

Supplement

ITU-T Y Suppl. 82 (07/2024)

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

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Standardization gaps and roadmap for artificial intelligence and Internet of things in digital agriculture

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Supplement 82 to ITU-T Y-series Recommendations

Standardization gaps and roadmap for artificial intelligence and Internet of things in digital agriculture

Summary

Supplement 82 to ITU-T Y-series Recommendations analyses and identifies standardization gaps related to artificial intelligence (AI) and Internet of things (IoT) in digital agriculture and develop a future standardization roadmap, taking into consideration the activities currently undertaken by other ITU groups, various standards developing organizations (SDOs) and forums.

History *

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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.

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Supplement 82 to ITU-T Y-series Recommendations

Standardization gaps and roadmap for artificial intelligence and Internet of things in digital agriculture

1 Scope

This Supplement identifies feasible artificial intelligence (AI) and Internet of things (IoT) technologies for digital agriculture while providing an analysis of standardization gaps related to AI and IoT in digital agriculture.

The main objectives of the roadmap are to:

- avoid duplication of standardization efforts within the domain of digital agriculture;
- gain insights into the various technologies utilized in digital agriculture;
- optimize collaboration and synergies among stakeholders in the digital agriculture sector; and
- underscores areas where progress is being made (i.e., trends) and where it is needed (i.e., gaps).

This Supplement offers an overview of standardization activities related to AI (and complementary technologies) for digitalization of agriculture.

2 References

- [ITU-T L.1504] Recommendation ITU-T L.1504 (2016), *ICT and adaptation of agriculture to the effects of climate change*.
- [ITU-T M.3080] Recommendation ITU-T M.3080 (2021), *Framework of artificial intelligence enhanced telecom operation and management (AITOM)*.
- [ITU-T Y.3172] Recommendation ITU-T Y.3172 (2019), *Architectural framework for machine learning in future networks including IMT-2020*.
- [ITU-T Y.4000] Recommendation ITU-T Y.4000/Y.2060 (2012), *Overview of the Internet of things*.
- [ITU-T Y.4450] Recommendation ITU-T Y.4450/Y.2238 (2015), *Overview of Smart Farming based on networks*.
- [ITU-T Y.Suppl.76] Supplement 76 to ITU-T Y.4000-series (2023), *Use cases of Internet of things-based smart agriculture*.

3 Definitions

3.1 Terms defined elsewhere

This Supplement uses the following terms defined elsewhere:

3.1.1 artificial intelligence (AI) [ITU-T M.3080]: Computerized system that uses cognition to understand information and solve problems.

NOTE 1 – ISO/IEC 2382-28 defines AI as "an interdisciplinary field, usually regarded as a branch of computer science, dealing with models and systems for the performance of functions generally associated with human intelligence, such as reasoning and learning".

NOTE 2 – In computer science, AI research is defined as the study of "intelligent agents": any device that perceives its environment and takes actions to achieve its goals.

NOTE 3 – This includes pattern recognition, the application of machine learning and related techniques.

NOTE 4 – Artificial-intelligence is the whole idea and concept of machines being able to carry out tasks in a way that mimics human intelligence and would be considered "smart".

3.1.2 climate-smart agriculture (CSA) [ITU-T L.1504]: CSA is an approach to developing the technical, policy and investment conditions to achieve sustainable agricultural development for food security under climate change.

3.1.3 machine learning (ML) [ITU-T Y.3172]: Processes that enables computational systems to understand data and gain knowledge from it without necessarily being explicitly programmed.

3.1.4 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.

3.1.5 smart livestock farming (SLF) [ITU-T Y.4450]: A convergence service which applies information and communication technologies (ICTs) to livestock value chains, with the potential to deliver more productive and sustainable production.

NOTE 1 – By integrating processes of smart farming, management information systems, stockbreeding automation and robotics, smart livestock farming helps decision-making for more effective and efficient exploitation, operations and management of livestock value chains.

NOTE 2 – Examples of products from domesticated animals (excluding pets) are meat, eggs, milk, honey, fur, leather and wool.

3.2 Terms defined in this Supplement

None.

4 Abbreviations and acronyms

This Supplement uses the following abbreviations and acronyms:

AI	Artificial Intelligence
FAO	Food and Agriculture Organization
ICT	Information and Communication Technology
IoT	Internet of Things
ISO	International Organization for Standardization
ITU	International Telecommunication Union
ITU-T	ITU Telecommunication Standardization Sector
ML	Machine Learning
SDO	Standards Development Organization
SLF	Smart Livestock Farming
UN	United Nations
WG	Working Group

5 Conventions

None.

6 Introduction

FG-AI4A established six working groups for pre-standardization activities in line with the agreed terms of reference. Among them, WG-Roadmap aims to develop a roadmap for future standardization related to AI and IoT in digital agriculture as follows:

The Working Group (WG) for mapping and analysing AI and IoT standards related activities in digital agriculture (WG-Roadmap) is dedicated to mapping, analysing and identifying the standardization gaps related to AI and IoT in agriculture and developing a future standardization roadmap, taking into consideration the activities currently undertaken by other ITU groups, various SDOs and forums. The activities include an accurate mapping of existing standards relevant to digital agriculture and an analysis of the standardization requirements needed for the existing solutions in the market to address challenges identified in WG-AS. It will also factor in the results of WG-DAM to develop its gap analysis.

There is a growing need for comprehensive guidelines that blend scientific knowledge, technological advancements, expert insights, and practical experience. These guidelines play a crucial role in promoting interoperability, aiding regulatory efforts, and facilitating capacity building. Standards Developing Organizations (SDOs) are instrumental in developing and disseminating such guidelines, operating at both national and international levels through organizations like the ITU, ISO, IEC, ETSI, and ANSI.

While official standards endorsed by Standard Development Organizations (SDOs) are essential, complementary guidelines can also be developed and implemented by UN agencies like UNESCO. This dynamic landscape of standardization involves numerous stakeholders focusing on diverse topics. Therefore, ongoing collaboration among these stakeholders is vital to prevent redundant efforts and identify areas where standardization is lacking but necessary.

The International Telecommunication Union (ITU) functions as the specialized United Nations agency for information and communication technologies (ICTs) and is the sole international SDO within the UN system. The ITU's primary standardization efforts are conducted through its ITU Telecommunication Standardization Sector (ITU-T). As part of ITU-T, Focus Groups play a crucial role by convening internal and external experts to aid in the preliminary standardization of particular ICT applications and emerging technologies. The Focus Group on "Artificial Intelligence (AI) and Internet of Things (IoT) for Digital Agriculture" (FG-AI4A) was established by ITU-T Study Group 20 on Internet of Things (IoT) and smart cities and communities (SC&C) to explore digital technologies to enhance the administration of farming operations and secure food stability. The activities of Focus Group on "Artificial Intelligence (AI) and Internet of Things (IoT) for Digital Agriculture" (FG-AI4A), are coordinated closely with the Food and Agriculture Organization of the United Nations (FAO).

In order to streamline efforts and enhance collaboration between the standardization and digital agriculture sectors, the FG-AI4A has created a Working Group dedicated to mapping AI and IoT activities within agriculture (WG-Roadmap). This group's objective is to conduct a comprehensive review of historical, ongoing, and planned standardization initiatives in this field, with a specific focus on Standard Development Organizations (SDOs) and United Nations (UN) bodies. By analysing these activities, this Supplement aims to highlight emerging standardization trends and identify areas where additional efforts are needed to guide future standardization endeavours effectively.

The Supplement provides an overview of the methods employed for gathering and analysing the standards and activities database. Curation involved comprehensive research of literature and online sources, supplemented by a survey administered by FG-AI4A. The analysis of standards involved conducting overviews of the standardization database, focusing on trend and gap analysis discussed in clause 8.