



国家海洋信息中心
NATIONAL MARINE DATA AND INFORMATION SERVICE

The Sixteenth International Conference on Advances in Databases, Knowledge, and Data
Applications
DBKDA 2024
March 10, 2024 to March 14, 2024 - Athens, Greece



Research and implementation of science data collection model based on blockchain

Xiaoyi Jiang, Mogeng Xu, Xin Tong

National Marine Data and Information Service of China



Introduction

About NMDIS

National Marine Data and Information Service (NMDIS) is a government funded public institution under the Ministry of Natural Resources of China, responsible for

- ❑ the management of national marine data and information resources,
- ❑ providing guidance and scientific stewardship for the national marine data and information,
- ❑ providing information and technical support for marine economy, marine management, public service and marine environmental protection, and conduct related research.



Office in December 1966



Office building in April 1989

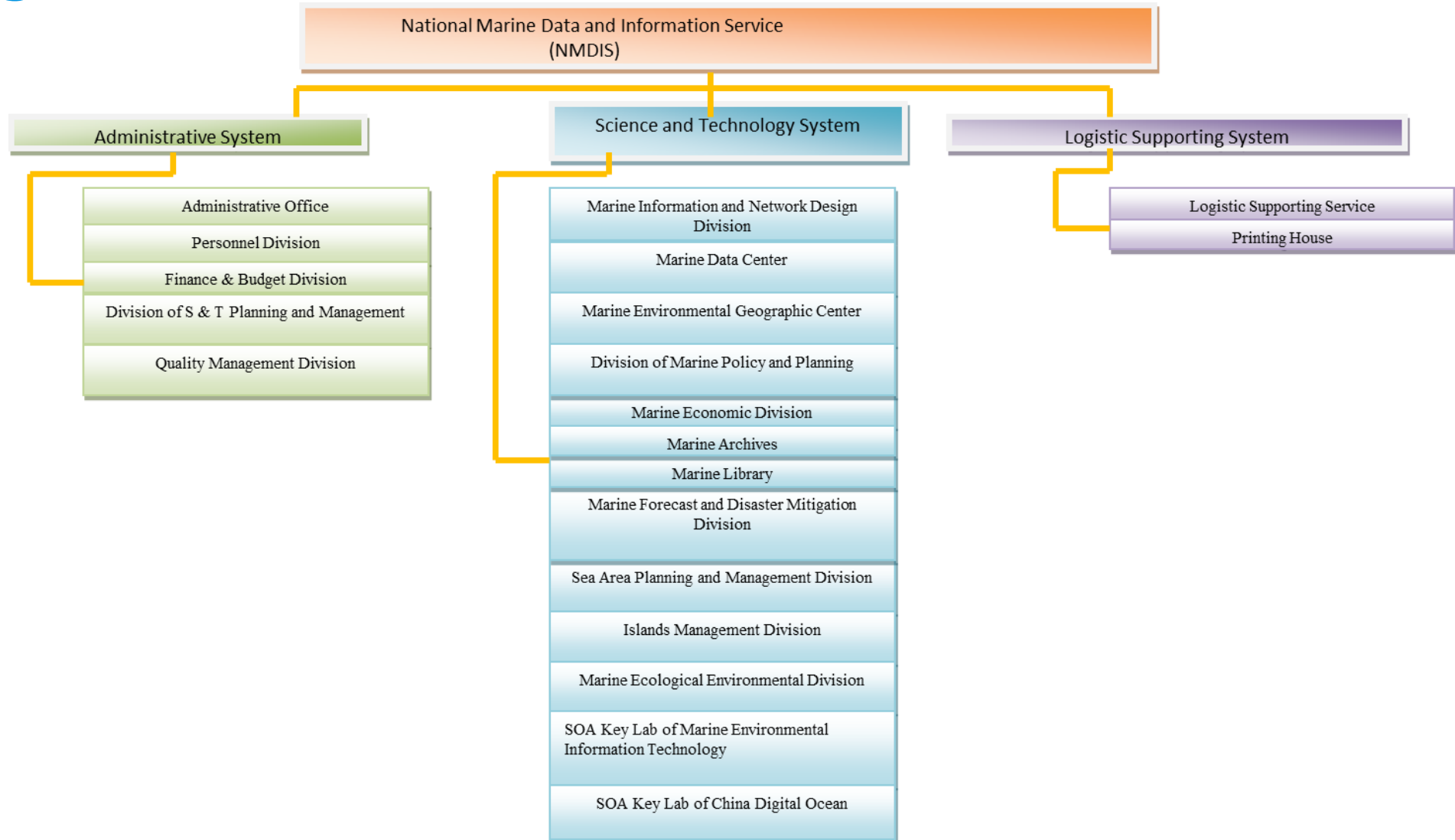


New look after reconstruction in September 2016



Introduction

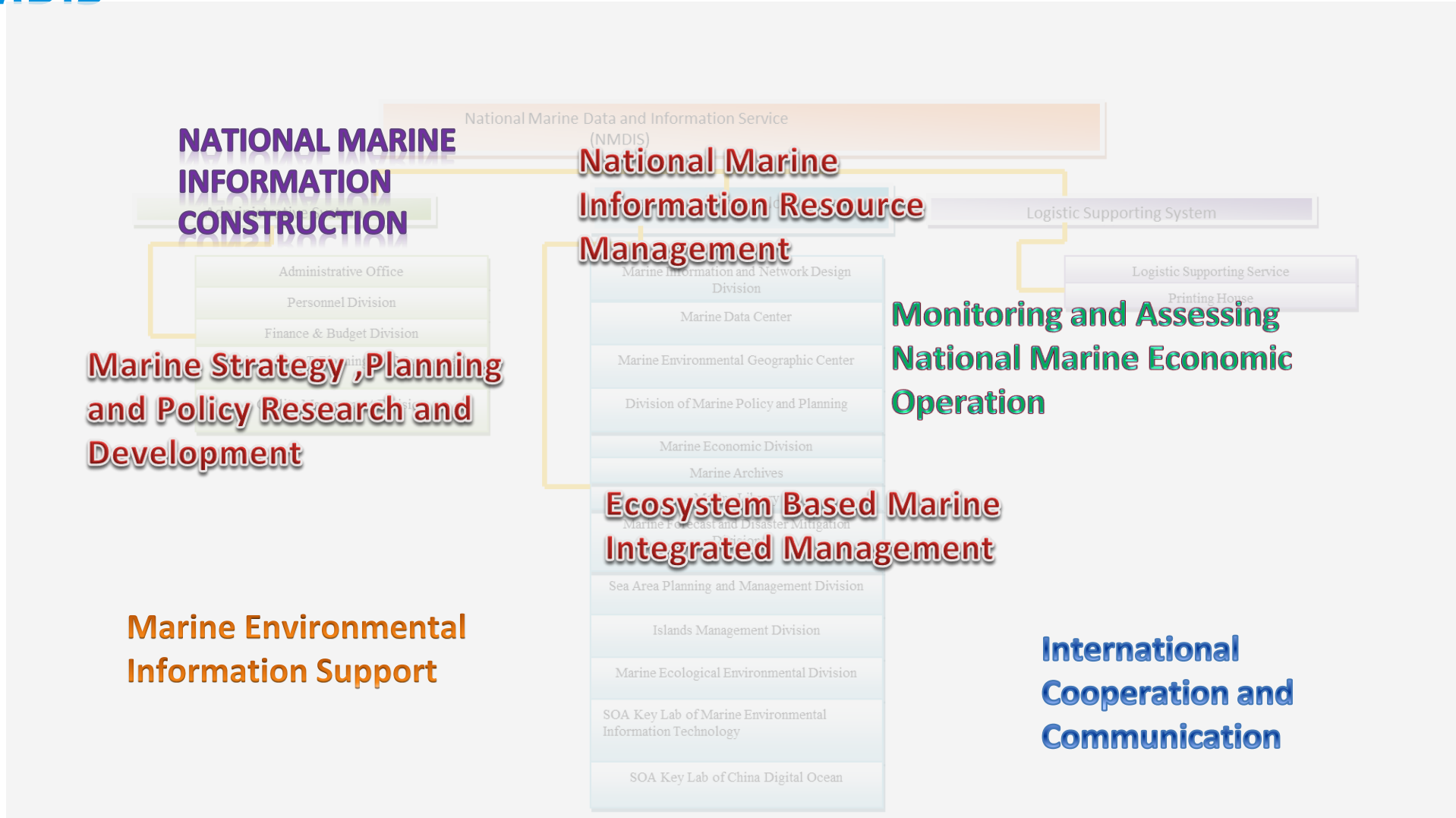
About NMDIS





Introduction

About NMDIS





Introduction

- ❑ The scientific data generated by science and technology planning projects is an important part of scientific and technological achievements, and the exchange of scientific data is a key link to collect scientific and technological achievements.
- ❑ At present, most of the scientific data center's exchange system adopts the "centralized" storage management mode in China, there are data ownership disputes, data easy to tamper with hidden dangers.
- ❑ Blockchain uses a distributed ledger to achieve system decentralization. A distributed ledger is a data structure that contains transaction lists in an orderly form, capable of storing large amounts of data and recording transactions between all blockchain nodes for the purpose of tracing any transaction.

Contents

Contents

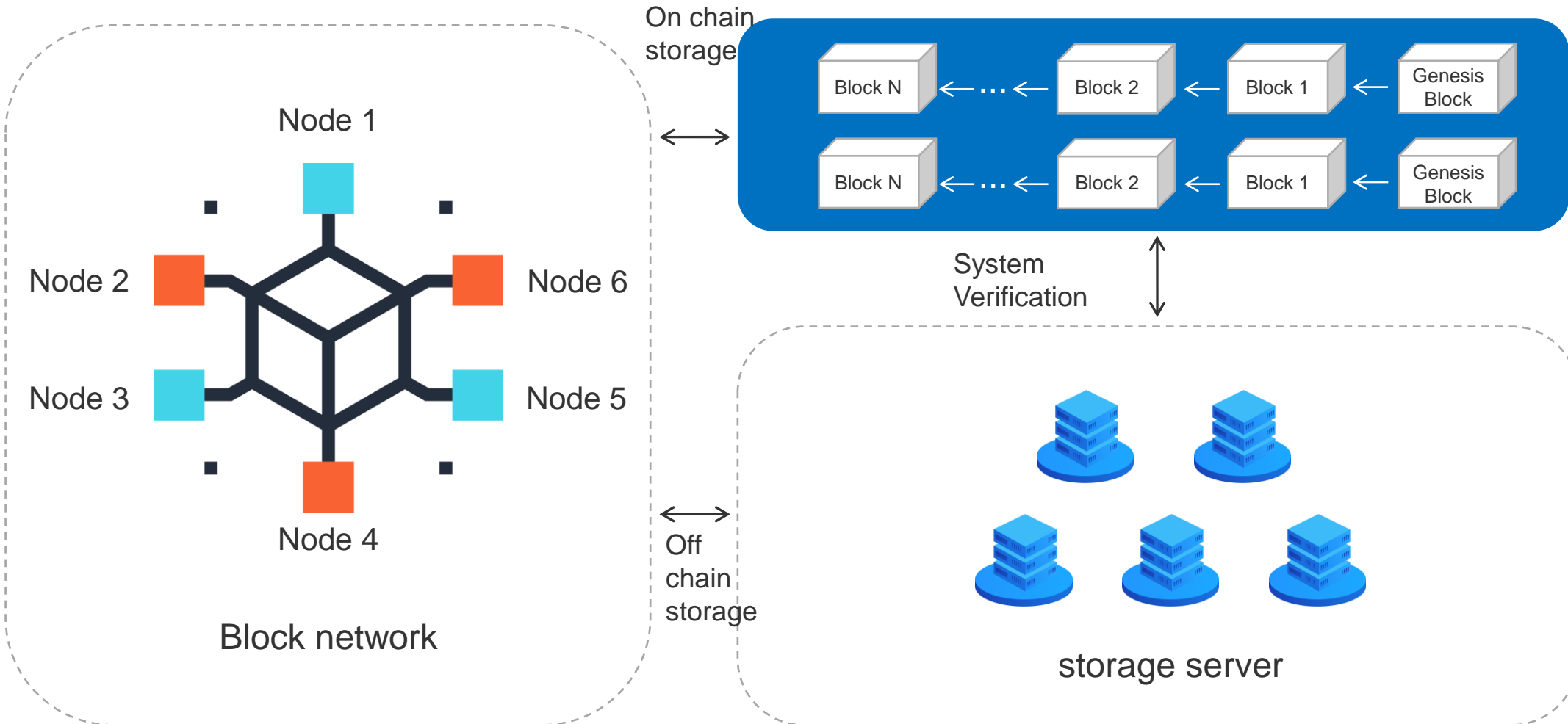


NATIONAL MARINE DATA AND
INFORMATION SERVICE

- ★ 1. Blockchain based certificate storage model and controllable sharing model
- ★ 2. A blockchain based data exchange system for marine technology projects
- ★ 3. Application cases
- ★ 4. Conclusions

1. Blockchain based certificate storage model and controllable sharing model

■ Model design



Part 1

Part 2

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Part 4

2. A blockchain based data exchange system for marine technology projects

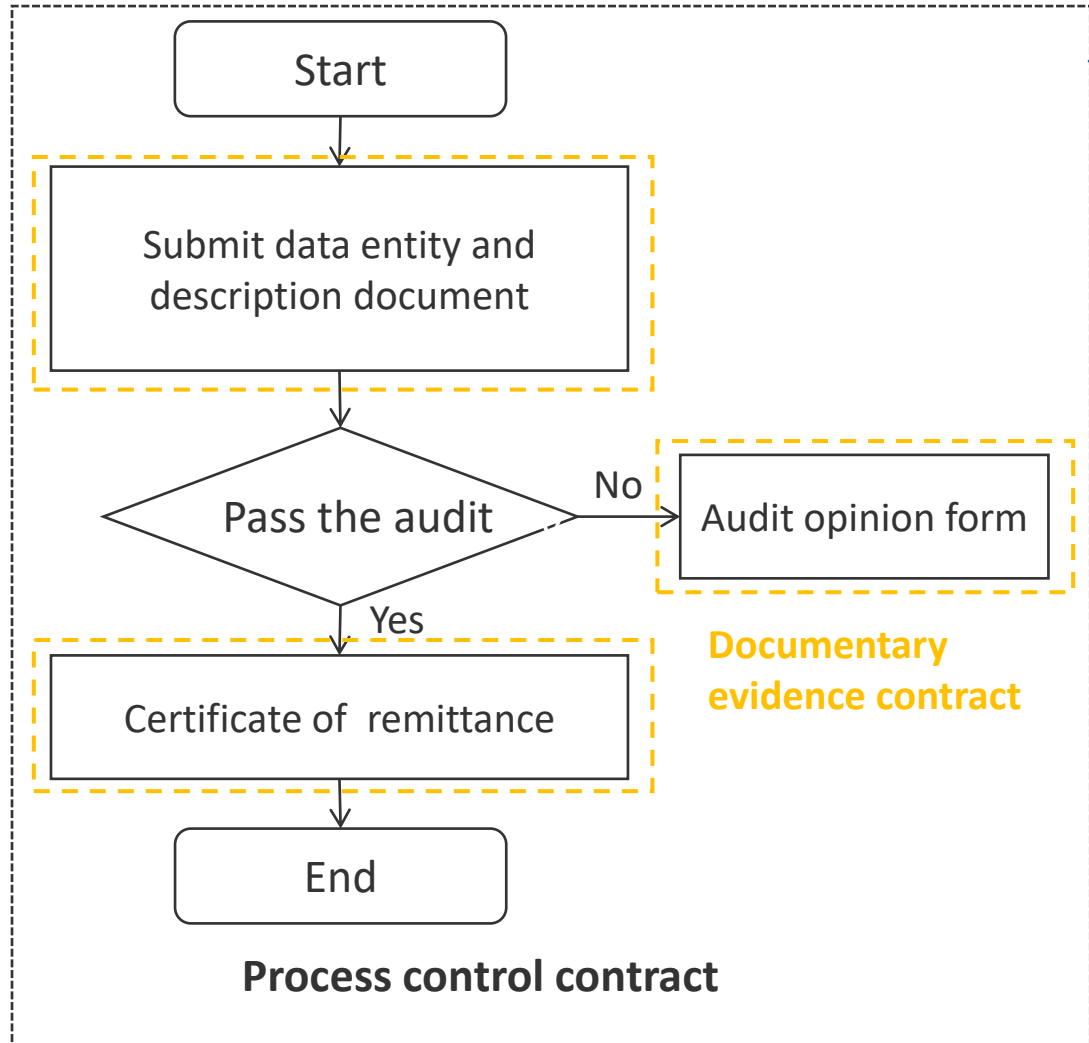
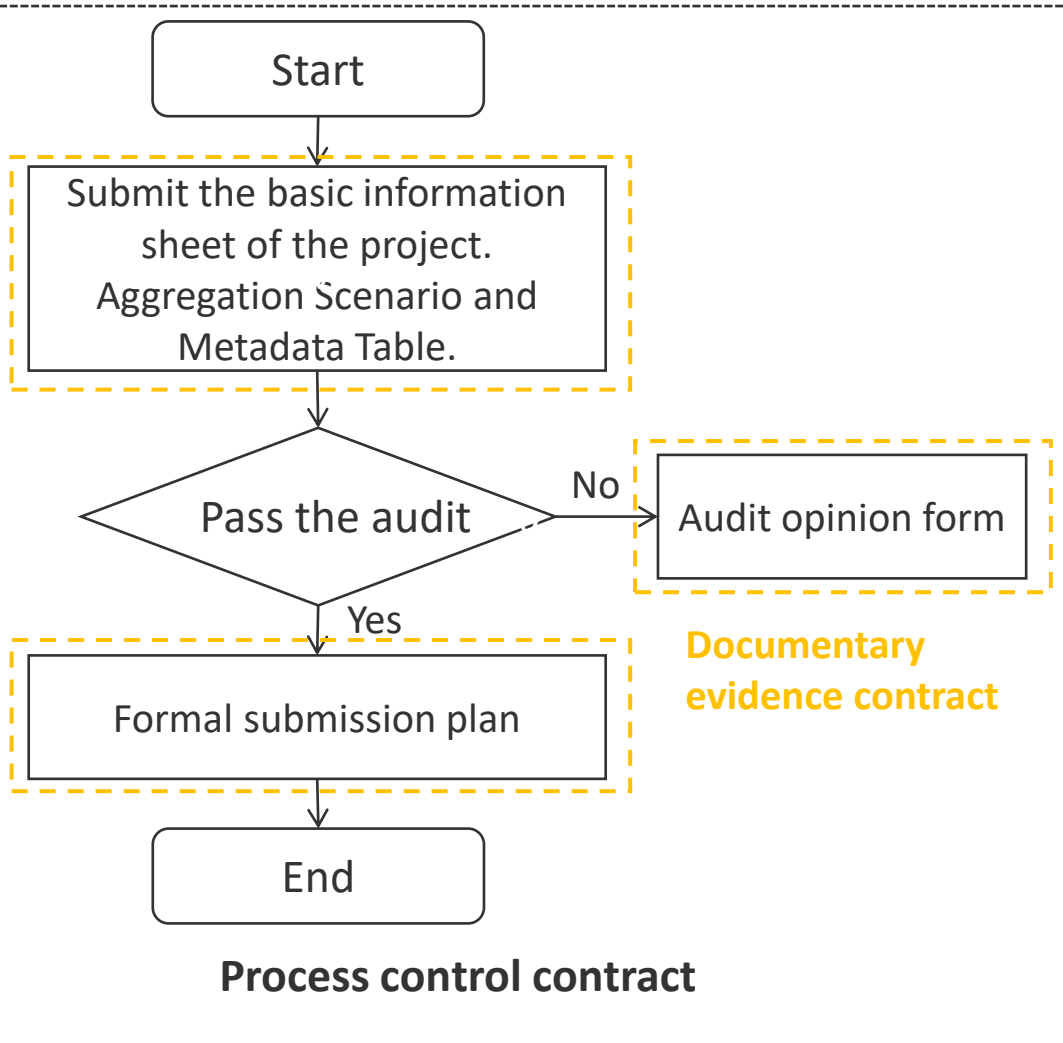
■ Application process

Part 1

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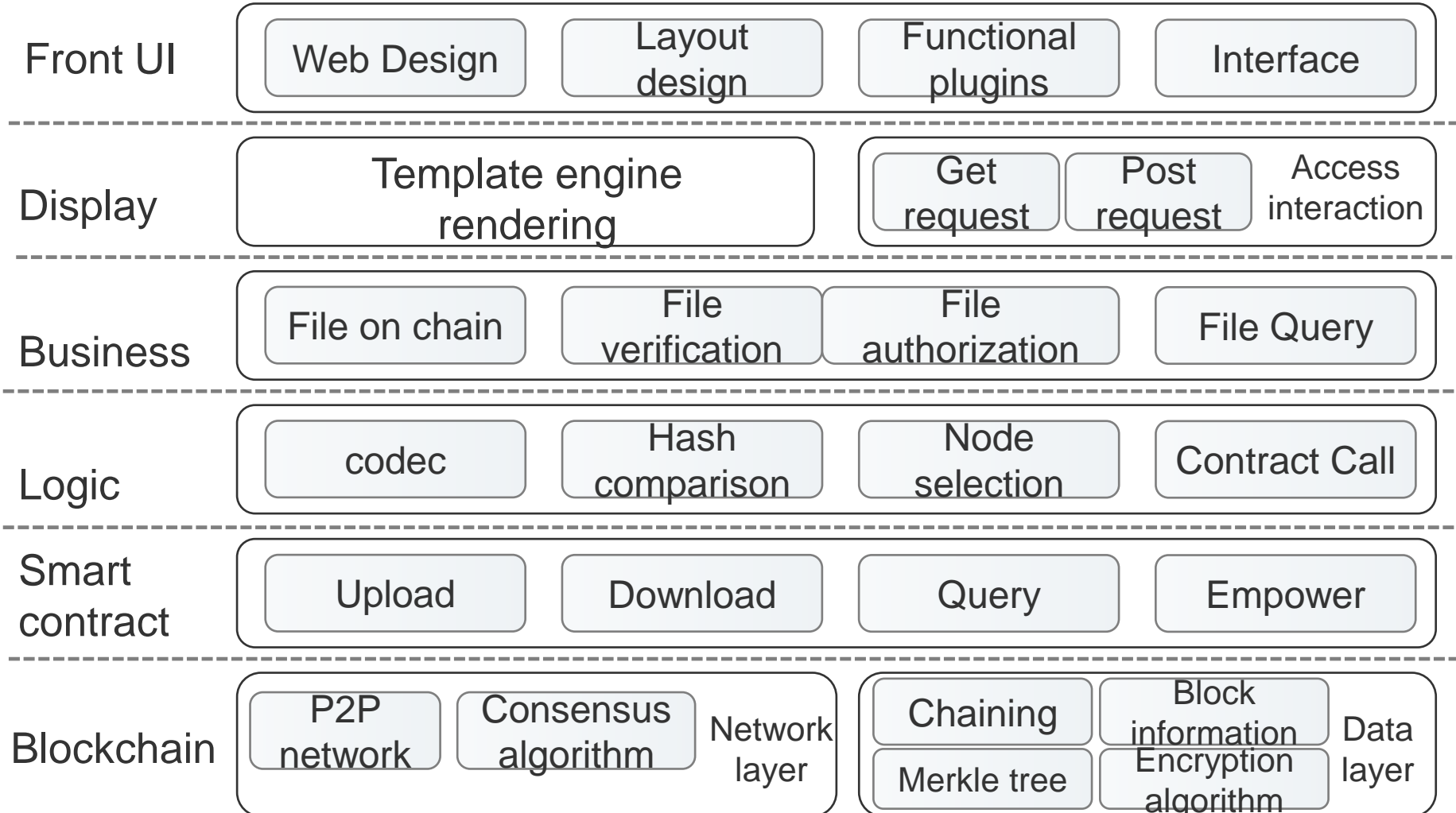
Part 4





2. A blockchain based data exchange system for marine technology projects

■ System functional architecture



Part 1

Part 2

Part 3

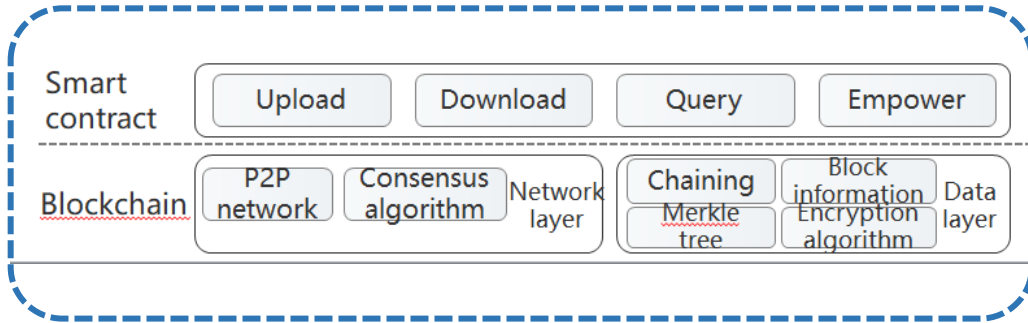
Part 4



NATIONAL MARINE DATA AND INFORMATION SERVICE

2. A blockchain based data exchange system for marine technology projects

Blockchain layer and smart contract layer



FISCO BCOS underlying architecture

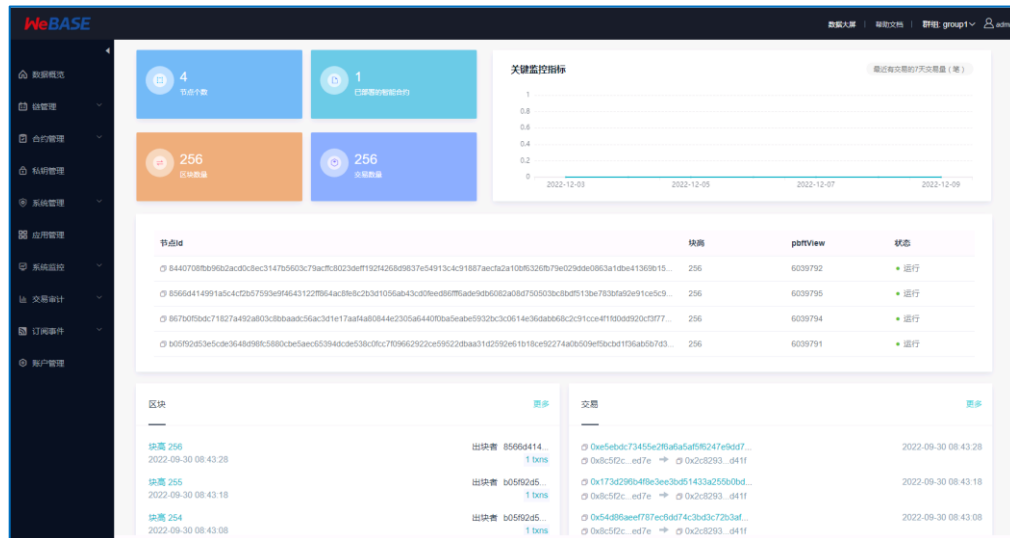
- Blockchain network construction
- Console construction
- Smart Contract Design
- Visual management platform construction
- Smart contract deployment

Part 1

Part 2

Part 3

Part 4



WeBASE Management Platform



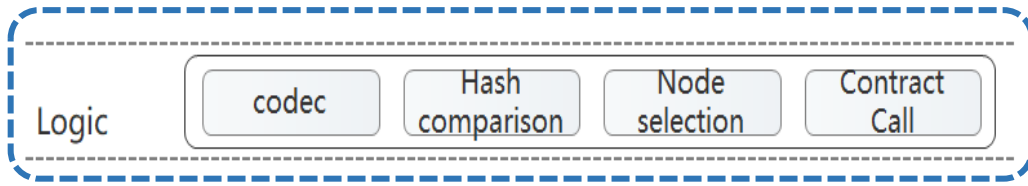
Smart contract deployment





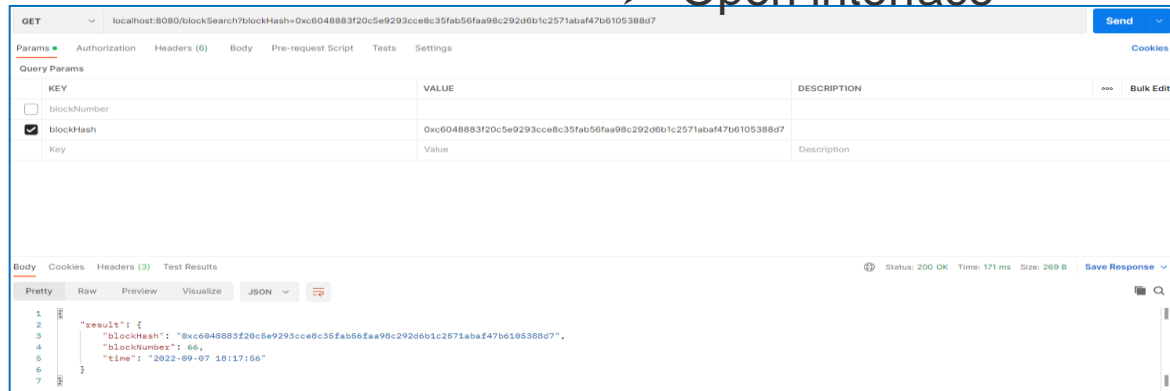
2. A blockchain based data exchange system for marine technology projects

Logic layer



Independently developed logic layer microservice Bridge

- JavaSDK
- WeBASE docking
- Functional logic development
- Open interface



Interface testing

The screenshot shows a REST client interface with a GET request to `localhost:8080/blockSearch?blockHash=0xc6048883f20c5e9293cce8c35fab56faa98c292d6b1c2571abaf47b6105388d7`. The response body is a JSON object:

```

{
  "result": {
    "blockHash": "0xc6048883f20c5e9293cce8c35fab56faa98c292d6b1c2571abaf47b6105388d7",
    "blockNumber": 66,
    "time": "2022-09-07 18:17:56"
  }
}

```

Interface link:

localhost:8080/blockSearch

Parameter:

blockNumber

blockHash

blockHash

blockNumber

blockHash

time

Return Info:

```

{"result": [{"blockHash": "0xc6048883f20c5e9293cce8c35fab56faa98c292d6b1c2571abaf47b6105388d7", "blockNumber": 66, "time": "2022-09-07 18:17:56"}]}

```

Interface documentation

Part 1

Part 2

Part 3

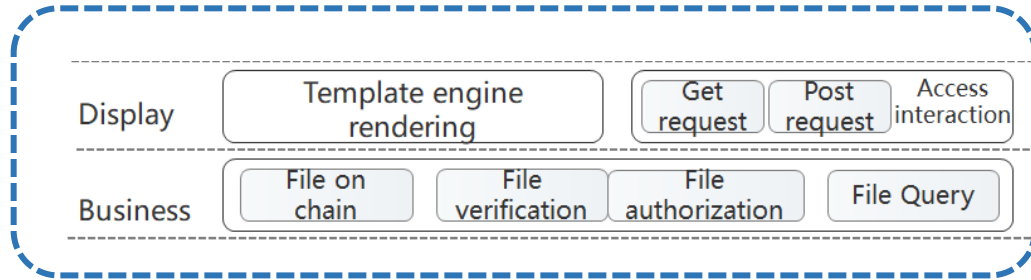
Part 4





2. A blockchain based data exchange system for marine technology projects

Business layer and presentation layer



Data exchange system renovation

- Database transformation
- Connect to Bridge service
- New functional interface added

Number of on chain projects : `SELECT COUNT(*) FROM special_science_technology WHERE file_hash IS NOT NULL;`
 Number of Upstream Datasets : `SELECT COUNT(*) FROM special_science_metadata WHERE datafile_hash IS NOT NULL;`
 Verification number : `SELECT COUNT(*) FROM special_science_verify_log;`

Functional statements

(1) special_science_technology

Add two fields

Name	Type & Size
file_hash	varchar (100)
transaction_hash	varchar (100)

(2) special_science_metadata

Add two fields

Name	Type & Size
datafile_hash	varchar (100)
transaction_hash	varchar (100)

(3) special_science_verify_log

Create a new validation log table

Name	Type & Size
verify_id	varchar (32)
project_num	varchar (32)
verify_user	varchar (255)
verify_user_id	varchar (50)

Database documents

Part 1

Part 2

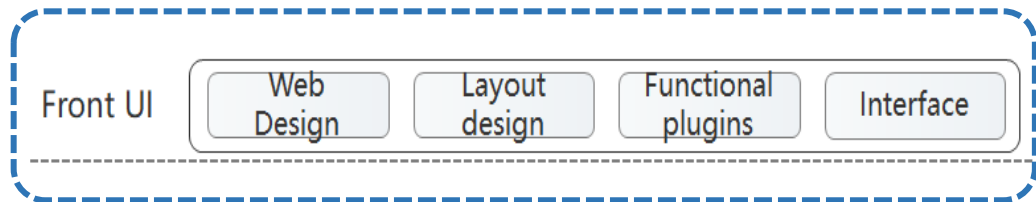
Part 3

Part 4



2. A blockchain based data exchange system for marine technology projects

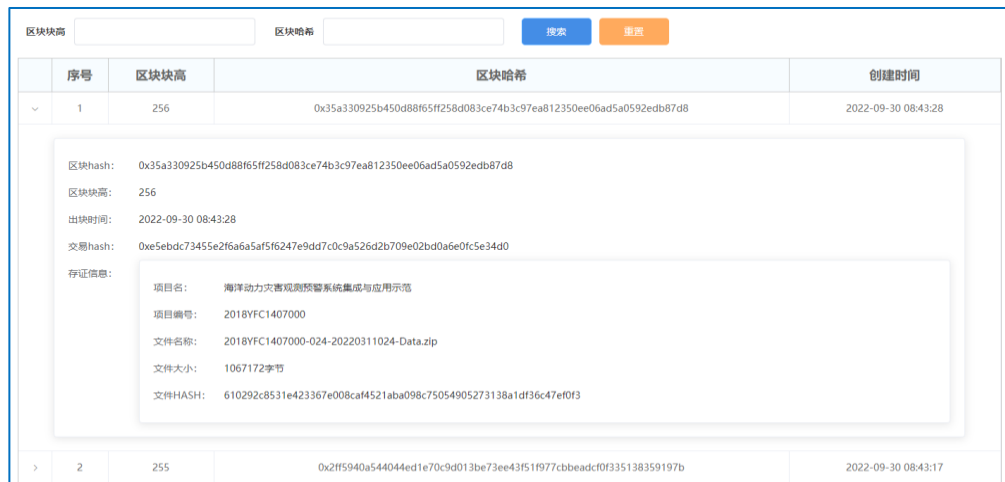
Front UI layer




科技计划项目数据区块链信息

- 部署: 6 个节点
- 上链: 32 个项目
- 上链: 165 个数据集
- 验证: 12 次
- 查看区块链详情

序号	项目编号	项目来源	项目名称	项目验收证明HASH	元数据总数	论文数量	第一承建单位
1	2019YFC1408100	重点研发计划	基于浮标的海洋环境电导率系统研发与应用	0xc051b6e10f035a7163bec032dea32ce11214ed51a2c209c084c5a3e957ef0e	7	10	青岛海洋科学与技术国家实验室发展中心
2	2019YFC1407900	重点研发计划	秦皇岛海域生态多样性及生物多样性监测与评估	0x2954ce4836eb32290a881afccc472f217c22b6ce7ae15be7ae6a194c1994	40	30	燕山大学
3	2019YFC1407800	重点研发计划	渤海湾生态环境监测评估及污染防控技术研究	0xc2c50da7720307e431a9d9a73500030c3e0f041228441a5b48ac1468e03e48	25	20	天津科技大学
4	2019YFC1407700	重点研发计划	辽东湾海域海洋生态环境修复关键技术研究与示范	0xb08e4e508023a991738825e790b2007ca185ae24a295da375eb3e7276c7c3f	90	60	大连理工大学
5	2018YF0101340	重点研发计划	自贸试验区环境多参数监测系统	0xfa2e03e856305d1dad3e6c864644190e8131e9970a6c9c6a9090ab7bc0c71	14	28	北京海兰信数据科技股份有限公司
6	2018YFC1407500	重点研发计划	渤海湾海域水环境生态健康风险评估及治理示范	0x94f0a11120c0b48e9180b619059a357907992c6a1971b559919752ad	38	68	厦门大学
7	2018YFC1407000	重点研发计划	海洋动力灾害观测预警系统集成与应用示范	0xc21a5883480a67415829c112e29a2543046da3d39c49c79a719771a1c27a	24	31	国家海洋环境预报中心



区块哈希: 0x35a330925b450d88f65f258d083ce74b3c97ea812350ee06ad5a0592edb87d8

区块高: 256

出块时间: 2022-09-30 08:43:28

交易HASH: 0xe5ebdc73455e2f6a5a5f56247e9dd7c0c9a526d2b709e02bd0a6e0fc5e340

存证信息:

- 项目名称: 海洋动力灾害观测预警系统集成与应用示范
- 项目编号: 2018YFC1407000
- 文件名称: 2018YFC1407000-024-20220311024-Data.zip
- 文件大小: 1067172字节
- 文件HASH: 610292c8531e423367e008ca4521aba098c75054905273138a1df36c47ef0f3



部署: 4个节点

上链: 15个项目

上链: 236个数...

验证: 31次

查看区块链详情

序号	项目编号	项目来源	项目名称	项目验收证明HASH	元数据总数	论文数量	第一承建单位
1	2019YFC1408100	重点研发计划	基于浮标的海洋环境电导率系统研发与应用	a19c7fa2421e76d719c11cb9d4fec68a6b2de7d4d2e9b03c99b8f2e998fc4	7	10	青岛海洋科学与技术国家实验室发展中心
2	2019YFC1407900	重点研发计划	秦皇岛海域生态多样性及生物多样性监测与评估	7776bbf4c543152cb3e2b589dbfeb02579bc0c777188e220bee9168bbeb8301c	40	30	燕山大学
3	2019YFC1407800	重点研发计划	渤海湾生态环境监测评估及污染防控技术研究	4de07cc9caa9d180c4e04c35e92abe6e6c091a6c41c77c4bc84560e6d85b925	25	20	天津科技大学
4	2019YFC1407700	重点研发计划	辽东湾海域海洋生态环境修复关键技术研究与示范	472d2e42527c9f653bced215bfc5eb8638838869e6017d19239450116c7b7bbb	90	60	大连理工大学

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2. A blockchain based data exchange system for marine technology projects

■ Auxiliary application system

Independently developed auxiliary application microservices -HashGod

- Automatic packaging of data files
- Data file hash calculation
- Generate JSON on the data file chain
- Data self verification

This service is used in conjunction with the backend management system to complete the uploading of historical data.

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NATIONAL MARINE DATA AND INFORMATION SERVICE



3. Application cases

Based on this platform, the Marine Science Data Center has deployed 4 nodes and completed the uploading of 236 datasets from 15 science and technology projects.

Part 1

Part 2

Part 3

Part 4



部署 4个节点 | 上链 15个项目 | 上链 236个数... | 验证 31次 | 查看区块链详情

项目编号: 项目名称: 项目来源:

序号	项目编号	项目来源	项目名称	项目验收证明HASH	元数据总数	论文数量	第一承建单位
1	2019YFC1408100	重点研发计划	基于浮标的海洋环境电... 测量系统研发与应用	a19c7fa2421e76d719cf1... cb9d4fec68a6b2de7fd4... d2e9b03c999b8f22e998f... c4	7	10	青岛海洋科学与技术国家... 实验室发展中心
2	2019YFC1407900	重点研发计划	秦皇岛海域生态灾害多发... 原因及监测预警系统研究	7776bbf4c543152cb3e2... b589dbfeb02579bc0c77... 7188e220bee9168bbeb... 8301c	40	30	燕山大学
3	2019YFC1407800	重点研发计划	渤海湾生态环境监测评估... 及污染控制技术研究	4de07cc9caa9d180c4e0... 4cb35e92abe6e6c091a6... c41c77c4bc84560e6d85... b925	25	20	天津科技大学
4	2019YFC1407700	重点研发计划	辽东湾污染防治与生态环... 境修复关键技术研究	472d2e42527c9f653bce... d215bfc5eb8638638869... e6017d19239450116c7b... 7bbb	90	60	大连理工大学
			青岛海洋环境数据监测... 系统研发与应用	b70de719eb1449a8444c... 9447444f3a13a56a24f...			北京瀚林信数据科技股份...

Blockchain based marine science data exchange platform page

详情

项目名称: 基于 ***** 系统研发与应用
 负责人: 李 **
 验收单位: 国家海洋信息中心
 文件HASH: a19c7fa2421e76d719cf1cb9d4fec68a6b2de7fd4d...
 2e9b03cf999b8f22e998fc4
 上链时间: 2022-09-23 at 20
 项目编号: 2019YFC1408100
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Details of on chain certificate information



4. Conclusions

- A blockchain based solution for scientific data exchange and certification has been proposed, and a certification smart contract has been designed in conjunction with the marine science data exchange system to achieve full traceability of the exchange and certification process;
- By utilizing the immutability of blockchain technology, marine science data is stored on and off the chain. The hash value of the original data is uploaded onto the chain and accompanied by a digital signature from an authoritative organization, ensuring that the on chain data is unforgeable and the off chain data can verify its authority, providing trustworthy marine science data for open sharing services.

Part 1

Part 2

Part 3

Part 4



Thank you!

Jiang Xiaoyi, Mogeng Xu, Xin Tong
National Marine Data and Information Service of China

Email: andyjiangxy@126.com



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