true if success, return false if failed	

10.2.2.2 Query Issuer

Interface Address	/did/queryAuthIssuerList			
Description	Check whether you are the issuer by DID and identify which type of credentials can be issued by name.			
Interface request parameter				
No.	**Parameter**	**Type**	**Required**	**Description**
1		AuthIssuerListWrapper	Y	Wrapper class
AuthIssuerListWrapper				
1	did	String	Y	DID
2	page	Integer	Y	Page
3	size	Integer	Y	Number of entries
Interface response parameter				
No.	**Parameter**	**Type**	**Description**	
1		AuthorityIssuer	Issuer Information	
AuthorityIssuer				
1	did	String	DID	
2	name	String	Issuer's name	

10.2.2.3 Register Credential Template

Interface Address	/did/registerCpt
Description	The issuer customizes the credential template and can agree on which attribute values must be provided by the applicant. For example, in the template of college diploma, you can agree that "name" and "student number" are mandatory information.

Interface request parameter				
No.	**Parameter**	**Type**	**Required**	**Description**
1		RegisterCptWrapper	Y	Wrapper class
RegisterCptWrapper				
1	did	String	Y	DID
2	cptJsonSchema	Map<String, JsonSchema>	Y	JsonSchema information for MapType
3	title	String	Y	Credential template title
4	description	String	Y	Credential template description
5	type	String	Y	Credential type, fill in proof
6	proof	Proof	Y	Signature
7	create	String	Y	Created date
8	update	String	Y	Updated date
Proof				
1	creator	String	Y	DID involved in the calculation of the Signature value
2	type	String	Y	Algorithm type
3	signatureValue	String	Y	Signature value
JsonSchema				
1	type	String	Y	Field type
2	description	String	Y	Field description
3	required	boolean	Y	Whether is required to fill

Interface response parameter			
No.	**Parameter**	**Type**	**Description**
1		CptBaseInfo	Credential template information
CptBaseInfo			
1	cptId	Long	Credential template ID
2	cptVersion	Integer	Version

10.2.2.4 Query Credential Template List

Interface Address	**/did/queryCptList**
Description	Anyone can check all their credential templates by DID. It is possible for the same individual/organization to register multiple credential templates. For example, a university may have a degree template, an incomplete template, etc. in addition to a diploma template.

Interface request parameter				
No.	**Parameter**	**Type**	**Required**	**Description**
1		QueryCptListWrapper	Y	Wrapper class
QueryCptListWrapper				
1	page	Integer	Y	Page
2	size	Integer	Y	Number of entries
3	did	String	Y	DID

Interface response parameter			
No.	**Parameter**	**Type**	**Description**
1		Pages<CptInfo>	Credential template list info
Pages<CptInfo>			
1	page	Integer	Page
2	size	Integer	Number of entries
3	totalNum	Integer	Number of entries in total
4	totalPage	Integer	Number of pages in total
5	result	List<CptInfo>	Result list
CptInfo			
1	cptVersion	Integer	Credential template version
2	cptJsonSchema	Map<String, JsonSchema>	JsonSchema information for MapType
3	title	String	Credential template title
4	description	String	Credential template description
5	publisherDid	String	DID of the credential template issuer
6	proof	Proof	Signature
7	cptId	Long	Credential template ID
8	create	String	Created date
9	update	String	Updated date
JsonSchema			
1	type	String	Field type
2	description	String	Field description
3	required	Boolean	whether is required to fill
Proof			
1	creator	String	DID involved in the calculation of the Signature value
2	type	String	Algorithm type
3	signatureValue	String	Signature value

10.2.2.5 Query Credential Template

Interface Address	**/did/queryCptById**			
Description	Query the contents of a specific credential template by its ID.			
Interface request parameter				
No.	**Parameter**	**Type**	**Required**	**Description**
1		QueryCptByIdWrapper	Y	Wrapper class
QueryCptByIdWrapper				
1	cptId	Long	Y	Credential template ID
Interface response parameter				
No.	**Parameter**	**Type**	**Description**	
1		CptInfo	Credential template information	
CptInfo				

1	cptVersion	Integer	Version
2	cptJsonSchema	Map<String, JsonSchema>	JsonSchema information for MapType
3	title	String	Credential template title
4	description	String	Credential template description
5	publisherDid	String	DID of the credential template issuer
6	proof	Proof	Signature
7	cptId	Long	Credential template ID
8	create	String	Created date
9	update	String	Updated date
JsonSchema			
1	type	String	Field type
2	description	String	Field description
3	required	boolean	WHETHER IS REQUIRED TO FILL
Proof			
1	creator	String	DID involved in the calculation of the Signature value
2	type	String	Algorithm type
3	signatureValue	String	Signature value

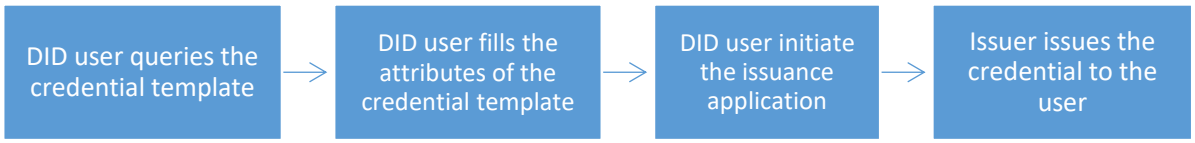
10.2.2.6 Update Credential Template

Interface Address	**/did/updateCpt**			
Description	The issuer updates the content of its own registered credential templates. The update of credential template does not affect credentials already issued.			
Interface request parameter				
No.	**Parameter**	**Type**	**Required**	**Description**
1		RegisterCptWrapper	Y	Wrapper class
RegisterCptWrapper				
1	did	String	Y	DID
2	cptJsonSchema	Map<String, JsonSchema>	Y	JsonSchema information for MapType
3	title	String	Y	Credential template title
4	description	String	Y	Credential template description
5	type	String	Y	Credential type, fill in proof
6	proof	Proof	Y	Signature
7	cptId	Long	Y	Credential template ID
8	create	String	Y	Created date
9	update	String	Y	Updated date
Proof				
1	creator	String	Y	DID involved in the calculation of the Signature value
2	type	String	Y	Algorithm type

3	signatureValue	String	Y	Signature value
JsonSchema				
1	type	String	Y	Field type
2	description	String	Y	Field description
3	required	boolean	Y	WHETHER IS REQUIRED TO FILL
Interface response parameter				
No.	**Parameter**	**Type**	**Description**	
1		CptBaseInfo	Credential template information	
CptBaseInfo				
1	cptId	Long	Credential template ID	
2	cptVersion	Integer	Version, plus one after each update is successful	

10.2.3 Credential

The credential is generated based on the credential template. The application of the credential is made by the user, and then the issuer issues the credential. The credential issuance process is generally as follows:



Once the user has the credentials issued by the issuer, he/she can present them to the verifier for further use.

10.2.3.1 Issue Credential

Interface Address	**/did/createCredential**			
Description	The attribute values defined in the credential template are provided by the issuer for the DID user to obtain on the front page. The issuer issues the credentials for the DID user through this interface. If there are more Claim parameters than defined in the credential template, the server side will discard them.			
Interface request parameter				
No.	**Parameter**	**Type**	**Required**	**Description**
1		CreateCredentialReq	Y	Wrapper class
CreateCredentialReq				
1	cptId	Long	Y	Credential template ID
2	issuerDid	String	Y	DID of the credential template issuer
3	userDid	String	Y	DID of the user requesting the credentials
4	expirationDate	String	Y	Credential expiration date
5	claim	Map<String,Object>	Y	Claim data
6	type	String	Y	Credential type, fill in Proof
7	shortDesc	String	N	Brief description of the credential template. If this field is null, the

				value of the title field in the credential template is displayed. If not, the input value is displayed.
8	longDesc	String	N	Detailed description of the credential template
Interface response parameter				
No.	**Parameter**	**Type**		**Description**
1		CredentialWrapper		Credential issuance information
CredentialWrapper				
1	context	String		Specification
2	id	String		Credential ID
3	type	String		Credential type, fill in proof
4	cptId	Long		Credential template ID
5	issuerDid	String		DID of credential issuer
6	userDid	String		DID of the user requesting the credentials
7	expirationDate	String		Expiration date
8	created	String		Created date
9	shortDesc	String		Brief description of the credential
10	longDesc	String		Detailed description of the credential
11	claim	Map<String, Object>		Claim data
12	proof	Map<String, Object>		Signature

10.2.3.2 Verify Credential

Interface Address	**/did/verifyCredential**			
Description	Generally called by the verifier. It can verify whether a particular credential is valid or not. Verify the signature of the credential, whether the credential is expired, and whether the credential is revoked, respectively.			
Interface request parameter				
No.	**Parameter**	**Type**	**Required**	**Description**
1		VerifyCredentialReq	Y	Wrapper class
VerifyCredentialReq				
1	credentialWrapper	CredentialWrapper	Y	Credential information
2	publicKey	PublicKey	Y	Issuer’s public key
CredentialWrapper				
1	context	String	Y	Specification
2	id	String	Y	Credential ID
3	type	String	Y	Credential type, fill in Proof
4	cptId	Long	Y	Credential template ID
5	issuerDid	String	Y	DID of credential issuer
6	userDid	String	Y	DID of the user requesting the credentials
7	expirationDate	String	Y	Expiration date

8	created	String	Y	Created date
9	shortDesc	String	N	Brief description of the credential
10	longDesc	String	N	Detailed description of the credential
11	claim	Map<String, Object>	Y	Claim data
12	proof	Map<String, Object>	Y	Signature
PublicKey				
1	publicKey	String	Y	Public key
2	type	String	Y	Algorithm type
Interface response parameter				
No.	**Parameter**	**Type**	**Description**	
1		Boolean	Return true if success, return false if failed	

10.2.3.3 Revoke Credential

Interface Address	**/did/revokeCredential**			
Description	Called by the issuer to revoke or void a credential that has been issued. Since the issued credential is already in the custody of the user, the revocation of the credential is followed by the upload of its credential ID.			
Interface request parameter				
No.	**Parameter**	**Type**	**Required**	**Description**
1		RevokCredentialReq	Y	Wrapper class
RevokCredentialReq				
1	credId	String	Y	Credential ID to be revoked
2	cptId	Long	Y	Credential template ID
3	did	String	Y	Issuer’s DID
4	revokeDate	String	Y	Revoked date
5	publicKeySign	String	Y	The primary private key performs a k1 signature on the primary public key
6	revokeSign	String	Y	After splicing the certificate ID and revocation time, use the primary private key for k1 revocation signature
Interface response parameter				
No.	**Parameter**	**Type**	**Description**	
1		Boolean	Return true if success, return false if failed	

10.2.3.4 Query Revoked Credential

Interface Address	**/did/getRevokedCredList**
Description	Called when verifying credentials. Find out all its revoked credential IDs by Issuer's DID.
Interface request parameter	

No.	Parameter	Type	Required	Description
1		QueryCredentialWrapper	Y	Wrapper class
QueryCredentialWrapper				
1	Page	Integer	Y	Page
2	Size	Integer	Y	Number of entries
3	did	String	Y	Issuer's DID
Interface response parameter				
No.	**Parameter**	**Type**	**Description**	
1		Pages<BaseCredential>	Revocation list information	
Pages<BaseCredential>				
1	page	Integer	Page	
2	size	Integer	Number of entries	
3	totalNum	Integer	Number of entries in total	
4	totalPage	Integer	Number of pages in total	
5	result	List<BaseCredential >	Result list	
BaseCredential				
1	id	String	Credential ID	
2	created	String	Revoked date	

10.2.4 Identity Hub

BSN provides users with a privacy data storage area (Identity Hub, hereinafter referred to as Hub) where users can choose to store their credentials or other data (both are called "resource") into the Hub, which verifies the identity of visitors while the data is encrypted during transmission and storage, leaving users in full control of access to their own data.

10.2.4.1 Register Hub User by DID

Interface Address	**/hub/regiter**			
Description	Register by DID, if successful, returns the user's ID in the Hub.			
Interface request parameter				
No.	**Parameter**	**Type**	**Required**	**Description**
1		RegisterHubReq	Y	Wrapper class
RegisterHubReq				
1	did	String	Y	DID
2	publicKey	String	Y	Public key
Interface response parameter				
No.	**Parameter**	**Type**	**Description**	
1		RegisterHubResult	Wrapper class of the returned value	
RegisterHubResult				
1	success	Boolean	Whether it is successful	
2	uid	String	ID in the Hub	
3	message	String	Result description	

10.2.4.2 Register Hub User by Public Key

Interface Address	/hub/regiterByIdPublicKey			
Description	Register by Public key. This function allows users define the ID by themselves. If successful, returns the user's ID in the Hub.			
Interface request parameter				
No.	**Parameter**	**Type**	**Required**	**Description**
1		RegisterHubReq	Y	Wrapper class
RegisterHubReq				
1	id	String	N	Self-defined Hub ID
2	publicKey	String	Y	Public key
3	cryptoType	String	Y	Encryption Algorithm: ECDSA
Interface response parameter				
No.	**Parameter**	**Type**	**Description**	
1		RegisterHubResult	Wrapper class of the returned value	
RegisterHubResult				
1	success	Boolean	Whether it is successful	
2	uid	String	ID in the Hub	
3	message	String	Result description	

10.2.4.3 Save Resource

Interface Address	/hub/saveResource			
Description	Store the resource to the Hub. If the user stores it himself, the uid and the ownerUid should be the same. At this time, there is no need to create permissions to call directly; if the issuer stores it for the user after issuing the credentials, the uid should be the issuer, and the ownerUid should be the user. At this time, the user must have created “WRITE” permissions for it, otherwise the storage will fail.			
Interface request parameter				
No.	**Parameter**	**Type**	**Required**	**Description**
1		SaveResourceReq	Y	Wrapper class
SaveResourceReq				
1	uid	String	Y	ID in the Hub
2	content	String	Y	Resource information
3	url	String	N	The path of the resource storage. Null when it is user self-storage; required when the issuer stores it for the user
4	ownerUid	String	Y	Resource owner
5	grant	String	Y	WRITE means add; UPDATE means update
6	key	String	Y	Key
7	sign	String	Y	Signature
Interface response parameter				

No.	Parameter	Type	Description
1		SaveResourceResp	Wrapper class
SaveResourceResp			
1	url	String	The path of the stored resource
2	encryptKey	String	Null when the issuer stores it for users; if it is the user self-storage, returns the KeyA encrypted by the user's Public key, and the user's private key decrypts KeyA to derive the plaintext Key. The resource stored in the Hub is encrypted by Key with AES-ECB algorithm.

10.2.4.4 Get Resource

Interface Address	/hub/getResource			
Description	Access the Hub and read the specified resource. Users have direct access, third parties need to obtain authorization from the user to access.			
Interface request parameter				
No.	Parameter	Type	Required	Description
1		QueryResourceReq	Y	Wrapper class
QueryResourceReq				
1	uid	String	Y	ID in the Hub
2	url	String	Y	The path of the stored resource
3	sign	String	Y	Signature
Interface response parameter				
No.	Parameter	Type	Description	
1	ResourceInfo	ResourceInfo	Wrapper class	
ResourceInfo				
1	content	String	Content of cryptographic resource	
2	key	String	For the ciphertext key, you need to use your own private key to decrypt it first, and then decrypt the content.	

10.2.4.5 Delete Resource

Interface Address	/hub/deleteResource			
Description	The owner of the resource can call this function to delete certain resource within the Hub.			
Interface request parameter				
No.	Parameter	Type	Required	Description
1		DeleteResourceReq	Y	Wrapper class
DeleteResourceReq				
1	uid	String	Y	ID in the Hub
2	url	String	Y	The path of the stored resource
3	sign	String	Y	Signature
Interface response parameter				
No.	Parameter	Type	Description	

1		Boolean	Return true if success, return false if failed

10.2.4.6 Create Permissions

Interface Address	**/hub/createPerm**			
Description	Resource owner creates the permissions of accessing to the resource in the Hub for third parties. Permissions WRITE means store resource, UPDATE means update resource, READ means read resource. An authorization can only be accessed once, and an authorization with the same uid and the same permission cannot be created again without access. However, the permissions of UPDATE and READ from the server side will return the same result for each call.			
Interface request parameter				
No.	**Parameter**	**Type**	**Required**	**Description**
1		CreatePermissionReq	Y	Wrapper class
CreatePermissionReq				
1	uid	String	Y	ID in the Hub
2	grant	String	Y	Permissions
3	grantUid	String	Y	Authorized ID in the Hub
4	grantPublicKey	String	Y	Authorized public key
5	grantEncryptKey	String	N	Encryption key. READ/UPDATE permission is required
6	url	String	N	The path of the stored resource. READ/UPDATE permission is required
7	sign	String	Y	Signature
Interface response parameter				
No.	**Parameter**	**Type**	**Description**	
1		AddPermissionResult	Response data	
AddPermissionResult				
1	url	String	The path of the stored resource.	
2	Key	String	Ciphertext key to encrypt the resource (encrypted using the authorized public key)	

10.2.4.7 Delete Permissions

Interface Address	**/hub/deletePermission**			
Description	Resource owner calls this function for permissions that have been created but not yet accessed by third parties.			
Interface request parameter				
No.	**Parameter**	**Type**	**Required**	**Description**
1		DeletePermissionReq	Y	Wrapper class
DeletePermissionReq				
1	uid	String	Y	ID in the Hub
2	grant	String	Y	Permissions

3	grantUid	String	Y	Authorized ID in the Hub
4	url	String	Y	The path of the stored resource.
5	sign	String	Y	Signature
Interface response parameter				
No.	**Parameter**	**Type**	**Description**	
1		DeletePermissionResult	Response data	
DeletePermissionResult				
1	succes	boolean	Whether deleted successfully	
2	message	String	Result description	

10.2.4.8 Query Permissions

Interface Address	**/hub/queryPermission**			
Description	Resource owner calls this function to query Permissions that have already been created.			
Interface request parameter				
No.	**Parameter**	**Type**	**Required**	**Description**
1		QueryPermissionReq	Y	Wrapper class
QueryPermissionReq				
1	uid	String	Y	ID in the Hub
2	flag	String	N	YES means accessed; NO means not accessed.
3	grantUid	String	N	Authorized ID in the Hub
4	sign	String	Y	Signature
Interface response parameter				
No.	**Parameter**	**Type**	**Description**	
1		List<PermissionInfo>	Response data	
PermissionInfo				
1	url	String	The path of the stored resource	
2	grant	String	Permissions	
3	grantUid	String	Authorized ID in the Hub	
4	status	Integer	0 means deleted; 1 means not deleted	
5	createTime	LocalDateTime	Created date	
6	readTime	LocalDateTime	Read time	
7	flag	UsedFlag	YES means accessed; NO means not accessed.	
8	uid	String	ID in the Hub	
9	key	String	Ciphertext key	
10	ownerKey	String	Owner's key	

10.2.4.9 Query Granted Permissions

Interface Address	/hub/queryGrantedPermission			
Description	Users can look up all or part of the permission records authorized to them in three dimensions: the uid of the resource owner, whether it has been accessed and the permission type.			
Interface request parameter				
No.	**Parameter**	**Type**	**Required**	**Description**
1		QueryGrantedPermissionReq	Y	Wrapper class
QueryGrantedPermissionReq				
1	uid	String	Y	ID in the Hub
2	ownerUid	String	N	Resource owner's ID in the Hub
3	flag	String	N	Access status. 0: query accessed permissions; 1: query unaccessed records; if null, query both
4	grant	Sting	N	Authorization type. READ: Read; WRITE: Add; UPDATE: Update
5	sign	String	Y	Signature
Interface response parameter				
No.	**Parameter**	**Type**		**Description**
1		List<GrantPermissionInfo>		List of authorized records
GrantPermissionInfo				
1	url	String		The path of the resource storage.
2	grant	String		Authorization type. READ: Read; WRITE: Add; UPDATE: Update
3	status	Integer		0: deleted; 1: not deleted
4	createTime	Date		Time to create authorization
5	readTime	Date		Accessed time. Null if not accessed.
6	flag	Integer		0: accessed; 1: not accessed.
7	ownerUid	String		ID in the Hub
8	OwnerKey	String		Ciphertext key
9	key	String		Owner's key

10.2.4.10 Query Operation Record of the Resource

Interface Address	/hub/getResourceHistory			
Description	Resource owner calls this function to query the operation record of the resource.			
Interface request parameter				
No.	**Parameter**	**Type**	**Required**	**Description**
1		QueryResourceHistoryReq	Y	Wrapper class

QueryPermissionReq				
1	uid	String	Y	ID in the Hub
2	url	String	N	The path of the stored resource.
3	operation	String	N	Authorization type. WRITE: Add; UPDATE: Update; DELETE: delete
4	sign	String	Y	Signature

Interface response parameter			
No.	**Parameter**	**Type**	**Description**
1		List<ResourceHistoryInfo>	Resource operation record list
PermissionInfo			
1	OperationUid	String	Operator's ID in the Hub
2	ownerUid	String	Owner's ID in the Hub
3	operation	String	Authorization type. WRITE: Add; UPDATE: Update; DELETE: delete
4	OperationTime	LocalDateTime	Operation time
5	url	String	The path of the stored resource.
6	key	String	Ciphertext key
7	content	String	Ciphertext resource content

10.2.4.11 Change Resource Owner

Interface Address	/hub/transferowner
Description	Change the resource owner in the Hub.

Interface request parameter				
No.	**Parameter**	**Type**	**Required**	**Description**
1		TransferOwnerReq	Y	Wrapper class
QueryPermissionReq				
1	uid	String	Y	ID in the Hub
2	url	String	Y	The path of the stored resource.
3	newOwnerUid	String	Y	New owner's ID in the Hub
4	newOwnerPublicKey	String	Y	New owner's public key
5	newKey	String	N	New ciphertext key
6	sign	String	Y	Signature

Interface response parameter			
No.	**Parameter**	**Type**	**Description**

1		Boolean	Y	Return true if success, return false if failure

10.3 Response Code

Response code	Description
0	Success
9999	Unknown exception
1001	{attribute} is null
1002	The format of {attribute} is invalid
1003	{attribute} contains a null attribute value
1004	{attribute} is too long
1005	Transaction timeout
1006	Transaction error
1008	Config file does not exist
1009	Node private key is empty
1010	DID contract address is empty
1011	CPT contract address is empty
1012	Auth issuer contract address is empty
1013	DID blockchain type is empty
1014	Failed to initialize the DID SDK
1020	Failed to create the key pair
1021	Public and private keys do not match
1022	Public key is empty
1023	Invalid public key format
1024	Private key is empty
1025	Invalid private key format
1027	Encryption Type is empty
1028	Invalid Encryption Type
1029	Failed to sign the data
1030	Signer and DID do not match
1031	Signature verification failed
1032	Public key and document's primary public key do not match
1033	Public key and document's recovery public key do not match
1040	DID already exists
1041	DID does not exist
1042	Failed to create DID
1043	Invalid DID
1044	Failed to generate the DID
1045	Failed to generate the DID Document

1046	DID Document verification success
1050	DID is registered as the issuer
1051	DID is not registered as the issuer
1052	Failed to register as the issuer
1054	Issuer does not exist
1060	CPT does not exist
1062	Issuer and publisherDid in the CPT do not match
1070	The credential has been revoked
1071	The credential has expired
1072	Failed to revoke the credential
1073	CPT and credential do not match
1074	Failed to create credential
1075	Credential verification success
1076	The credential is not in the revoke list
1077	Computed DID from the document is not the same with the DID in the document
1078	Created time is different with updated time in DID Document
1079	Public key signature verification failed
1080	DID is not the same with the proof creator in CPT
1081	The DID Document version does not match the one on-chain
1082	The DID Document created time does not match the one on-chain
1083	The DID Document recovery key does not match the one on-chain
1084	Failed to add DID Document to the chain
1085	Failed to create the key pair
1086	Failed to calculate the DID
1087	Failed to calculate the DID Document signature
1088	Failed to create the DID Document
1090	The mnemonic is empty
1337	Failed to encrypt the key
1338	Failed to sign the data
Identity Hub	
1303	Private key is empty
1304	Private key format is invalid
1305	Public key is empty
1306	Public key format is invalid
1307	Public key and private key do not match
1309	The content is empty
1310	The URL is empty
1321	The URL of the Identity Hub cannot be empty
1322	The public key of the Identity Hub cannot be empty

1327	Failed to send the request
1328	The format of the grant is invalid
1329	Grant cannot be empty
1335	Resource does not exist
1336	The key is empty
1337	Failed to encrypt the key
1338	Failed to sign the data
1341	Failed to delete permission
1342	Failed to query permission
1343	Grant is empty
1344	Failed to check permission
1347	Failed to query publicKey
1350	Config file does not exist
1351	The public key is empty
1352	You cannot add permissions to yourself
1354	Illegal flag
1361	The user ID is empty
1362	The granted user ID is empty
1363	The public key of the granted user is empty
1364	Failed to generate the user ID
1365	Failed to decrypt the data
1366	Failed to encrypt the data
1367	Failed to decrypt Identity Hub's private key
1368	The private key of Identity Hub is empty
1369	The public key of Identity Hub is empty
1370	No permission to save resource
1371	No permission to update resource
1372	The resource has been saved, cannot be saved again
1373	The granted user already has an unused permission
1400	Permission does not exist
1402	Failed to delete permission
1403	Failed to query permission
1406	Failed to get the public key
1407	Failed to update the public key
1408	Failed to save the resource
1409	Failed to query the resource
1410	Failed to delete the resource
1411	Failed to update the resource
1412	Failed to get the HTTP request
1413	Failed to get the private key of the Identity Hub

1414	Missing request data
1415	Failed to convert the request parameter
1416	Unknown client data or not connected
1417	Parse return code error
1418	Resource does not exist
1419	The URL format is invalid
1422	Signature verification failed
1423	The user is not registered
1424	User registration failed, the format of the public key is invalid
1425	The user is already registered
1426	The granted user does not exist
1427	The resource owner does not exist
1428	Failed to close the permission
1429	Only the resource owner can delete it
1430	Failed to add operation record
1431	Failed to register the user
1432	The user ID is empty
1433	Failed to parse the request parameter
1434	Failed to add the operation record
1435	Failed to update the resource
1436	The resource does not exist
1437	Failed to save the resource
1438	Failed to save the user information to the database
1441	The current permission has been used or the user does not have permission
1442	Failed to check the permission
1455	decrypt encptyKey failed
1456	decrypt content failed
1460	New owner's user ID is empty
1461	Failed to change the owner
1462	The uid and the ownerUid cannot be the same
1463	The ownerUid is not exist
1465	The new owner and new owner's public key do not match
1501	Failed to query the encryption key of the granted resource
1502	Failed to decrypt the key of the granted resource
1503	The resource does not exist
1504	The recovery key pair is incorrect, cannot reset DID authentication
1505	The primary private key and public key do not match

Note: {attribute} is a dynamic parameter.

10.4 SDK

BSN provides a Java version SDK, which implements signature, verification, communication and other methods, so Java developers can quickly make API calls through the SDK.

1. Steps to Use

1) Download the SDK source code and compile and package it as a jar named did-sdk-1.0.jar;

2) Add the did-sdk-1.0.jar to the classpath directory of the project project;

3) Create an instance of DidClient:
DidClient didClient = new DidClient(URL,PROJECTID,TOKEN);

4) Call the method in the SDK, as follows:

DidDataWrapper didData = didClient.createDid(true);

1. Specifications

- Timestamp

  The format of the time is a string in the form of yyyy-MM-dd HH:mm:ss, for example: 2021-05-25 12:30:59 means May 25, 2021 at 12:30:59.

- Exception

  A runtime exception “RuntimeException" is thrown when there is a runtime error.

2. Function Description

The methods in the SDK can be divided into four categories according to their functional properties: DID, issuer, credential and privacy area, and each method is described below:

10.4.1 DID

10.4.1.1 Generate Private and Public Keys by Mnemonics

The user can customize mnemonics and call this function to generate a pair of public-private keys for the k1 algorithm offline. As long as mnemonics are the same, the generated public and private keys must be the same for each call.

Function name	**createKeyPair(List<String> mnemList)**			
Description	The user can generate the private and public keys by mnimonics			
Request Parameters				
No.	Parameter	Type	Required	Description
1	mnemList	List<String>	Y	Mnemonics
Response Parameters				
No.	Parameter	Type	Required	Description
1		DidDataWrapper	Y	Private key
KeyPair				
1	privateKey	String	Y	Private key
2	publicKey	String	Y	Public key
3	type	String	Y	Algorithm Type

10.4.1.2 Create DID

Function name	createDid(Boolean isStorageOnChain)			
Description	Call this function to create a DID. isStorageOnChain indicates whether the DID Document is stored on-chain or not.			
Request Parameters				
No.	Parameter	Type	Required	Description
1	isStorageOnChain	Boolean	Y	On-chain marker. true means DID Document is stored on-chain; false means DID Document is not stored on-chain.
Response Parameters				
No.	Parameter	Type	Required	Description
1		DidDataWrapper	Y	

DidDataWrapper

No.	Parameter	Type	Required	Description
1	did	String	Y	DID
2	authPublicKey	KeyPair	Y	Primary public/private key information
3	recyPublicKey	KeyPair	Y	Recovery public/private key information
4	document	DocumentInfo	N	DID Document
5	didSign	String	Y	DID signature
6	address	String	Y	Account address

DocumentInfo

No.	Parameter	Type	Required	Description
1	did	String	Y	DID
2	version	String	Y	Version
3	created	String	Y	Created date
4	updated	String	Y	Updated date
5	authentication	PublicKey	Y	Primary public key
6	recovery	PublicKey	Y	Recovery public key
7	proof	Proof	Y	Signature

KeyPair

No.	Parameter	Type	Required	Description
1	privateKey	String	Y	Private key
2	publicKey	String	Y	Public key
3	type	String	Y	Algorithm type

PublicKey

No.	Parameter	Type	Required	Description
1	type	String	Y	Algorithm type
2	publicKey	String	Y	Public key

Proof

No.	Parameter	Type	Required	Description
1	type	String	Y	Algorithm type
2	creator	String	Y	DID
3	signatureValue	String	Y	Signature value

10.4.1.3 Verify DID Document

Function name	verifyDidDocument(DidDocument didDocument)			
Description	Verify the content format and signature value of the offline generated DID Document.			
Request Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		DidDocument	Y	
DidDocument				
1	did	String	Y	DID
2	version	String	Y	Version
3	created	String	Y	Created date
4	updated	String	Y	Updated date
5	authentication	PublicKey	Y	Primary public key
6	recovery	PublicKey	Y	Recovery public key
7	proof	Proof	Y	Signature
PublicKey				
1	type	String	Y	Algorithm type
2	publicKey	String	Y	Public key
Proof				
1	type	String	Y	Algorithm type
2	creator	String	Y	DID
3	signatureValue	String	Y	Signature value
Response Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		Boolean	Y	Return true if success, return false if failure

10.4.1.4 Upload DID Document

Function name	storeDidDocumentOnChain(DidDocument didDocument)			
Description	Store the DID document on-chain. Firstly to execute the verification, so that you can call this function if you want to store the DID Document on chain.			
Request Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		DidDocument	Y	
DidDocument				
1	did	String	Y	DID

2	version	String	Y	Version
3	created	String	Y	Created date
4	updated	String	Y	Updated date
5	authentication	PublicKey	Y	Primary public key
6	recovery	PublicKey	Y	Recovery public key
7	proof	Proof	Y	Signature
PublicKey				
1	type	String	Y	Algorithm type
2	publicKey	String	Y	Public key
Proof				
1	type	String	Y	Algorithm type
2	creator	String	Y	DID
3	signatureValue	String	Y	Signature value
Response Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		Boolean	Y	Storage result

10.4.1.5 Get DID Document

Function name	**getDidDocument(String did)**			
Description	The information in the DID Document is a record and description of the DID, and anyone can query the corresponding DID Document from the chain by the DID. It can be used to verify the DID and obtain the DID public key.			
Request Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1	did	String	Y	DID
Response Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1	didDocument	DidDocument	Y	DID Document

DidDocument

No.	**Parameter**	**Type**	**Required**	**Description**
1	did	String	Y	DID
2	version	String	Y	Version
3	created	String	Y	Created date
4	updated	String	Y	Updated date
5	authentication	PublicKey	Y	Primary public key
6	recovery	PublicKey	Y	Recovery public key
7	proof	Proof	Y	Signature
PublicKey				
1	type	String	Y	Algorithm type
2	publicKey	String	Y	Public key
Proof				

1	type	String	Y	Algorithm type
2	creator	String	Y	DID
3	signatureValue	String	Y	Signature value

10.4.1.6 Verify DID

Function name	**verifyDIdSign(String did, String didSign)**			
Description	Verify the digital signature value of the DID, so that it can ensure the authenticity and validity of the current DID.			
Request Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1	did	String	Y	DID
2	didSign	String	Y	DID signature
Response Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		Boolean	Y	Return true if success, return false if failure

10.4.1.7 Key Update

Function name	**resetDidAuth(ResetDidAuth restDidAuth)**			
Description	If the primary private key is lost or leaked, a pair of primary public and private keys can be regenerated by the recovery private key. The user completes the primary public-private keys update with the recovery public-private keys. After the key is updated, the user's DID Document will also be updated, but the DID remains the same. If the user fills in the primary public-private keys, the primary public keys in the DID Document is updated and the signature is recalculated using the filled-in primary public key; otherwise, a new pair of primary public private keys is automatically generated and the primary public key and signature calculation of the DID Document are updated. *Note: If the issuer updates the key, all the previously issued credentials will not pass the signature verification (if the issuer records the master public key of the credential in the business system, it can transmit the old master public key information to the user, then it can also pass the credential verification).*			
Request Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		ResetDidAuth	**Y**	
ResetDidAuth				
1	did	String	Y	DID
2	primaryKeyPair	KeyPair	N	Primary public and private key
3	recoveryKey	KeyPair	Y	Recovery public and private key
KeyPair				
1	privateKey	String	Y	Private Key
2	publicKey	String	Y	Public Key
3	type	String	Y	Algorithm type
Response Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**

1		KeyPair	Y	New public and private key pair

KeyPair

No.	Parameter	Type	Required	Description
1	privateKey	String	Y	Private key
2	publicKey	String	Y	Public key
3	type	String	Y	Algorithm type

10.4.2 Issuer

10.4.2.1 Register Issuer

Function name	**registerAuthIssuer(RegisterAuthorityIssuer register)**			
Description	The DID user becomes the issuer, and the issuer information is uploaded to the chain if the registration is successful.			
Request Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		RegisterAuthorityIssuer	Y	
RegisterAuthorityIssuer				
1	privateKey	String	Y	Private key
2	did	String	Y	DID
3	name	String	Y	Issuer's name
Response Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		Boolean	Y	Return true if success, return false if failure

10.4.2.2 Query Issuer

Function name	**queryAuthIssuerList(AuthIssuerList query)**			
Description	You can query whether it is the issuer through DID and identify the type of credential that can be issued by name.			
Request Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		AuthIssuerList	Y	
AuthIssuerList				
1	page	Integer	Y	Number of pages
2	size	Integer	Y	Number of entries per page
3	did	String	Y	DID
Response Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		Pages<AuthorityIssuer>	Y	Query result, the list of issuers

Pages

No.	Parameter	Type	Required	Description
1	page	Integer	Y	Page number

2	size	Integer	Y	Paging Size
3	totalNum	Integer	Y	Total number
4	totalPage	Integer	Y	Total pages
5	result	List< AuthorityIssuer>	Y	List of issuers

AuthorityIssuer

No.	Parameter	Type	Required	Description
1	did	String	Y	DID
2	name	String	Y	Issuer's name

10.4.2.3 Register credential template

Function name	registerCpt(RegisterCpt registerCpt)			
Description	The issuer customizes the credential template and can agree on which attribute values must be provided by the applicant. For example, in the template of college diploma, you can agree that "name" and "student number" are mandatory information.			
Request Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		RegisterCpt	Y	
RegisterCpt				
1	did	String	Y	DID
2	privateKey	String	Y	Private key
3	cptJsonSchema	Map<String, JsonSchema>	Y	JsonSchema of credential template
4	title	String	Y	Title
5	description	String	Y	Description
6	type	String	Y	Credential Type, fill in Proof
7	cptId	Long	Y	Credential template ID
JsonSchema				
1	type	String	Y	Field type
2	description	String	Y	Field description
3	required	Boolean	Y	true: required; false: optional
Response Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		CptBaseInfo	Y	Registration result, basic information of credential template

CptBaseInfo

No.	Parameter	Type	Required	Description
1	cptId	Long	Y	Credential template ID
2	cptVersion	Integer	Y	Credential template Version

10.4.2.4 Query Credential Template List

Function name	queryCptListByDid(QueryCptList query)

Description	Anyone can check all their credential templates by DID. It is possible for the same individual/organization to register multiple credential templates. For example, a university may have a degree template, an incomplete template, etc. in addition to a diploma template.

Request Parameters

No.	Parameter	Type	Required	Description
1		QueryCpt	Y	

QueryCpt

1	page	Integer	Y	Number of pages
2	size	Integer	Y	Number of entries per page
3	did	String	Y	DID

Response Parameters

No.	Parameter	Type	Required	Description
1		Pages<CptInfo>	Y	Query result, credential template information list

Pages

No.	Parameter	Type	Required	Description
1	page	Integer	Y	Page number
2	size	Integer	Y	Paging Size
3	totalNum	Integer	Y	Total number
4	totalPage	Integer	Y	Total pages
5	result	List<CptInfo>	Y	List of credential templates

CptInfo

No.	Parameter	Type	Required	Description
1	cptJsonSchema	Map<String, JsonSchema>	Y	JsonSchema for Credential template
2	title	String	Y	Title
3	description	String	Y	Description
4	publisherDid	String	Y	DID to create credential template
5	proof	Proof	Y	Signature
6	create	String	Y	Created date
7	update	String	Y	Updated date
8	cptId	Long	Y	Credential template ID
9	cptVersion	Integer	Y	Credential template version

Proof

No.	Parameter	Type	Required	Description
1	type	String	Y	Algorithm type
2	creator	String	Y	DID
3	signatureValue	String	Y	Signature value

JsonSchema

1	type	String	Y	Type
2	description	String	Y	Description
3	required	Boolean	Y	true：required；false：optional

10.4.2.5 Query Credential Template

Function name	**queryCptById(Long cptId)**			
Description	Query the contents of a specific credential template by its ID.			
Request Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1	cptId	Long	Y	Credential template ID
Response Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		CptInfo	Y	Query result, credential template information

CptInfo

No.	**Parameter**	**Type**	**Required**	**Description**
1	cptJsonSchema	Map<String, JsonSchema>	Y	JsonSchema for Credential template
2	title	String	Y	Title
3	description	String	Y	Description
4	publisherDid	String	Y	DID to create the credential template
5	proof	Proof	Y	Signature
6	create	String	Y	Created date
7	update	String	Y	Updated date
8	cptId	Long	Y	Credential template ID
9	cptVersion	Integer	Y	Credential template version
JsonSchema				
1	type	String	Y	Type
2	description	String	Y	Description
3	required	Boolean	Y	true：required；false：optional

Proof

No.	**Parameter**	**Type**	**Required**	**Description**
1	type	String	Y	Algorithm type
2	creator	String	Y	DID
3	signatureValue	String	Y	Signature value

10.4.2.6 Update Credential Template

Function name	**updateCpt(RegisterCpt registerCpt)**
Description	The issuer updates the content of its own registered credential templates. The update of the credential template ID does not affect issued credentials.
Request Parameters	

No.	Parameter	Type	Required	Description
1		RegisterCpt	Y	
RegisterCpt				
1	did	String	Y	DID
2	privateKey	String	Y	Private key
3	cptJsonSchema	Map<String, JsonSchema>	Y	JsonSchema for Credential template
4	title	String	Y	Credential template title
5	description	String	Y	Credential template description
6	type	String	Y	Credential Type, fill in proof
7	cptId	Long	Y	Credential template ID
JsonSchema				
1	type	String	Y	Type
2	description	String	Y	Description
3	required	Boolean	Y	true：required；false：optional
Response Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		CptBaseInfo	Y	Update result, basic information of credential template

CptBaseInfo

No.	Parameter	Type	Required	Description
1	cptId	Long	Y	Credential template ID
2	cptVersion	Integer	Y	Credential template version, add 1 after each successful update

10.4.3 Credential

10.4.3.1 Create Credential

Function name	**createCredential(CreateCredential createCredential)**			
Description	The attribute values defined in the credential template are provided by the issuer for the DID user to obtain on the front page. The issuer issues the credentials for the DID user through this interface. If there are more Claim parameters than defined in the credential template, the server side will discard them.			
Request Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		CreateCredential	Y	
CreateCredential				
1	cptId	Long	Y	Credential template ID
2	issuerDid	String	Y	DID of the credential template issuer
3	userDid	String	Y	DID of the user who created the credentials
4	expirationDate	String	Y	Credential expiration date. Should be greater

				than today. In the form of yyyy-mm-dd
5	claim	Map<String, Object>	Y	Content of the credential. The claim data needs to correspond to the format of the credential template
6	type	String	Y	Credential type, input Proof
7	privateKey	String	Y	Private key
8	shortDesc	String	N	Brief description of the credential. The default value is the credential template title.
9	longDesc	String	N	Detailed description of the credential
Response Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		CredentialWrapper	Y	Creation result, Credential information

CredentialWrapper

No.	Parameter	Type	Required	Description
1	context	String	Y	Version
2	id	String	Y	Credential ID
3	type	String	Y	Credential type, Proof
4	cptId	Long	Y	Credential template Id
5	issuerDid	String	Y	DID of the credential template issuer
6	userDid	String	Y	DID of the user who created the credentials
7	expirationDate	String	Y	Credential expiration date
8	created	String	Y	Created date
9	shortDesc	String	Y	Brief description of the credential
10	longDesc	String	N	Detailed description of the credential
11	claim	Map<String, Object>	Y	Claim data
12	proof	Map<String, Object>	Y	Signature

10.4.3.2 Verify Credential

Function name	**verifyCredential(CredentialWrapper createCredential,PublicKey publicKey)**
Description	Generally called by the verifier. It can verify whether a particular credential is valid or not. Verify the signature of the credential, whether the credential is expired, and whether the credential is revoked, respectively.
Request Parameters	

No.	Parameter	Type	Required	Description
1	createCredential	CredentialWrapper	Y	
2	publicKey	PublicKey	Y	Public key
CredentialWrapper				
1	context	String	Y	Version
2	id	String	Y	Credential ID
3	type	String	Y	Credential type, Proof
4	cptId	Long	Y	Credential template ID
5	issuerDid	String	Y	DID of the credential template issuer
6	userDid	String	Y	DID of the user who created the credentials
7	expirationDate	String	Y	Credential expiration date
8	created	String	Y	Created date
9	shortDesc	String	N	Brief description of the credential
10	longDesc	String	N	Detailed description of the credential
11	claim	Map<String, Object>	Y	Claim data
12	proof	Map<String, Object>	Y	Signature
PublicKey				
1	type	String	Y	Algorithm type
2	publicKey	String	Y	Public key
Response Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		Boolean	Y	Return true if success, return false if failure

10.4.3.3 Revoke Credential

Function name	revokeCredential(RevokeCredential cred)			
Description	Called by the issuer to revoke or void a credential that has been issued. Since the issued credential is already in the custody of the user, the revocation of the credential is followed by the upload of its credential ID.			
Request Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		RevokeCredential	Y	
RevokeCredential				
1	credId	String	Y	Credential ID
2	cptId	Long	Y	Credential template Id
3	did	String	Y	DID
4	privateKey	String	Y	Private key

Response Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		Boolean	Y	Return true if success, return false if failure

10.4.3.4 Query Revoked Credential

Function name	**getRevokedCredList(QueryCredentialList queryCredentialList)**			
Description	Called when verifying credentials. Find out all its revoked credential IDs by Issuer's DID.			
Request Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		QueryCredential	Y	
QueryCredential				
1	page	Integer	Y	Number of pages
2	size	Integer	Y	Number of entries per page
3	did	String	Y	DID
Response Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		Pages<BaseCredential>	Y	Query result, basic info list of the credential

Pages

No.	Parameter	Type	Required	Description
1	page	Integer	Y	Page number
2	size	Integer	Y	Paging Size
3	totalNum	Integer	Y	Total number
4	totalPage	Integer	Y	Total pages
5	result	List<BaseCredential>	Y	List of revoked documents

BaseCredential

No.	Parameter	Type	Required	Description
1	id	String	Y	Credential ID
2	created	String	Y	Revoked time

10.4.4 Identity Hub

10.4.4.1 Register Hub User by DID

Function name	**registerHub(String did)**			
Description	Register by DID, if successful, returns the user's ID in the Hub.			
Request Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1	did	String	Y	DID
Response Parameters				

No.	Parameter	Type	Required	Description
1		RegisterHubResult	Y	Registration result

RegisterHubResult

No.	Parameter	Type	Required	Description
1	success	Boolean	Y	Return true if success, return false if failure
2	uid	String	Y	ID in the Hub
3	message	String	Y	Result description

10.4.4.2 Register Hub User by Public Key

Function name	registerHub(String id, String publicKey, CryptoType cryptoType)
Description	Register by Public key. This function allows users define the ID by themselves. If successful, returns the user's ID in the Hub.

Request Parameters

No.	Parameter	Type	Required	Description
1	id	String	N	Self-defined hub ID
2	publicKey	String	Y	Public key
3	CryptoType	String	Y	ECDSA

Response parameter

No.	Parameter	Type	Required	Description
1		RegisterHubResult	Y	Registration result

RegisterHubResult

1	success	Boolean	Return true if success, return false if failure
2	uid	String	ID in the Hub
3	message	String	Result description

10.4.4.3 Save Resource

Function name	saveResource(SaveResource saveResource)
Description	Store the resource to the Hub. If the user stores it himself, the uid and the ownerUid should be the same. At this time, there is no create permission need and can call directly; if the issuer stores it for the user after issuing the credentials, the uid should be the issuer, and the ownerUid should be the user. At this time, the user must have created WRITE permission for it, otherwise the storage will fail.

Request Parameters

No.	Parameter	Type	Required	Description
1		SaveResource	Y	

SaveResource

1	did	String	Y	ID in the Hub
2	content	String	Y	Resource content
3	url	String	N	The path of the stored resource. Null when stored by the user; required when stored by the issuer.

4	ownerUid	String	Y	Resource owner's ID in the Hub
5	grant	Operation	Y	Operation permissions: WRITE/UPDATE
6	privateKey	String	Y	Private key
Response Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		SaveResourceResult	Y	Save result

SaveResourceResult

No.	Parameter	Type	Required	Description
1	url	String	Y	The path of the stored resource.
2	encryptKey	String	Y	Ciphertext key

10.4.4.4 Get Resource

Function name	**getResource(String did,String privateKey, String url)**			
Description	Access the Hub and read the specified resource. Users can directly access, third parties need to obtain authorization from the user to access.			
Request Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1	uid	String	Y	ID in the Hub
2	privateKey	String	Y	Private key
3	url	String	Y	The path of the stored resource.
Response Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		QueryResourceResp	Y	Query result

QueryResourceResp

No.	Parameter	Type	Required	Description
1	content	String	Y	Ciphertext resource content
2	key	String	Y	Ciphertext key

10.4.4.5 Delete Resource

Function name	**deleteResource(String did,String privateKey, String url)**			
Description	The resource owner can call this function to delete a certain resource in the Hub.			
Request Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1	uid	String	Y	ID in the Hub
2	privateKey	String	Y	Private key
3	url	String	Y	The path of the stored resource.
Response Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		Boolean	Y	Return true if success, return

				false if failure

10.4.4.6 Create Permissions

Function name	createPermission(CreatePermission createPermission)			
Description	Resource owner creates the permissions of accessing to the resource in the Hub for third parties. Permissions WRITE means store resource, UPDATE means update resource, READ means read resource. An authorization can only be accessed once, and an authorization with the same uid and the same permission cannot be created again without access. However, the permissions of UPDATE and READ from the server side will return the same result for each call.			
Request Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		CreatePermission	Y	
CreatePermission				
1	uid	String	Y	ID in the Hub
2	url	String	N	The path of the stored resource. Can be null if the permission is WRITE, required when the permission is READ/UPDATE
3	grant	Operation	Y	Operation permissions: WRITE/UPDATE/READ
4	grantUid	String	Y	Authorized ID in the Hub
5	grantPublicKey	String	Y	Authorized public key
6	privateKey	String	Y	Private key
Response Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		CreatePermissionResp	Y	Creation result

CreatePermissionResp

No.	Parameter	Type	Required	Description
1	url	String	Y	The path of the stored resource.
2	key	String	Y	Ciphertext key

10.4.4.7 Delete Permissions

Function name	deletePermission(DeletePermission deletePermission)			
Description	Resource owner calls this function to delete permissions that are not yet accessed by a third party.			
Request Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		DeletePermission	Y	
DeletePermission				
1	uid	String	Y	ID in the Hub
2	url	String	Y	The path of the stored resource.
3	grantUid	String	Y	Authorized ID in the Hub

4	grant	Operation	Y	Operation permissions: WRITE/UPDATE/READ
5	privateKey	String	Y	Private key
Response Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		DeletePermissionResp	Y	Deletion result

DeletePermissionResp

No.	Parameter	Type	Required	Description
1	success	Boolean	Y	Return true if success, return false if failure
2	message	String	Y	Result description

10.4.4.8 Query Permissions

Function name	**queryPermission(QueryPermission queryPermission)**			
Description	Resource owner can call this function to query Permissions that have been created.			
Request Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		QueryPermission	Y	
QueryPermission				
1	uid	String	Y	ID in the Hub
2	grantUid	String	N	Authorized ID in the Hub
3	flag	UsedFlag	N	Access flag. YES: accessed; NO: Not accessed
4	privateKey	String	Y	Private key
Response Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		List<PermissionInfo>	Y	Query result, list of Permissions
PermissionInfo				
1	uid	String	Y	ID in the Hub
2	grantUid	String	Y	Authorized ID in the Hub
3	url	String	Y	The path of the stored resource.
4	grant	String	Y	Operation permissions: WRITE/UPDATE/READ
5	createTime	LocalDateTime	Y	Authorization created time
6	readTime	LocalDateTime	N	Authorization used time
7	flag	UsedFlag	Y	Access flag. YES: accessed; NO: Not accessed
8	status	Integer	Y	Delete flag. 0: Deleted; 1: Not deleted
9	key	String	N	Ciphertext key
10	ownerKey	String	N	Owner's key

10.4.4.9 Query Granted Permissions

Function name	queryGrantedPermission(QueryGrantedPermission queryPermission)			
Description	Users can look up all or part of the permission records authorized to them in three dimensions: the uid of the resource owner, whether it has been accessed and the permission type.			
Request Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		QueryGrantedPermission	Y	
QueryGrantedPermission				
1	uid	String	Y	ID in the Hub
2	grantUid	String	N	Resource owner's ID in the Hub
3	grant	Operation	N	Operation permissions: WRITE/UPDATE/READ
4	flag	UsedFlag	N	Access flag. YES: accessed; NO: Not accessed
5	privateKey	String	Y	Private key
Response Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		List<GrantPermissionInfo>	Y	Query result, list of Permissions
GrantPermissionInfo				
1	url	String	Y	The path of the stored resource.
2	grant	String	Y	Operation permissions: WRITE/UPDATE/READ
3	status	Integer	Y	Delete flag. 0: Deleted; 1: Not deleted
4	createTime	LocalDateTime	Y	Authorization created time
5	readTime	LocalDateTime	N	Authorization used time
6	flag	UsedFlag	Y	Access flag. YES: accessed; NO: Not accessed
7	ownerUid	String	Y	Resource owner's ID in the Hub
8	key	String	N	Ciphertext key
9	ownerKey	String	N	Owner's key

10.4.4.10 Query Resource Operation Record

Function name	queryResourceHistory(QueryResourceHistory queryResourceHistory)			
Description	Resource owner calls this function to query the operation record of the resource.			
Request Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		QueryResourceHistory	Y	

QueryResourceHistory				
1	uid	String	Y	ID in the Hub
2	url	String	N	The path of the stored resource.
3	operation	Operation	N	Authorization type: WRITE/UPDATE/DELETE
4	privateKey	String	Y	Private key
Response Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		List<ResourceHistoryInfo>	Y	Query result, list of Permissions
ResourceHistoryInfo				
1	operationUid	String	Y	Operator's ID in the Hub
2	ownerUid	String	Y	Owner's ID in the Hub
3	operation	String	Y	Operation type: WRITE/UPDATE/READ
4	content	String	Y	Ciphertext resource content
5	url	String	Y	The path of the stored resource.
6	key	String	N	Ciphertext key
7	operationTime	LocalDateTime	Y	Operated time

10.4.4.11 Change Resource Owner

Function name	**transferOwner(TransferOwner transferOwner)**			
Description	Change the resource owner in the Hub.			
Request Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		TransferOwner	Y	
TransferOwner				
1	uid	String	Y	ID in the Hub
2	url	String	Y	The path of the stored resource.
3	newOwnerUid	String	Y	New owner's ID in the Hub
4	newOwnerPublicKey	String	Y	New owner's public key
5	privateKey	String	Y	Private key
Response Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		Boolean	Y	Return true if success, return false if failure

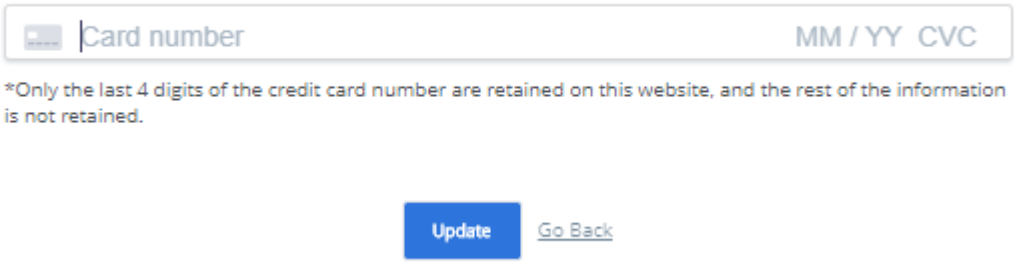
10.4.4.12 Decrypt Resource

Function name	decrypt(String content, String encptyKey, String privateKey)			
Description	Decrypt the ciphertext resource content returned from the Get Resource interface using the ciphertext key returned from the Get Resource interface to get the plaintext resource content			
Request Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1	content	String	Y	Ciphertext resource content
2	encptyKey	String	Y	Ciphertext key
3	privateKey	String	Y	Private key
Response Parameters				
No.	**Parameter**	**Type**	**Required**	**Description**
1		String	Y	Plaintext resource content

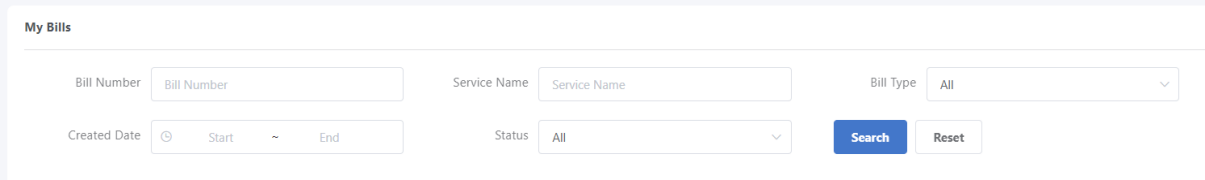
11 Account Management

In the **My Account** page, the user can view details of their card and transactions they performed on the network. To work with **My Account**, follow these steps:

1. In the **User Center** menu, click the dropdown to reveal the list, in the menu list, click **My Account** to display the page.
2. To update the user **Card Information**, click the **Update card information** to display the **My Credit Card** page. The user will be redirected to the Stripe website. The BSN portal can never see and does not store credit card information.
3. Update the card details as needed and click **Update**.



4. To search a bill in the **My Bills** section, enter or select the following:
   - **Bill Number** - Enter the bill number if known
   - **Created Date -** Select a start and end date
   - **Service Name -** Enter a service name if known
   - **Status -** Select from the options available in the dropdown
   - **Bill Type -** Select from the options available in the dropdown
   - Click **Search** to display the bill information.



5. In the **Bill list**, under the **Status** and **Action** columns, the user can perform certain actions including **Pay** and **Details** on each bill. To **pay** a bill, click **Pay** and to **View** a bill, click **Details**.

Bill Number	Service Name	Bill Type	Total Amount (USD)	Payment Amount (USD)	Created Date	Status	Action
5F39EA142CC44C9E8CF9D49E01...	WineTrace	Data Usage	0.00	0.00	(UTC+8:00) 07/21/2021 02:00:05	Paid	Details
33B3753E168E469FA77F11EC73...	WineTrace	Service Publish	860.03	0.00	(UTC+8:00) 07/14/2021 10:30:40	Partial Refund	Details
4E34B5D582E34AB8ADF5F7052D...	WineTrace	Service Publish	863.35	0.00	(UTC+8:00) 06/28/2021 14:34:42	Expired	Details
9D6C81B4D9FA4DE1A7F6881B1...	Team demonstration	Service Publish	863.35	0.00	(UTC+8:00) 06/28/2021 13:47:22	Expired	Details

12 Online Documentation

White Papers			
Name	**Version**	**Update**	**Details**
BSN Introduction White paper	V1.05	February 5th,2020	PDF
BSN Technical White Paper	V1.0.0	April 25th,2020	PDF

Site Documents			
Name	**Version**	**Update**	**Details**
User Manual	1.8.1	October 18th,2024	Online PDF
Fabric Examples	1.0.1	April 24th,2020	Github
FISCO BCOS Examples	1.0.1	April 24th,2020	Github
SDK Examples	1.0.1	April 24th,2020	Github

Permissioned Frameworks		
Name	**Official Website**	**Details**
Hyperledger Fabric	https://www.hyperledger.org/	Github Documentation
FISCO BCOS	http://fisco-bcos.org/	Github Documentation
ConsenSys Quorum	https://consensys.net/quorum/	Github Documentation
Hyperledger Besu	https://www.hyperledger.org/use/besu	Github Documentation

Public Chains		
Name	**Official Website**	**Details**
ETH	https://ethereum.org/	Github Documentation
Tezos	https://tezos.com/	Github Documentation
EOS	https://eos.io/	Github Documentation
Near	https://near.org/	Github Documentation

13 Contact Us

If you have any questions or find any errors in this manual, please contact us:

Customer service hotline: +86-400-071-8215 (workday: 08:00 - 17:30)

Email: support@bsnbase.com

Telegram BSN Support Group: https://t.me/bsnsupport

International Social Media: