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International Telecommunication Union
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Recommendation
ITU-T F.751.5 (12/2022)

SERIES F: Non-telephone telecommunication services

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Recommendation ITU-T F.751.5

Requirements for distributed ledger technology-based power grid data management

Summary

Recommendation ITU-T F.751.5 defines requirements for distributed ledger technology (DLT)-based power grid data management, including framework of DLT-based power grid data management, requirements for infrastructure layer, requirements for service layer, requirements for application layer and requirements for data governance. This Recommendation can be used as a guideline for power grid data management with DLT technologies.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T F.751.5	2022-12-14	16	11.1002/1000/15199

Keywords

Data management, distributed ledger technology, DLT, power grid.

* To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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Requirements for distributed ledger technology-based power grid data management

1 Scope

This Recommendation defines requirements for DLT-based power grid data management, including:

– requirements for infrastructure layer;

– requirements for service layer;

– requirements for application layer; and

– requirements for data governance.

This Recommendation can be used as a guideline for power grid data management with DLT technologies.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

None.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 distributed ledger [b-ITU-T X.1400]: A type of ledger that is shared, replicated, and synchronized in a distributed and decentralized manner.

3.1.2 DLT [b-ITU-T X.1400]: A kind of distributed ledger with confirmed blocks organized in an append-only, sequential chain using cryptographic links. DLTs are designed to be tamper resistant and to create final, definitive and immutable ledger records.

3.1.3 consensus [b-ITU-T F.751.0]: Agreement that a set of transactions is valid.

3.1.4 smart contract [b-ITU-T F.751.0]: Program written on the distributed ledger system which encodes the rules for specific types of distributed ledger system transactions in a way that is recommended to be validated and triggered by specific conditions.

3.1.5 peer-to-peer [b-ITU-T X.1400]: Relating to, using, or being a network of equal peers that share information and resources with each other directly without relying on a central entity.

3.1.6 on-chain [b-ITU-T X.1400]: Located, performed or run inside a DLT system.

3.1.7 off-chain [b-ITU-T X.1400]: Related to a DLT system, but located, performed or run outside that DLT system.

3.2 Terms defined in this Recommendation

This Recommendation defines the following term:

3.2.1 power grid: The whole consisting of substations of various voltages and transmission and distribution lines in the power system.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

DLT Distributed Ledger Technology

DPoS Deposit-based Proof of Stake

P2P Peer-to-Peer networking

PBFT Practical Byzantine Fault Tolerance

PoS Proof of Stake

PoW Proof of Work

5 Conventions

The following conventions are used in this Recommendation:

– The keywords "**is required to"** indicate a requirement which must be strictly followed and from which no deviation is permitted, if conformance to this Recommendation is to be claimed;

– The keywords "**is recommended**" indicate a requirement which is recommended but which is not absolutely required. Thus, this requirement need not be present to claim conformance;

– The keywords "**is not recommended**" indicate a requirement which is not recommended but which is not specifically prohibited. Thus, conformance with this Recommendation still be claimed even if this requirement is present.

6 Framework of DLT-based power grid data management

DLT-based power grid data management improve the real-time interaction between power supply and demand response, and make the power grid dispatching process more transparent, more accurate, more economical. The DLT-based power grid data is stored in DLT, and the transaction data can be traced and tampered-proof in the whole process, thus ensuring the authenticity and uniqueness of the power grid data.

DLT-based data management has the feature of tamper-proof, traceability, collective maintenance, and high transparency. A reference framework for DLT-based power grid data management is shown in Figure 1. This framework is composed of four layers, including the infrastructure layer, the service layer, the application layer and data governance. The requirements are described in the following clauses according to this framework.

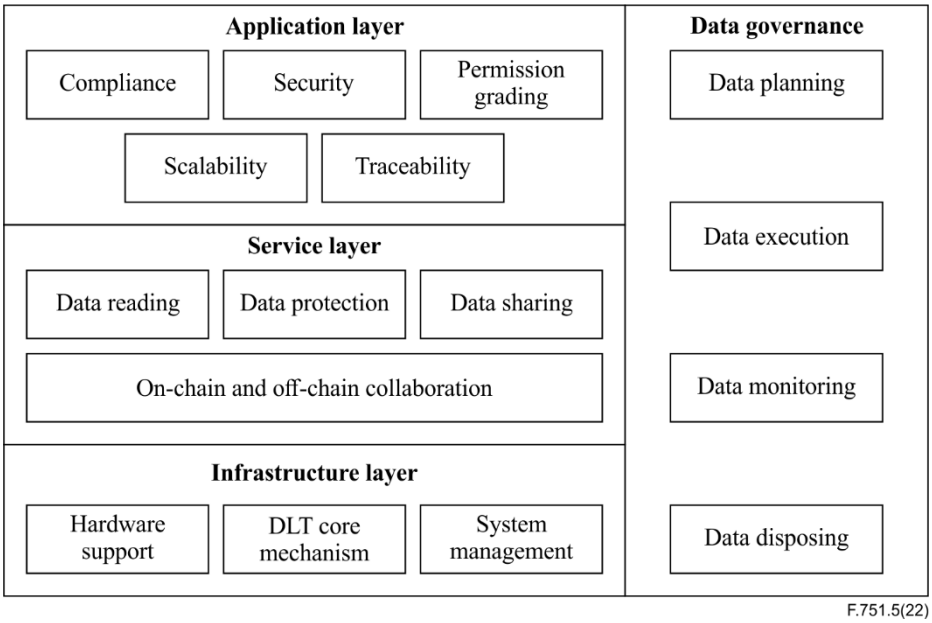

Figure 1 – Framework of DLT-based power grid data management

7 Requirements for the infrastructure layer

The infrastructure layer provides the operating environment and basic components needed by the DLT-based power grid data management system, including hardware support, DLT core mechanism and system management.

The following are the requirements for the infrastructure layer:

IL-01: The hardware support of the DLT-based power grid data management is required to have the ability to prevent physical attacks.

IL-02: The core mechanism is required to include the smart contract, consensus mechanism and peer-to-peer (P2P) network. The consensus mechanism includes but is not limited to practical Byzantine fault tolerance (PBFT) algorithm, proof of work (PoW) algorithm, proof of stake (PoS) algorithm, and deposit-based proof of stake (DPoS) algorithm.

IL-03: System management is required to provide the function of account management, node management and access control. System management is required to support external interaction management functions.

8 Requirements for the service layer

The service layer provides services of data reading, data protection, data sharing, and on-chain and off-chain data collaboration.

The following are the requirements for the service layer:

BDS-01: Data reading is required to provide data access permissions.

BDS-02: Data protection is required to provide security measures, including physical security measures and software security measures.

BDS-03: Data sharing is required to ensure the security of the data link and to adopt an encrypted transmission protocol.

BDS-04: On-chain and off-chain data collaboration is required to ensure relevance and consistency, and to increase the interoperability and scalability between chains.

9 Requirements for the application layer

The application layer provides customizable, visualized and interactive data applications for power grid data management users.

The following are the requirements for the application layer:

AL-01: The application layer of power grid data management is required to meet the compliance requirements, including:

- the responsibilities and authorities of the DLT-based power grid data management system are required to be specified clearly in the design document;
- the DLT-based power grid data management system adopts encryption protection and security management measures for users' personal information;
- the management principles of independence, systematicity, full participation, mandatory, clear management status and responsibilities.

AL-02: The application layer of power grid data management is required to meet the security requirements, including:

- the confidentiality and security protection, the selection of a private key algorithm, and the security guarantee of data transmission at all levels of the system;
- to be equipped with an emergency response mechanism and practical measures;
- to ensure that the identities of all parties joining the node are safe and reliable, the assets are real and legal, and the node authority is controllable;
- to ensure the data security of data generation, transmission, storage and invocation, the key is required to be separated from the data, thus ensuring its confidentiality.

AL-03: The application layer of power grid data management is required to meet permission grading requirements, including:

- establish and improve the related party's account management system, such as account management, related party management, authority management, scope of authorization, etc;
- reduce unnecessary information collection, adopt the principle of least privilege and multi-role authorization scheme;
- corresponding permissions are granted according to the relevant party level, without overstepping the authority, and the division is clear. Different levels of relevant parties obtain corresponding data access permissions.

AL-04: The application layer of power grid data management is required to meet scalability requirements, including:

- the scalability of the internal functions of the DLT-based power grid data management system, and fully consider the future growth of the DLT-based power grid data management system;
- the construction of the system is required to make a scientific prediction of the future development trend, and the architecture component design is extensible;
- the modularization and componentization of the DLT-based power grid data management system is required to be fully considered and planned in the design document, and well-designed code allows more functions to be added to appropriate locations.

AL-05: The application layer of power grid data management is required to meet traceability requirements, including:

- unique identification and storage of asset-related data generated during the entire lifecycle;

- the consideration of traceable data including data generation time, data type, data source, data query party information, authorization information, ownership change, traceability history record, data change and access records, etc.;
- the traceability of system, user, authorization information and other data is required to be divided according to the sensitivity and importance of the data, and the corresponding traceability plans are required to be adopted according to the nature of the data;
- the system displays different types of data in turn according to the sensitivity and importance of the data to meet different traceability requirements.

10 Requirements for data governance

Data governance is the control of the entire stages of data management for the power grid, including planning stage, the execution stage and monitoring stage and the disposing stage.

The following are the requirements for data governance:

DG-01: The planning stage is required to ensure data usage, data specification and resource budgets. In the data planning stage, it is advisable to clarify data requirements, explain data usage, standardize data format and estimate resource budget.

DG-02: The execution stage is required to ensure data generation, data collection, data processing and data application. In the implementation stage, the data production standards, data collection standards, data processing standards and data application standards are required to be strictly implemented.

DG-03: The monitoring stage is required to ensure data status monitoring, data logic monitoring, data indicator monitoring, performance evaluation, etc. In the monitoring stage, monitoring configuration, monitoring alarms, monitoring processing, etc. is required to be set.

DG-04: The disposing stage is required to ensure settlement of charges, audit records, summaries and review results, and final deletion, transfer or reuse of data collected and processed in the data management lifecycle.

Bibliography

[b-ITU-T F.751.0] Recommendation ITU-T F.751.0 (2020), *Requirements for distributed ledger systems*.

[b-ITU-T X.1400] Recommendation ITU-T X.1400 (2020), *Terms and definitions for distributed ledger technology*.

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