

Recommendation

ITU-T Y.4486 (03/2023)

SERIES Y: Global information infrastructure, Internet protocol aspects, next-generation networks, Internet of Things and smart cities

Internet of things and smart cities and communities –
Frameworks, architectures and protocols

**Framework of cross edge decentralized service
by using digital ledger technology and edge
computing technologies for Internet of things
devices**

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Recommendation ITU-T Y.4486

Framework of cross edge decentralized service by using digital ledger technology and edge computing technologies for Internet of things devices

Summary

Decentralized services such as distributed ledger technology (DLT) service for Internet of things (IoT) devices are usually deployed in local area networks (LANs) or in core clouds. When only deployed in LANs, the decentralized services may be affected by the limited capabilities of storage, computation and communication of IoT devices. When only deployed in core clouds, the decentralized services may be affected by the communication capabilities between the IoT devices in LANs and the peers in core clouds. With the popularization of the use of edge computing, parts or all of functionalities of the decentralized services can be deployed in edge clouds.

Recommendation ITU-T Y.4486 introduces a cross edge decentralized service (CEDS) by using DLT and edge computing technologies, which supports seamless cross edge DLT services for IoT devices (fixed and mobile) by using DLT and edge computing technologies. The CEDS can take the advantages of edge computing to speed up the service efficiency of DLT services for IoT devices. In addition, the CEDS provides adaptive service management to match the dynamic changes of IoT devices.

This Recommendation provides relevant general characteristics and requirements of the decentralized service by using DLT and edge computing technologies, and also provides its functional framework, common capabilities and general procedures.

History

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Decentralized service, distributed ledger technology (DLT), edge computing, framework, Internet of things (IoT).

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Recommendation ITU-T Y.4486

Framework of cross edge decentralized service by using digital ledger technology and edge computing technologies for Internet of things devices

1 Scope

This Recommendation introduces a cross edge decentralized service (CEDS) by using decentralized ledger technology (DLT) and edge computing technologies for IoT devices, and provides relevant general characteristics and requirements, a functional framework, common functionalities and general procedures.

The scope of this Recommendation includes:

- Introduction of the cross edge decentralized service by using DLT and edge computing technologies;
- General characteristics and requirements of the cross edge decentralized service by using DLT and edge computing technologies;
- Functional framework, common functionalities and general procedures of the cross edge decentralized service by using DLT and edge computing 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.

[ITU-T Y.4000] Recommendation ITU-T Y.4000/Y.2060 (2012), *Overview of the Internet of things*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 application [b-ITU-T Y.2091]: A structured set of capabilities, which provide value-added functionality supported by one or more services, which may be supported by an API interface.

3.1.2 core cloud [b-ITU-T Y.3508]: A cloud computing, which manages resource pools including resources in the edge of the network and enables cloud service.

NOTE – Enabled cloud service on the core cloud is provided by a cloud service provider (CSP).

3.1.3 decentralized system [b-ITU-T X.1400]: Distributed system wherein control is distributed among the persons or organizations participating in the operation of system.

3.1.4 device [ITU-T Y.4000]: With regard to the Internet of things, this is a piece of equipment with the mandatory capabilities of communication and the optional capabilities of sensing, actuation, data capture, data storage and data processing.

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

3.1.6 distributed ledger technology (DLT) [b-ITU-T X.1400]: Technology that enables the operation and use of distributed ledgers.

3.1.7 distributed ledger technology client (DLT client) [b-ITU-T X.1409]: A client to access the distributed ledger technology system.

3.1.8 distributed ledger technology system (DLT system) [b-ITU-T X.1400]: A system that implements a distributed ledger.

3.1.9 edge cloud [b-ITU-T Y.3508]: A cloud computing deployed to the edge of the network accessed by cloud service customers (CSCs) with small capacity resources enabling cloud service.

NOTE 1 – Enabled cloud service on the edge cloud is lightweight cloud service provided by a cloud service provider (CSP) depending on cloud service category.

NOTE 2 – Lightweight cloud service refers to a portion of cloud service to reconfigure the functionality of cloud service to fit on edge cloud such as base station and gateway with small capacity resource.

3.1.10 edge computing [b-ITU-T Y.3073]: This refers to a strategy to deploy processing capability at network edge where end terminals are connected, and to perform the processing of data which is derived from and fed to the end terminals.

3.1.11 Internet of things (IoT) [ITU-T Y.4000]: A global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on, existing and evolving, interoperable information and communication technologies.

NOTE 1 – Through the exploitation of identification, data capture, processing and communication capabilities, the IoT makes full use of things to offer services to all kinds of applications, whilst ensuring that security and privacy requirements are fulfilled.

NOTE 2 – In a broad perspective, the IoT can be perceived as a vision with technological and societal implications.

3.1.12 ledger [b-ITU-T X.1400]: Information store that keeps final and definitive (immutable) records of transactions.

3.1.13 multi-access edge computing (MEC) [b-ITU-T J.1303]: System which provides an IT service environment and cloud-computing capabilities at the edge of an access network that contains one or more types of access technology, and in close proximity to its users.

3.1.14 mobility [b-ITU-T Q.1743]: The ability for the user to communicate whilst moving independent of location.

3.1.15 node [b-ITU-T X.1400]: Device or process that participates in a distributed ledger network.

NOTE – A node can store a complete or partial replica of the distributed ledger.

3.1.16 peer [b-ITU-T X.1161]: Communication node on peer-to-peer (P2P) network that functions simultaneously as both "client" and "server" to the other nodes on the network.

3.1.17 service [b-ITU-T Y.2091]: A set of functions and facilities offered to a user by a provider.

3.1.18 thing [ITU-T Y.4000]: With regard to the Internet of things, this is an object of the physical world (physical things) or of the information world (virtual things), which is capable of being identified and integrated into the communication networks.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 distributed ledger technology service (DLT service): A decentralized service provided by a distributed ledger technology (DLT) system.

NOTE – DLT system can be deployed in core clouds and/or edge clouds.

3.2.2 cross edge distributed ledger technology service (cross edge DLT service): A distributed ledger technology (DLT) service for Internet of things (IoT) devices enabled by edge computing technologies, in which the IoT devices can get seamless service wherever they are roaming in different edge clouds.

NOTE 1 – A cross edge DLT service is performed by multiple DLT systems as deployed in related edge clouds and core clouds, and those DLT systems collaborate to provide the service for IoT devices.

NOTE 2 – A cross edge DLT service needs to interact with entities in edge clouds to follow mobility information (such as location) of the connected IoT devices in order to provide seamless service when the IoT devices are roaming in different edge clouds.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

CCA-FC	Core-Core Agent Functional Component
CDA-FC	Core-DLT Agent Functional Component
CDM-FC	Core Data Migration Functional Component
CDS-FC	Core Data Synchronization Functional Component
CEA-FC	Core-Edge Agent Functional Component
CEDS	Cross Edge Decentralized Service
CSC	Cloud Service Customer
CSM-FC	Core Service Management Functional Component
CSP	Cloud Service Provider
CSS-FC	Core Service Synchronization Functional Component
CVM-FC	Core service Migration Functional Component
DLT	Distributed Ledger Technology
ECA-FC	Edge-Core Agent Functional Component
EDA-FC	Edge-DLT Agent Functional Component
EDM-FC	Edge Data Migration Functional Component
EDS-FC	Edge Data Synchronization Functional Component
EEA-FC	Edge-Edge Agent Functional Component
EMA-FC	Edge-MEC Agent Functional Component
ESM-FC	Edge Service Management Functional Component
ESS-FC	Edge Service Synchronization Functional Component
EVM-FC	Edge service Migration Functional Component
FC	Functional Component
IoT	Internet of Things
IoV	Internet of Vehicles
MEC	Multi-access Edge Computing
P2P	Peer-to-Peer
PII	Personally Identifiable Information