DLT Interoperability Framework

Kai Wei (weikai@caict.ac.cn), Secretary General of Trusted Blockchain Initiatives(TBI), CAICT
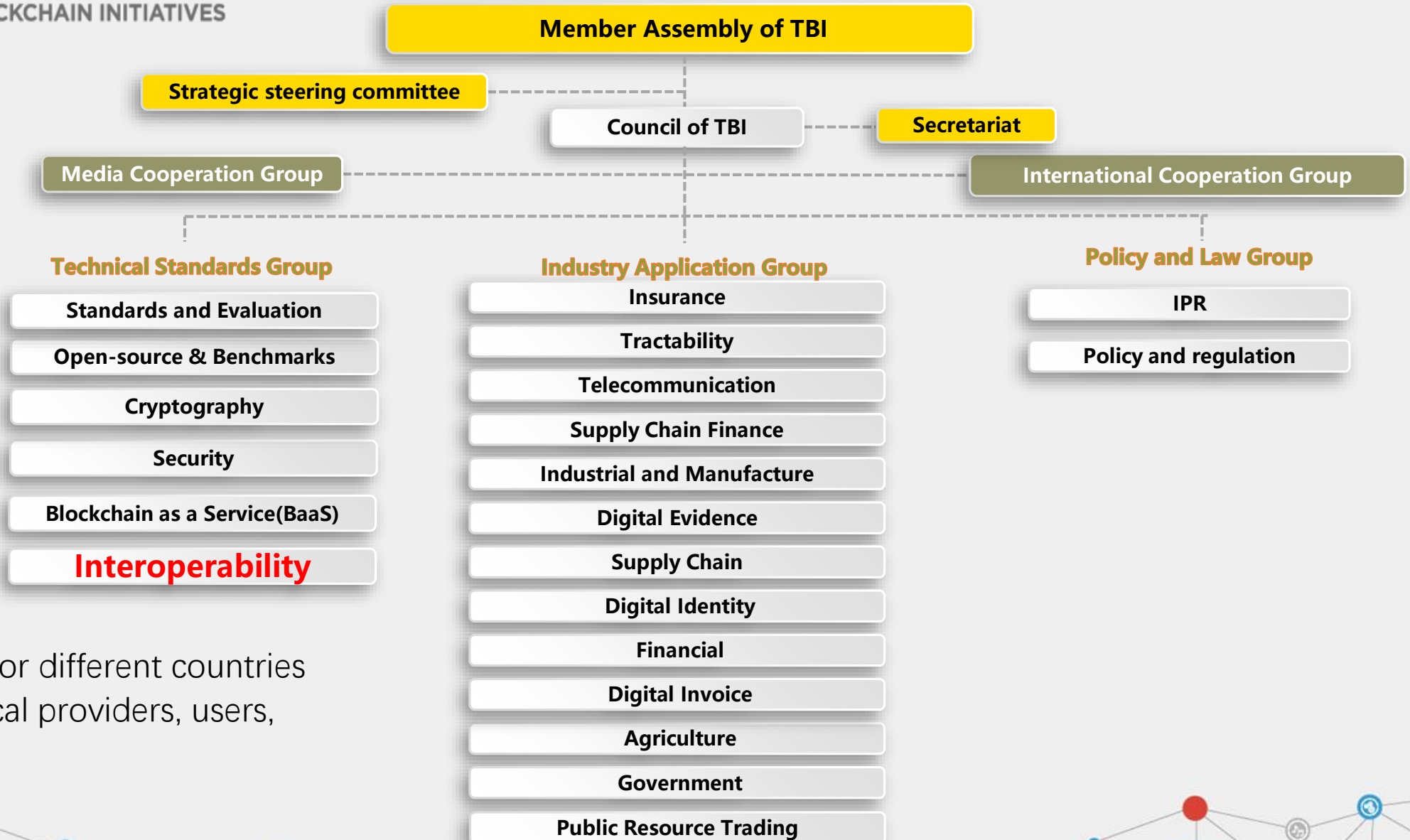
Qiang Yan (qyan@webank.com), Blockchain Scientist, WeBank

Xiaofeng Chen (chenxiaofeng@hyperchain.cn), Co-chair of TBI Interoperability Working Group, Qulian

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Member Assembly of TBI

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Standards and Evaluation

Open-source & Benchmarks

Cryptography

Security

Blockchain as a Service(BaaS)

Interoperability

Industry Application Group

Insurance

Tractability

Telecommunication

Supply Chain Finance

Industrial and Manufacture

Digital Evidence

Supply Chain

Digital Identity

Financial

Digital Invoice

Agriculture

Government

Public Resource Trading

Policy and Law Group

IPR

Policy and regulation

410 members for different countries
Including technical providers, users,
academia…

Evolution of (DLT) Interoperability

2000, ITU *(ITU-T Y.201-2000）*：
Interoperability is the ability of two or more systems or applications to exchange information and to mutually use the information that has been exchanged.

2016, Vitalik Buterin *(Co-founder of Ethereum）*：
DLT interoperability is cross-chain interoperability, and three kinds of cross-chain interoperation techniques are proposed as follows:
- notary schemes
- side chain / relay chain
- hash time locking

2020, WEF *(World Economic Forum)* and Deloitte:
DLT interoperability focuses on the interaction of assets and information between different chain systems. The approaches to DLT interoperability are proposed: cross authentication, oracles and API gateways.
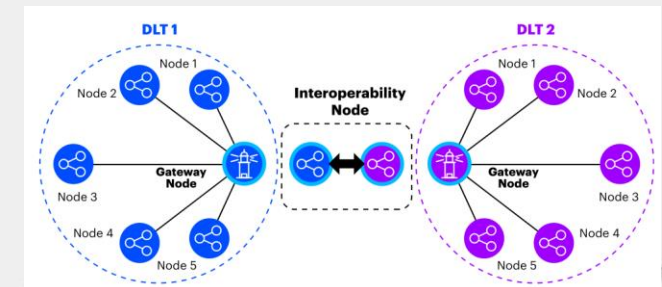

Cross-authentication   Oracle   API gateway

2015, Interoperability Working Group of AFUL
(Association Francophone des Utilisateurs de Logiciels Libres）：
Interoperability is a characteristic of a product or system, whose interfaces are completely understood, to work with other products or systems, at present or in the future, in either implementation or access, without any restrictions.

Compatibility   De facto standard   Interoperability

2020, David Treat *(Accenture Managing Director of Global Blockchain Lead）*：
DLT interoperability is the ability of a DLT system to interconnect with multiple DLT systems and multiple DLT subsystems
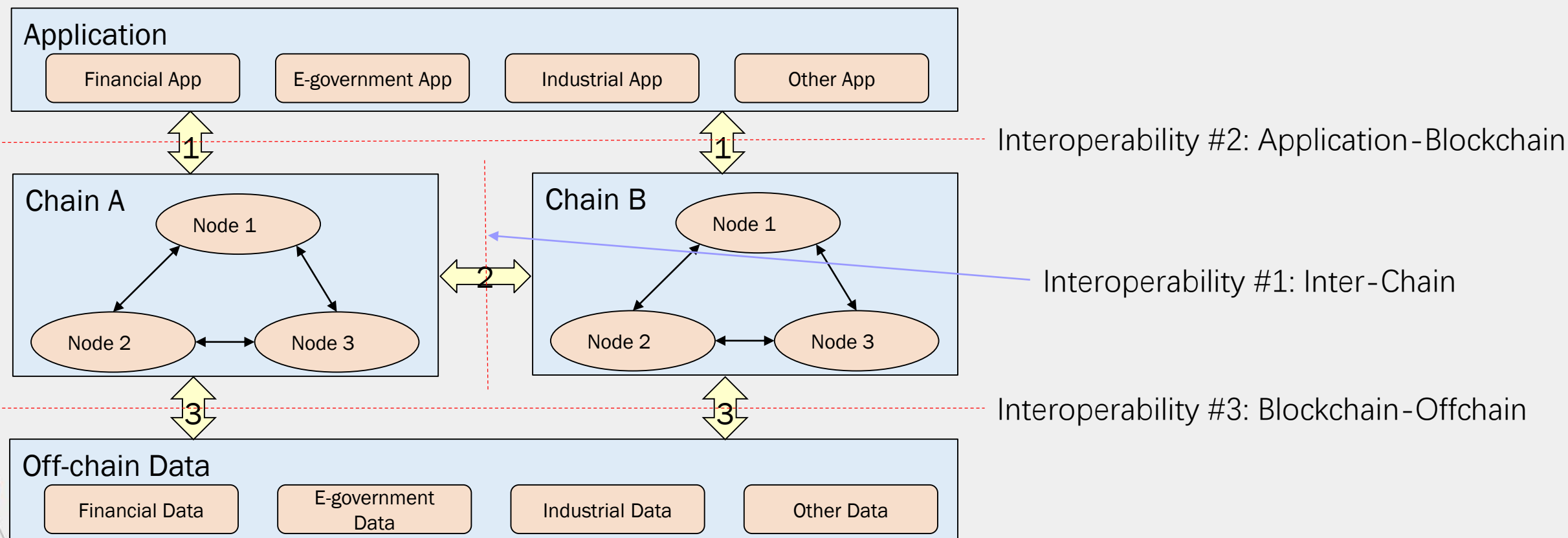
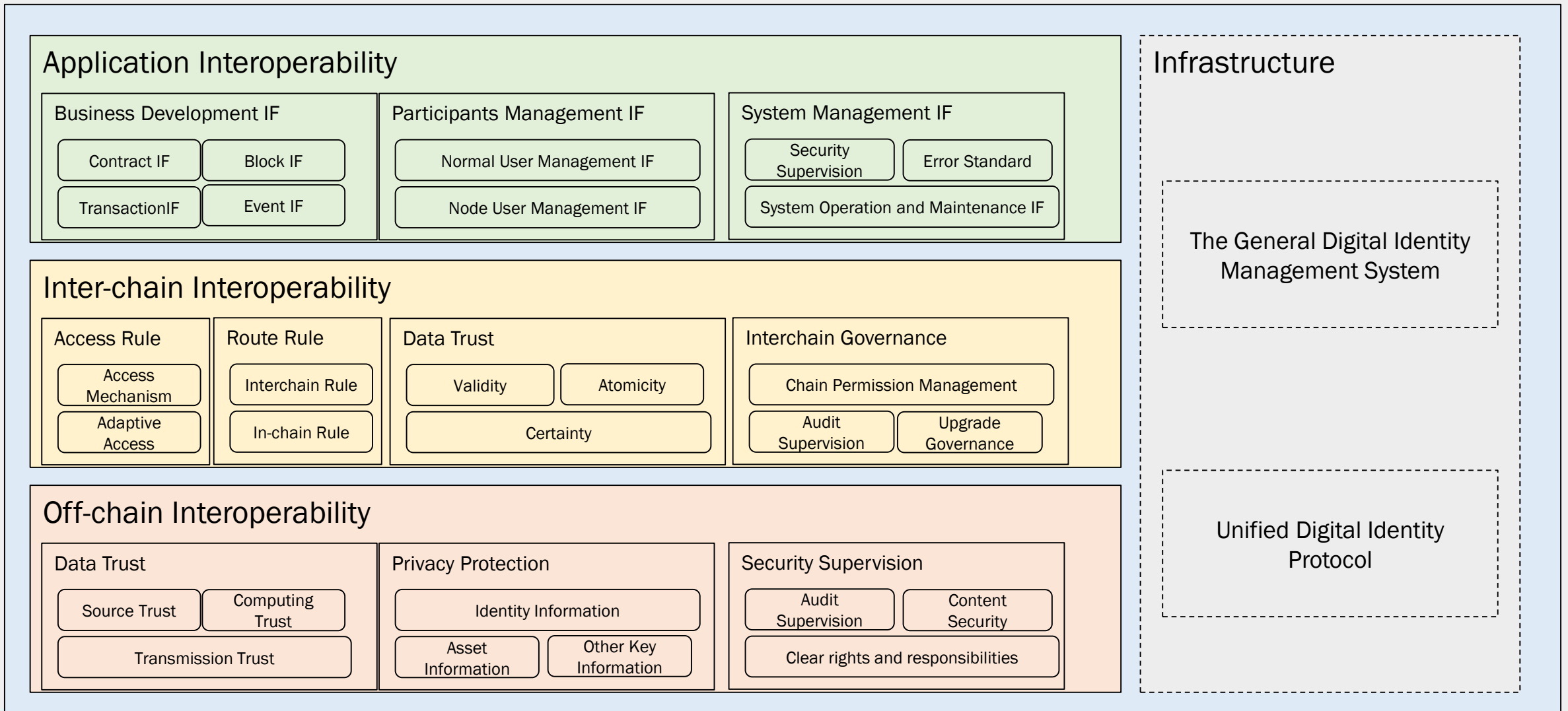# TBI Definition of DLT Interoperability

DLT interoperability is an ability that a DLT system instance exchange information with other system instances and use the information that has been exchanged. Other system instances refer to all external system instances, such as application system instances, other DLT system instances, and off-chain data system instances.

Source: Blockchain Interoperability White Paper, Trusted Blockchain Initiatives, July 2020

TBI DLT Interoperability Framework

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Application Interoperability

Business Development IF
| Contract IF | Block IF |
| TransactionIF | Event IF |

Participants Management IF
Normal User Management IF

Node User Management IF

System Management IF
| Security Supervision | Error Standard |

System Operation and Maintenance IF

Inter-chain Interoperability

Access Rule
Access Mechanism

Adaptive Access

Route Rule
Interchain Rule

In-chain Rule

Data Trust
| Validity | Atomicity |

Certainty

Interchain Governance
Chain Permission Management

| Audit Supervision | Upgrade Governance |

Off-chain Interoperability

Data Trust
| Source Trust | Computing Trust |

Transmission Trust

Privacy Protection
Identity Information

| Asset Information | Other Key Information |

Security Supervision
| Audit Supervision | Content Security |

Clear rights and responsibilities

Infrastructure

The General Digital Identity Management System

Unified Digital Identity Protocol

Source: Blockchain Interoperability White Paper, Trusted Blockchain Initiatives, July 2020

Part 2: Inter-chain Interoperability

Qiang Yan (qyan@webank.com) Blockchain Scientist, WeBank

One interchain network for many chains
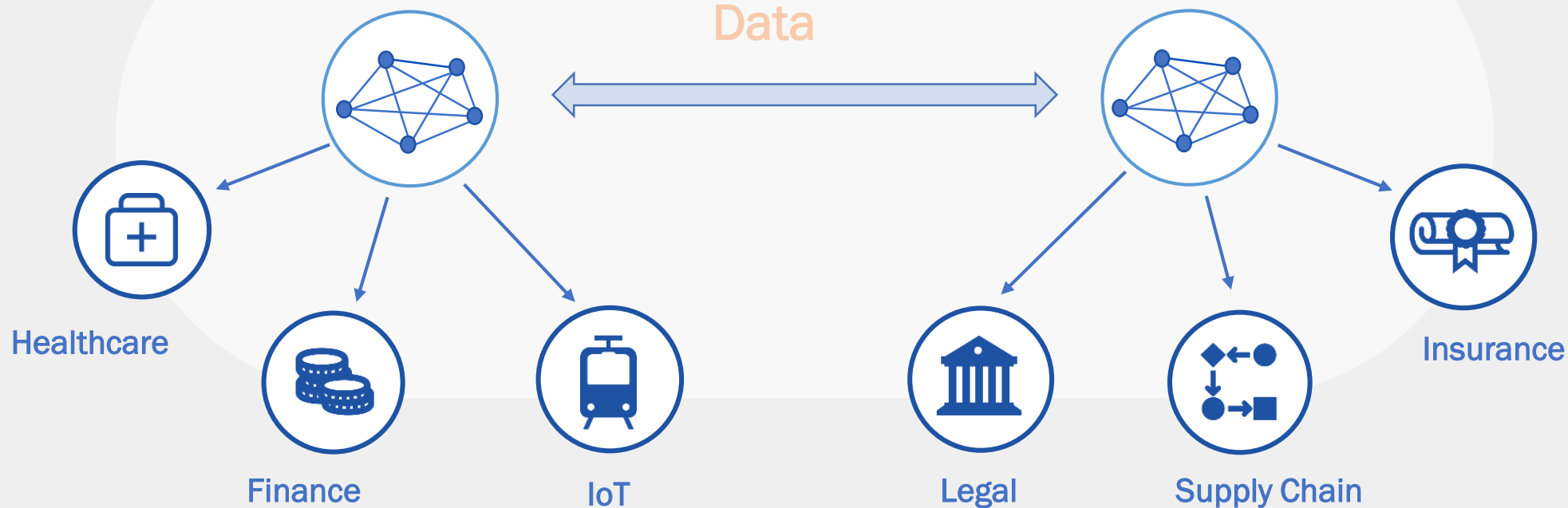
Key challenges of interchain operations

Different System Semantics   System semantics might be incompatible among different blockchains.

Different Data Structure   Data structures might be incompatible among different blockchains.

Different Protocol   Network protocols might be incompatible among different blockchains.

Different Trust Model   Trust models might not be mutually verifiable among different blockchains.

Different Business Logic   Transactional requirements might not be satisfied among different blockchains.

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Interchain interoperability framework

Interchain Network

1. Interchain Adaptation

- ◆ Different system semantics?
- ◆ Different data structures?

2. Interchain Communication

- ◆ Different network protocols?

3. Interchain Transaction

- ◆ Different trust models?

4. Interchain Governance

- ◆ Different business logic?
- ◆ General access control, auditing, regulation support, and more?
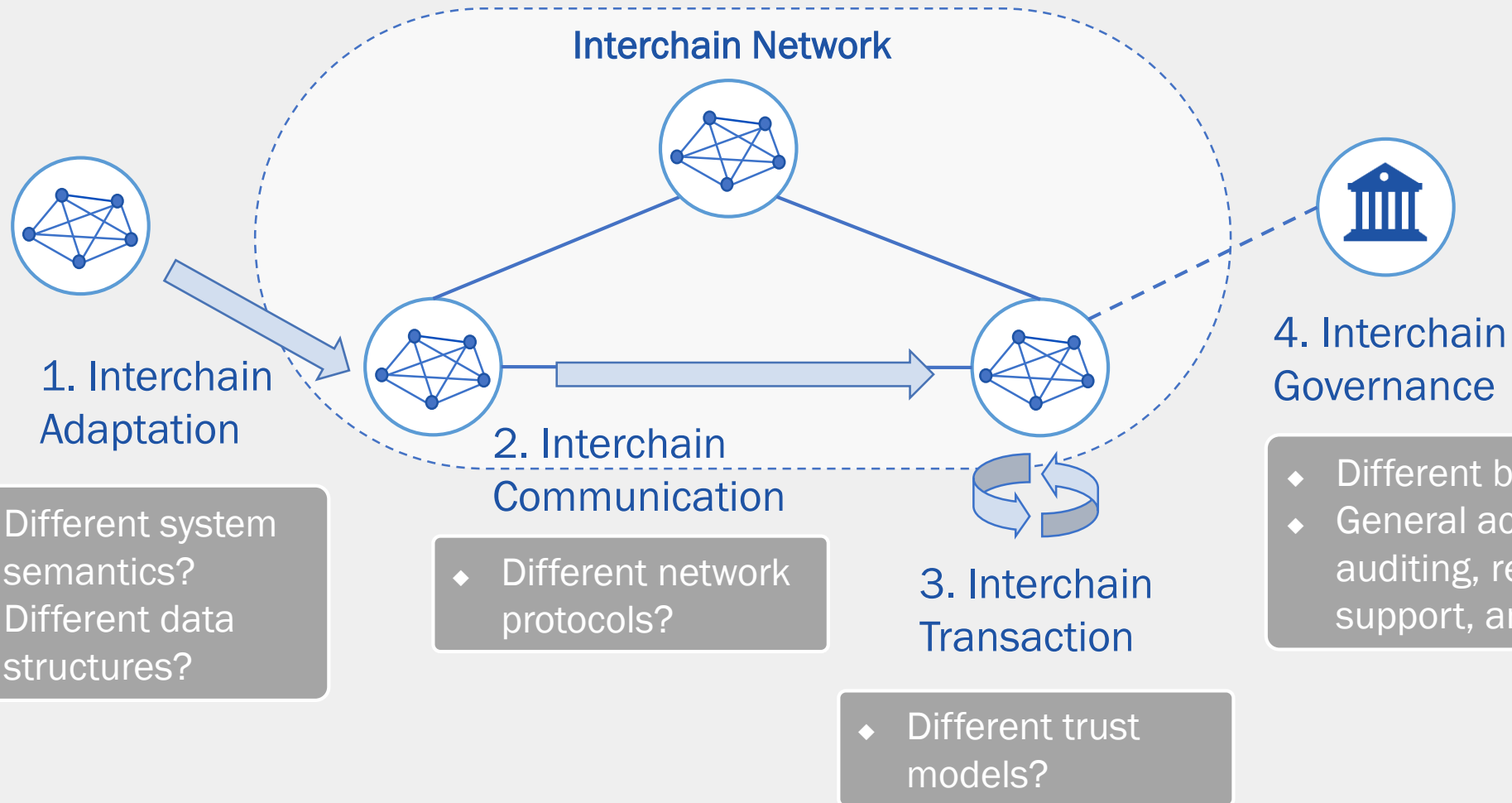
Interchain adaptation and communication

Unify and abstract interchain entry and communication protocols, data structure, API interface for **seamless and trusted block data exchange.**

Adaptation Framework

Resource Access
- Data API
- Contract API
- Event API

Chain Access
- Block data API
- Status API

Blockchain Adaptor
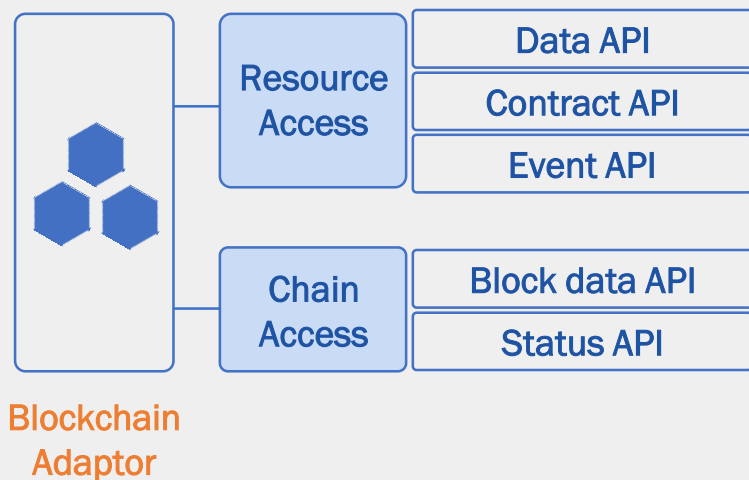
Communication Framework

Zone
- Blockchain
- Blockchain

Zone
- Blockchain

Interchain Router — Blockchain Adaptor

Resource Locating Protocol

Interchain Router — Blockchain Adaptor

Resource Locating Protocol

Interchain Router — Blockchain Adaptor

User

User

User

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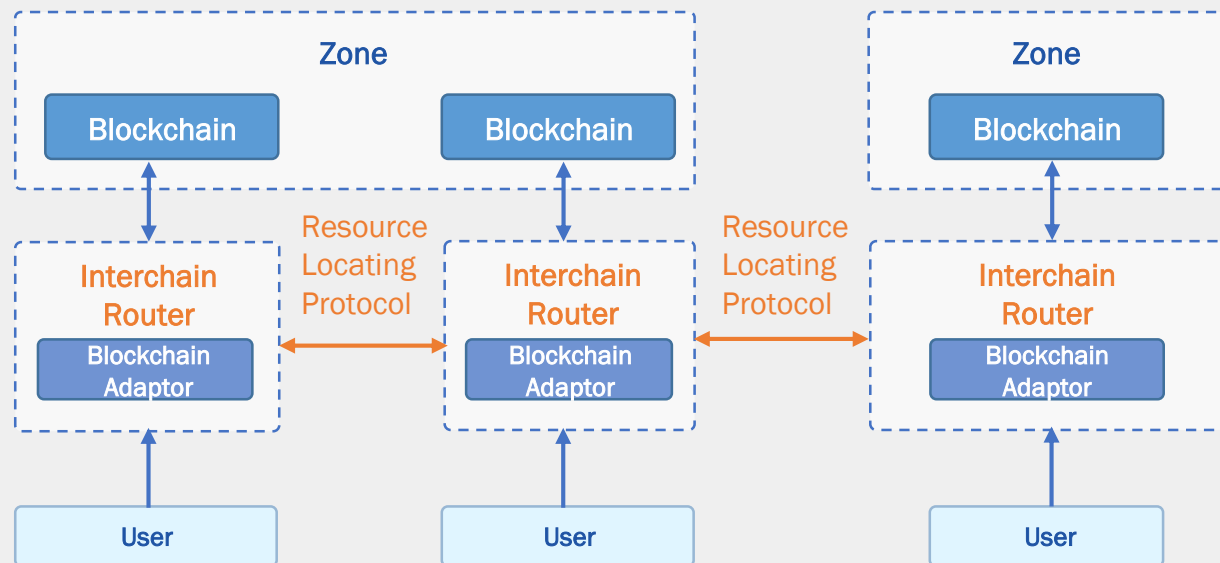
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Interchain transaction

Ensure a transaction execution involving resources from multiple blockchain to be **verifiable**, **deterministic**, and **atomic**.
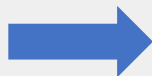
verifiable ➡ Unified Data Structure
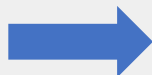
deterministic ➡ Signature
Merkle Proof
Block Metadata Relay
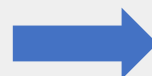
atomic ➡ **HTLC:** Hashed Timelock Contract
2PC: Two Phase Commit

Interchain governance

Enable essential governance capabilities for **reliable** and **accountable** interchain networks.

Common Governance Capabilities:

- Access control for member blockchains
- Rollback mechanism for malicious transactions
- Network anomaly detection and recovery
- Upgrade support
- Auditing and regulation support

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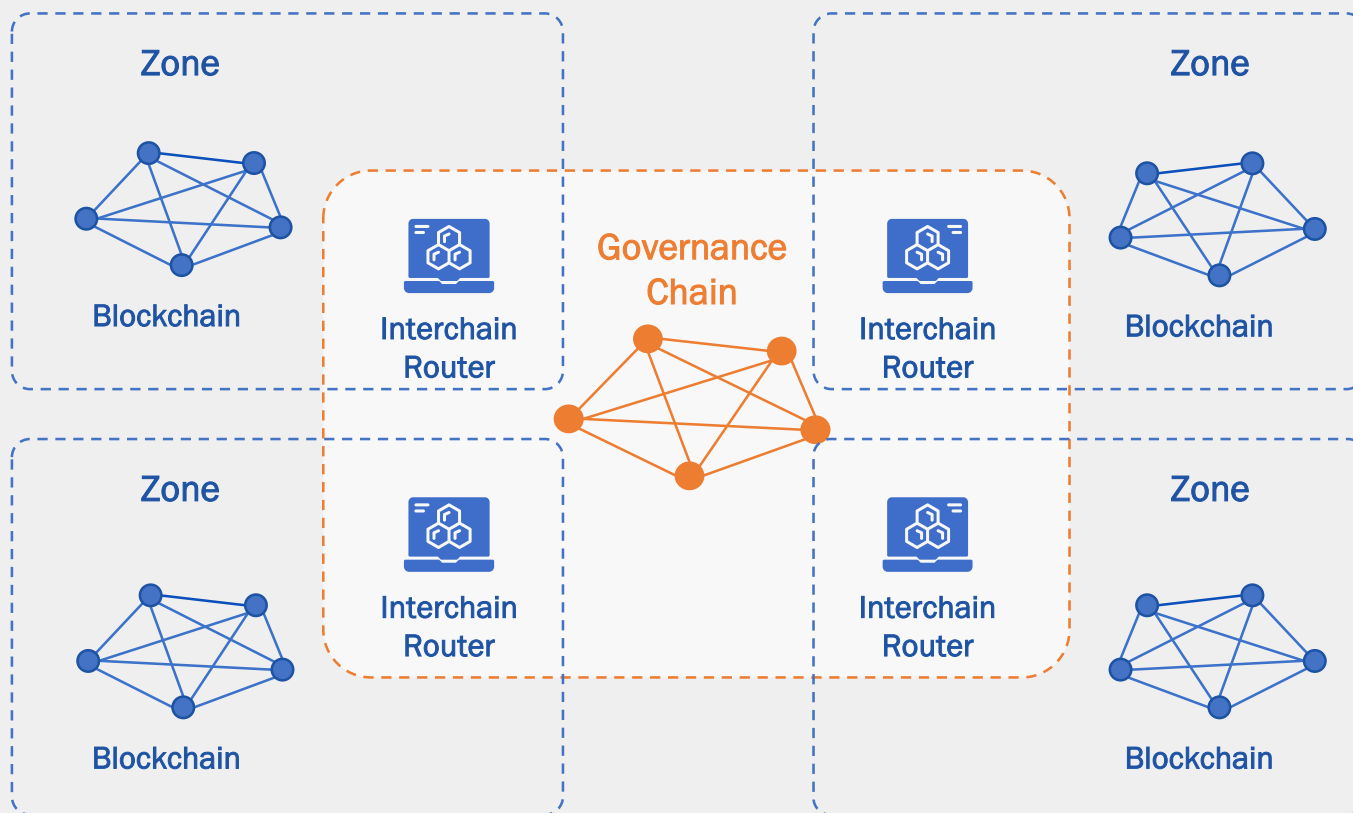
TBI interchain reference platform: WeCross

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Key challenges

- Different System Semantics
- Different Data Structure
- Different Protocol
- Different Trust Model
- Different Business Logic

TBI interchain interoperability framework

- Interchain Adaptation
- Interchain Communication
- Interchain Transaction
- Interchain Governance
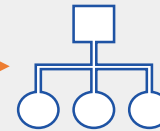
WeCross Features

- Universal Blockchain Interfaces
- Heterogeneous Interchain Protocols
- Trust Transaction Management
- Multilateral Inter-Domain Governance

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Part3: Application Interoperability && Off-chain Interoperability

Xiaofeng Chen (chenxiaofeng@hyperchain.cn), Co-chair, TBI Interoperability Working Group, Hangzhou Qulian Technology Co., Ltd

One Institution, Multi chains, Multi DApps

Finance DApp

Supply Chain DApp

Healthcare DApp

Fabric

FISCO BCOS

Hyperchain

Institution A
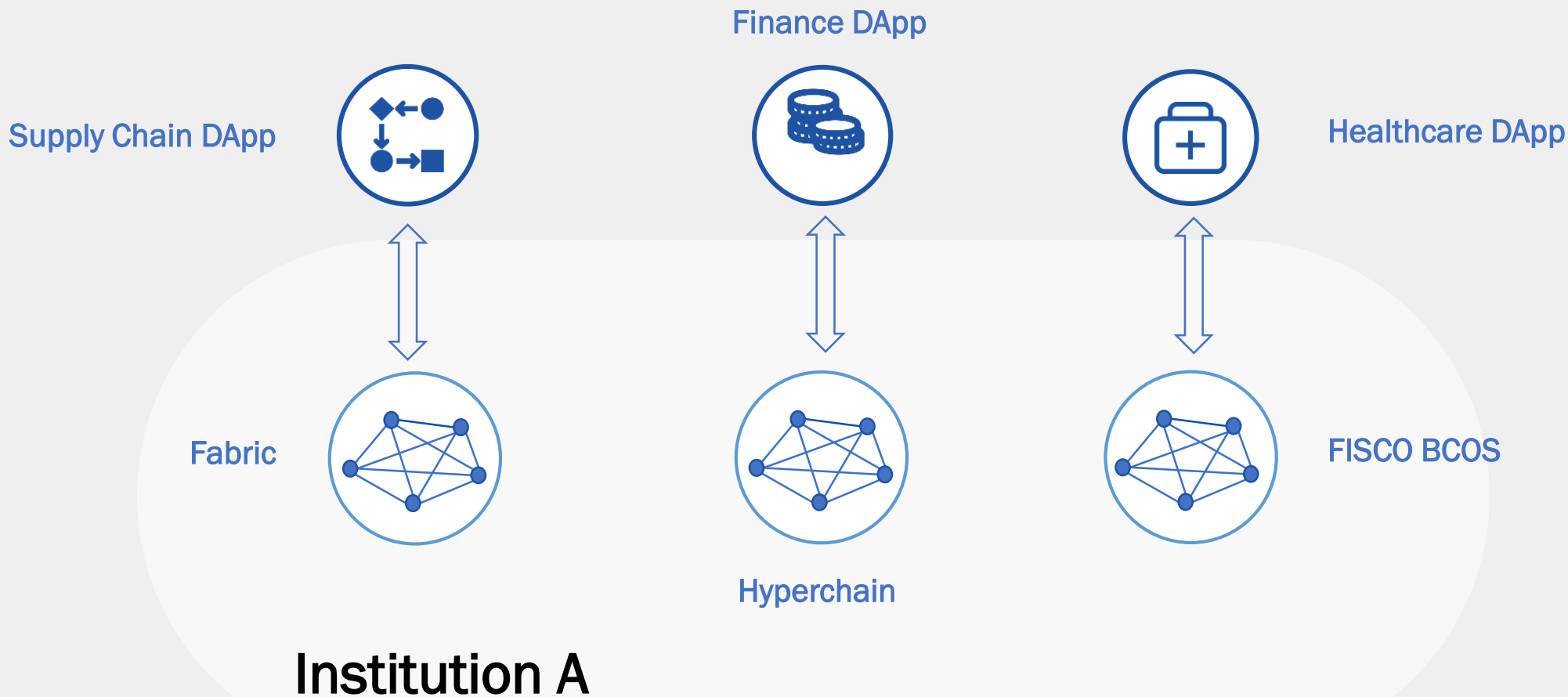
Key challenges of Inter-DApp

Different APIs

Types	JSON-RPC	gRPC	Restful API	HTTP/S API
FISCO BCOS	√		√	√
XuperChain		√		√
Hyperchain	√	√		√
UChains		√	√	√
TCChain		√		√
Fabric		√	√	√
Z-Ledger		√	√	√

Key challenges of Inter-DApp

Different SDKs with Diff-PL

Types	SDK					
	Java	JavaScript	Go	Python	C/C++	Other
FISCO BCOS	√	√	√	√		
XuperChain	√	√	√	√		C#
Hyperchain	√	√	√		√	C#
UChains	√		√			
TCChain	√	√	√	√	√	php、C#
Fabric	√	√	√	√		
Z-Ledger	√	√	√	√		

Key challenges of Inter-DApp

Different API Types & Scopes

Account Management

Network Management

Transaction Process

Block Process

Event Management

Contract Management

Configuration Management

Node Management

Devops Management

...

Abstract API List

Business Development IF

Contract IF	Block IF
TransactionIF	Event IF

Participants Management IF

Normal User Management IF

Node User Management IF

System Management IF

Security Supervision	Error Standard

System Operation and Maintenance IF
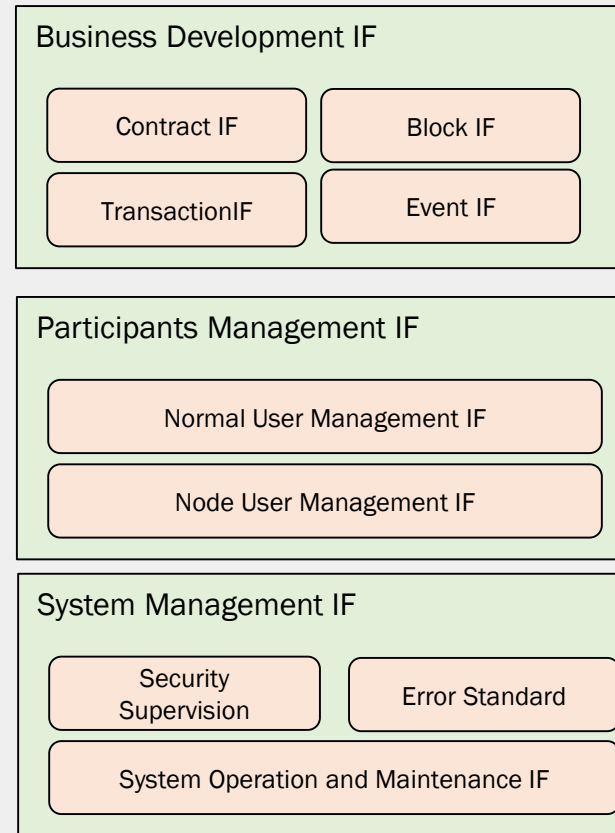
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Status：Baas，Online IDE

Supply Chain DApp
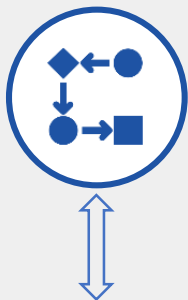
Finance DApp
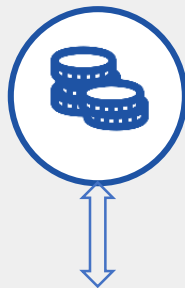
Healthcare DApp

Baas

Fabric
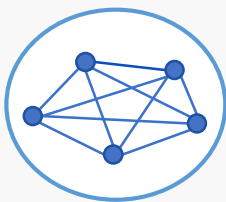
Hyperchain
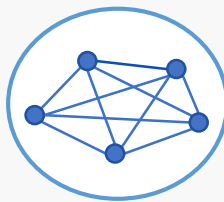
FISCO BCOS

...
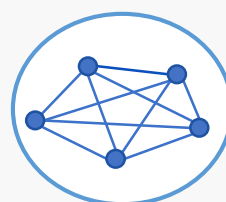
Institution A
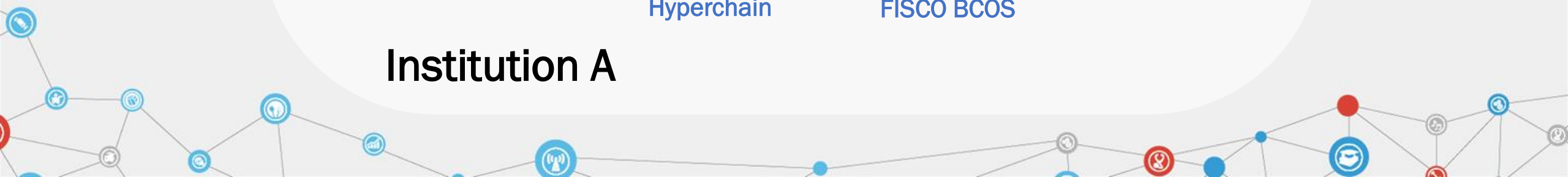
Status：Baas， Online IDE

Choose a blockchain to start

Consortium Blockchains

Ant OC | Filoop | FISCO BCOS | Libra

Public Blockchains

CocosBcx | Ethereum | IOST | Nervos | Ultrain

Goal：Open Blockchain Connectivity
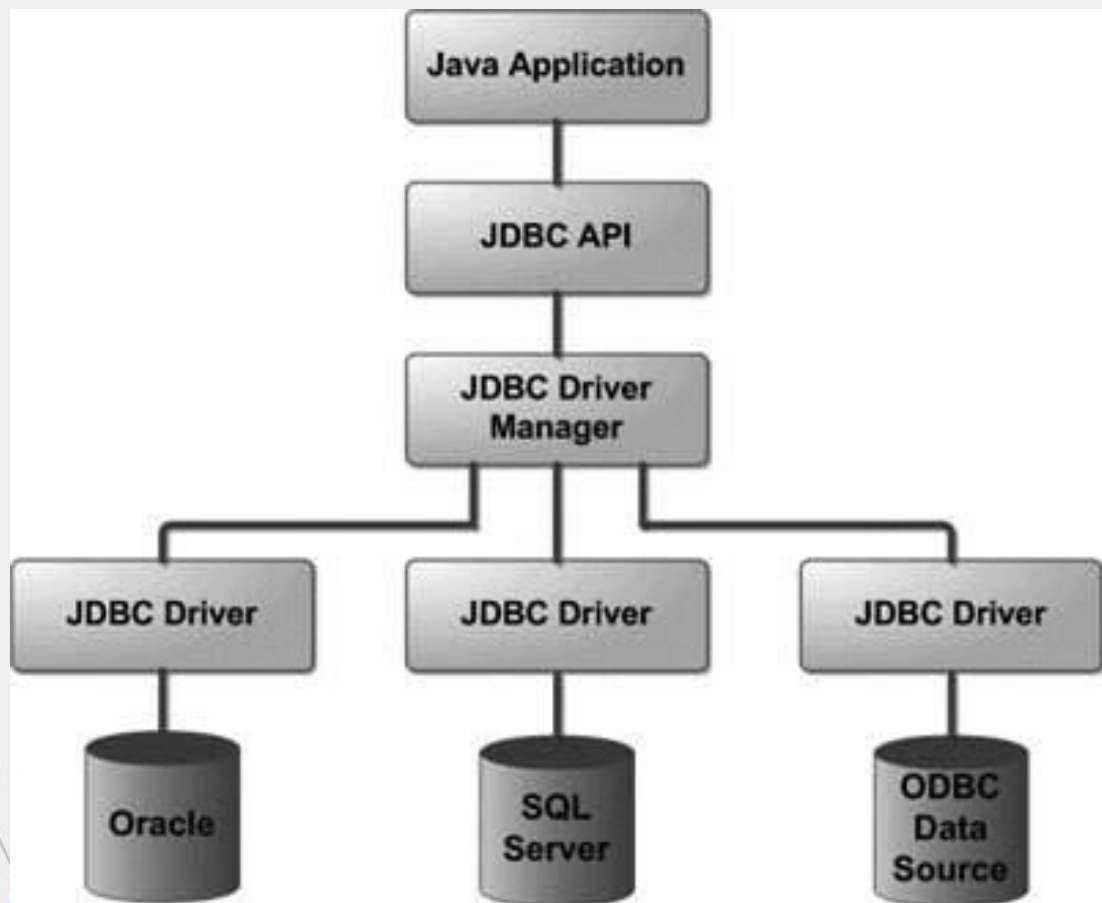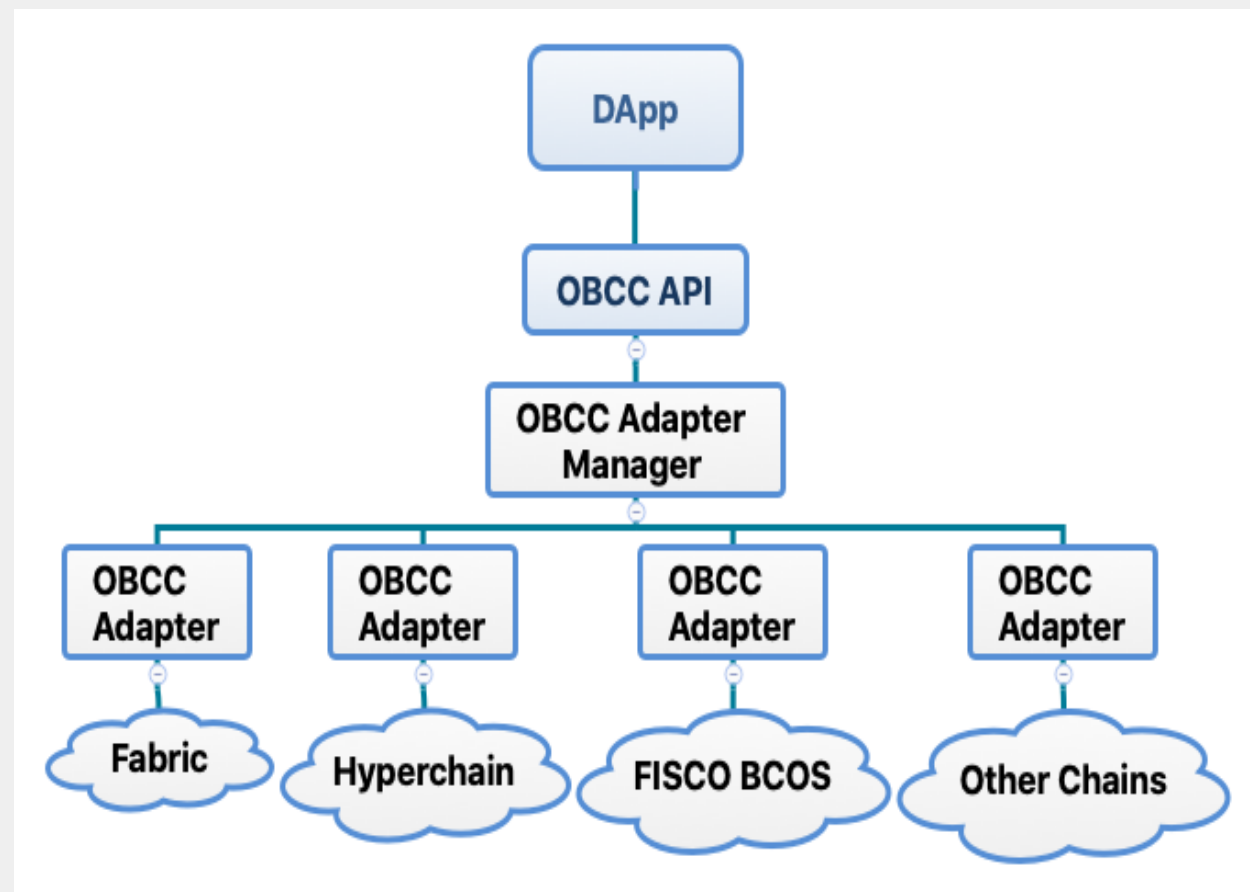
JDBC

OBCC

Off-Chain Data, Off-Chain Computing

Identity Information

Education Information

Work Information

Company Information

Travel Information

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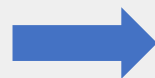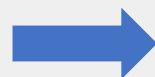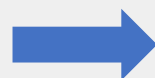
The General Digital Identity Management System

Unified Digital Identity Protocol

Off-Chain Data, Off-Chain Computing

TEE

TrustZone

➡️

SGX

Result: Available

MPC

➡️

Source: Invisible

Federated Learning
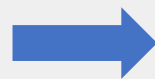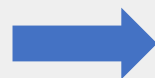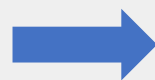
➡️

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Real Economy
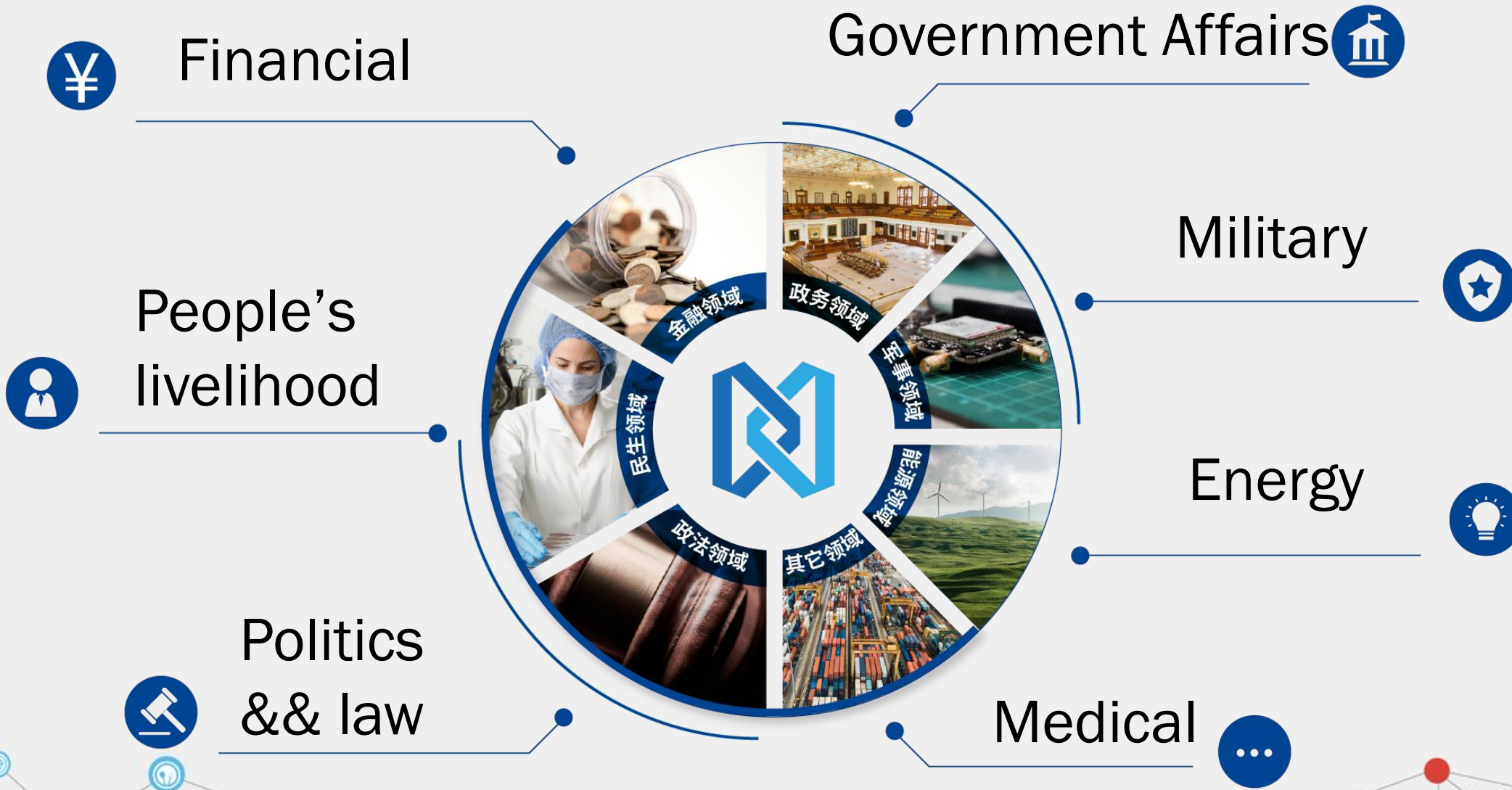
THANKS

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