

Supplement

ITU-T Y Suppl. 88 (01/2025)

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

Supplements to the Y-series Recommendations

Applicability cases of blockchain in the Internet of things

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

GLOBAL INFORMATION INFRASTRUCTURE	Y.100-Y.999
General	Y.100-Y.199
Services, applications and middleware	Y.200-Y.299
Network aspects	Y.300-Y.399
Interfaces and protocols	Y.400-Y.499
Numbering, addressing and naming	Y.500-Y.599
Operation, administration and maintenance	Y.600-Y.699
Security	Y.700-Y.799
Performances	Y.800-Y.899
INTERNET PROTOCOL ASPECTS	Y.1000-Y.1999
General	Y.1000-Y.1099
Services and applications	Y.1100-Y.1199
Architecture, access, network capabilities and resource management	Y.1200-Y.1299
Transport	Y.1300-Y.1399
Interworking	Y.1400-Y.1499
Quality of service and network performance	Y.1500-Y.1599
Signalling	Y.1600-Y.1699
Operation, administration and maintenance	Y.1700-Y.1799
Charging	Y.1800-Y.1899
IPTV over NGN	Y.1900-Y.1999
NEXT GENERATION NETWORKS	Y.2000-Y.2999
Frameworks and functional architecture models	Y.2000-Y.2099
Quality of Service and performance	Y.2100-Y.2199
Service aspects: Service capabilities and service architecture	Y.2200-Y.2249
Service aspects: Interoperability of services and networks in NGN	Y.2250-Y.2299
Enhancements to NGN	Y.2300-Y.2399
Network management	Y.2400-Y.2499
Computing power networks	Y.2500-Y.2599
Packet-based Networks	Y.2600-Y.2699
Security	Y.2700-Y.2799
Generalized mobility	Y.2800-Y.2899
Carrier grade open environment	Y.2900-Y.2999
FUTURE NETWORKS	Y.3000-Y.3499
CLOUD COMPUTING	Y.3500-Y.3599
BIG DATA	Y.3600-Y.3799
QUANTUM KEY DISTRIBUTION NETWORKS	Y.3800-Y.3999
INTERNET OF THINGS AND SMART CITIES AND COMMUNITIES	Y.4000-Y.4999
General	Y.4000-Y.4049
Definitions and terminologies	Y.4050-Y.4099
Requirements and use cases	Y.4100-Y.4249
Infrastructure, connectivity and networks	Y.4250-Y.4399
Frameworks, architectures and protocols	Y.4400-Y.4549
Services, applications, computation and data processing	Y.4550-Y.4699
Management, control and performance	Y.4700-Y.4799
Identification and security	Y.4800-Y.4899
Evaluation and assessment	Y.4900-Y.4999

For further details, please refer to the list of ITU-T Recommendations.

Supplement 88 to ITU-T Y-series Recommendations

Applicability cases of blockchain in the Internet of things

Summary

Cities are taking action and embracing cutting-edge solutions such as artificial intelligence (AI), fifth generation (5G), digital twin, Internet of Things (IoT) and the metaverse to digitize and automate city operations. Digital technologies are at the forefront of creating smart sustainable cities that promote efficiency, economic development and improved quality of life for inhabitants.

Blockchain is identified as one of the important cutting-edge (also referred to as emerging technologies) digital technologies enabling city digital transformation.

As the lead group of IoT and its applications, as well as the lead group of smart cities and communities and related digital services, ITU-T SG20 has published various normative and non-normative documents on blockchain integration with IoT.

Supplement 88 to ITU-T Y-series Recommendations complements the ITU-T SG20 blockchain-related documents and is expected to benefit further research and standardization on blockchain integration with IoT.

History *

Edition	Recommendation	Approval	Study Group	Unique ID
1.0	ITU-T Y Suppl. 88	2025-01-24	20	11.1002/1000/16220

Keywords

Applicability cases, blockchain, blockchain integration, IoT.

* To access the Recommendation, type the URL <https://handle.itu.int/> in the address field of your web browser, followed by the Recommendation's unique ID.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, and information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

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

This is an informative ITU-T publication. Mandatory provisions, such as those found in ITU-T Recommendations, are outside the scope of this publication. This publication should only be referenced bibliographically in ITU-T Recommendations.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this publication may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the standards development process.

As of the date of approval of this publication, ITU had not received notice of intellectual property, protected by patents/software copyrights, which may be required to implement this publication. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the appropriate ITU-T databases available via the ITU-T website at <https://www.itu.int/ITU-T/ipr/>.

© ITU 2025

All rights reserved. No part of this publication may be reproduced, by any means whatsoever, without the prior written permission of ITU.

Table of Contents

	Page
1 Scope	1
2 References.....	1
3 Definitions	1
3.1 Terms defined elsewhere	1
3.2 Terms defined in this Supplement	2
4 Abbreviations and acronyms	2
5 Conventions	2
6 Recommended template for the description of use cases	2
7 Use cases of blockchain integration with IoT.....	3
7.1 Traceability of black pigs and black pork based on blockchain technology ..	4
7.2 Real-world asset tokenization.....	11
7.3 Blockchain-based precision irrigation system.....	15
Bibliography.....	23

Supplement 88 to ITU-T Y-series Recommendations

Applicability cases of blockchain in the Internet of things

1 Scope

Applicability cases of blockchain in IoT are collected from the market and illustrate how blockchain can be integrated with IoT.

This Supplement addresses:

- A recommended template for the description of use cases;
- Use cases of blockchain integration with IoT.

The Supplement complements blockchain-related normative and non-normative documents on blockchain integration with IoT, and it is expected to benefit further research and standardization on blockchain integration with IoT.

More particularly, the Supplement is intended to extend in terms of non-normative text some specific aspects of [ITU-T Y.4227], [ITU-T Y.4560] and [ITU-T Y.4561] with the intention of enhancing the understanding and application of the above Recommendations.

2 References

- [ITU-T Y.4000] Recommendation ITU-T Y.4000/Y.2060 (2012), *Overview of the Internet of things*.
- [ITU-T Y.4114] Recommendation ITU-T Y.4114 (2017), *Specific requirements and capabilities of the Internet of things for big data*.
- [ITU-T Y.4227] Recommendation ITU-T Y.4227 (2024), *Internet of things requirements and capabilities to support blockchain*.
- [ITU-T Y.4560] Recommendation ITU-T Y.4560 (2023), *Blockchain-based data exchange and sharing for supporting Internet of things and smart cities and communities*.
- [ITU-T Y.4561] Recommendation ITU-T Y.4561 (2020), *Blockchain-based data management for supporting Internet of things and smart cities and communities*.
- [ITU-T Y-Suppl.53] ITU-T Y.4000-series Recommendations – Supplement 53 (2018), *Internet of Things use cases*.

3 Definitions

3.1 Terms defined elsewhere

This Supplement uses the following terms defined elsewhere:

3.1.1 blockchain [b-ITU-T F.751.0]: A type of distributed ledger that is composed of digitally recorded data arranged as a successively growing chain of blocks with each block cryptographically linked and hardened against tampering and revision.

3.1.2 consortium blockchain [b-ITU-T Y.4052]: A blockchain platform that is accessible for use only to a consortium whose members establish and maintain the blockchain platform.

3.1.3 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, 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 – From a broader perspective, IoT can be perceived as a vision with technological and societal implications.

3.1.4 nonfungible token [b-ITU-T X.1400]: An entirely unique digital representation of an asset.

3.1.5 private blockchain [b-ITU-T Y.4052]: A blockchain platform that is accessible for use only to a limited group of entities that participate in its activities.

3.2 Terms defined in this Supplement

None.

4 Abbreviations and acronyms

This Supplement uses the following abbreviations and acronyms:

API	Application Program Interface
ID	Identifier
IoT	Internet of Things
LAN	Local Area Network
MIM	Man-In-The-Middle Attack
NB-IoT	Narrowband Internet of Things
NFT	Nonfungible Token
PI	Precision Irrigation
RWA	Real-World Asset

5 Conventions

None.

6 Recommended template for the description of use cases

Recommended template [ITU-T Y-Suppl.53]

- 1) Title of the use case (title is strictly related with the application area addressed)
 - a) Name of the use case
 - b) Identifier (ID) of the use case (ID will be given by ITU-T SG-20 such as vertical name/001/16-17)
 - c) Version/revision history (such as no./month/year)
 - d) Source (country/ITU-T member/organization registered with ITU).
- 2) Objective of the use case (aligned with title, it has explanatory content)
- 3) Background
 - a) Current practice (current process/context which will benefit from the implementation of the use case)

- b) Need for use case
- c) Country ecosystem specifics.
- 4) Description
 - a) Ecosystem description in terms of actors and business roles
 - b) Contextual illustration
 - c) Prerequisites
 - d) Preconditions (if any)
 - e) Triggers
 - f) Scenario

NOTE – The option to have a single scenario per single use case is the basic one. However, multiple scenarios for a single use case are not prevented; in this case, they are indicated in this same field as appropriate.

- g) Process flow diagram
- h) Post-conditions (if any)
- i) Information exchange.

NOTE – It is expected to have the information exchange (field i) associated with the process flow (and process flow diagram if any) (field g).

- 5) Architectural considerations
 - a) Deployment considerations
 - b) Geographical considerations
 - c) Communication infrastructure
 - d) Performance criteria
 - e) Interface requirements
 - f) User interface
 - g) Application program interfaces (APIs) to be exposed to the application from platform
 - h) Data management
 - i) Data backup, archiving and recovery
 - j) Remote device management
 - k) Startup/shutdown process
 - l) Security requirements.
- 6) Potential market growth forecast
- 7) Implementation constraints (for the support of the use case)
- 8) Statutory compliances and related regulations
- 9) Available international standards
- 10) General remarks

7 Use cases of blockchain integration with IoT

Table 1 summarizes the main technical benefits of the blockchain for the selected use cases of blockchain integration with IoT.

Table 1 – Use cases of blockchain integration with IoT and related main technical benefits of the blockchain

Use case clause	Use case name	Main technical benefits of the blockchain
7.1	Traceability of black pigs and black pork based on blockchain technology	Blockchain-enabled data traceability in the IoT
7.2	Real-world asset tokenization	Blockchain-enabled real-world assets conversion into digital tokens in the IoT
7.3	Blockchain-based precision irrigation system	Blockchain-enabled data sharing in the IoT

7.1 Traceability of black pigs and black pork based on blockchain technology

- 1) Title of the use case
 - a) Name of the use case: Traceability of black pigs and black pork based on blockchain technology
 - b) ID of the use case: Agriculture/001/2023
 - c) Version/revision history (such as no./month/year): No.1/2023
 - d) Source (country/ITU-T member/organization registered with ITU): China/ CIACT, Zhigui Technology, China Unicom.
- 2) Objective of the use case: This use case describes how to track the full lifecycle process of black pig and black pork. The usage of blockchain technology can prevent data tampering.
- 3) Background
 - a) Current practice:

Pig and pork traceability systems have gained widespread attention and application. Such systems aim to ensure the quality and safety of live pigs and meat products, while enabling effective data tracking and real-time decision-making in all aspects of breeding, processing, circulation and sales through information services covering the entire supply chain.

In the pork traceability system, pig testing is an important part of ensuring the quality and safety of livestock products, as it helps identify and control potential quality problems and safety risks in a timely manner. The results and information from pig testing are also important components of pork traceability systems, and they are used to generate and update traceability information to ensure that consumers can access to accurate and comprehensive product information.

Overall, pork traceability and pig testing are important tools for ensuring food safety and protecting consumer rights.
 - b) Need for use case

Under the traditional model, black pig meat faces various problems in its production and operation:

 - Fraud: Competitors may take advantage of information asymmetry to manufacture counterfeit and shoddy goods.
 - Data tampering: Data are stored centrally, and the system is independent, belonging to different enterprises or departments. Out of interest considerations, there may be data tampering problems in order to cover up counterfeit and shoddy commodities.