ISO/IEC 30179

Edition 1.0 2023-01

INTERNATIONAL STANDARD

Internet of Things (IoT) – Overview and general requirements of IoT system for ecological environment monitoring



ISO/IEC 30179:2023-01(en)



THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2023 ISO/IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about ISO/IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, …). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch
Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org
The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

ISO/IEC 30179

Edition 1.0 2023-01

INTERNATIONAL STANDARD

Internet of Things (IoT) – Overview and general requirements of IoT system for ecological environment monitoring

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 35.020

ISBN 978-2-8322-6400-3

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD 4
INTRODUCTION 5
1 Scope 7
2 Normative references 7
3 Terms and definitions 7
4 Symbols and abbreviated terms 7
5 IoT system overview for ecological environment monitoring 8
5.1 System infrastructure overview 8
5.2 Entities description 9
5.2.1 Entities in Physical Entity Domain (PED) 9
5.2.2 Entities in Sensing and Controlling Domain (SCD) 9
5.2.3 Entities in Application and Service Domain (ASD) 11
5.2.4 Entities in User Domain (UD) 12
5.2.5 Entities in Operations and Management Domain (OMD) 12
5.2.6 Entities in Resource Access and Interchange Domain (RAID) 13
5.3 Interface description 13
6 General requirements of IoT system for EEM 14
6.1 System functional requirements 14
6.1.1 Data acquisition and data collection 14
6.1.2 Auto configuration 15
6.1.3 IoT gateway 15
6.1.4 Network communication 15
6.1.5 Applications and services 15
6.1.6 Users and supporting facilities 16
6.1.7 Operation and maintenance management 16
6.1.8 Context-awareness 16
6.1.9 Discoverability 16
6.1.10 Sharing ability 16
6.1.11 Resource access and interchange 17
6.1.12 Identification 17
6.1.13 Flexibility 17
6.1.14 Regulation 17
6.1.15 Equipment, network and service scalability 17
6.1.16 Eco-environment analysis and alarming 17
6.2 System security requirements 17
6.2.1 Reliability 17
6.2.2 Resilience 18
6.2.3 Accessibility and availability 18
6.2.4 Confidentiality and privacy 18
6.2.5 Integrity 18
6.3 System performance requirements 18
6.3.1 Data acquisition sampling rate 18
6.3.2 Data accuracy 19
6.3.3 Enclosure protection 19
6.3.4 Sensor working mode 19
6.3.5 Sensor durability 19

6.3.6 Communication protocols 19
6.3.7 Data communication latency 19
6.3.8 Power supply 20
6.3.9 Synchronization 20
6.3.10 Applications and services 20
6.3.11 Users and supporting facilities 20
6.3.12 Operation and management 20
6.3.13 Resource access and interchange 20
Bibliography 21

Figure 1 – System infrastructure of IoT system for EEM 8

Table 1 – Entity descriptions in PED 9
Table 2 – Entity descriptions in SCD 10
Table 3 – Entity descriptions in ASD 11
Table 4 – Entity descriptions in UD 12
Table 5 – Entity descriptions in OMD 13
Table 6 – Entity descriptions in RAID 13
Table 7 – Interface description 14

INTERNET OF THINGS (IoT) – OVERVIEW AND GENERAL REQUIREMENTS OF IoT SYSTEM FOR ECOLOGICAL ENVIRONMENT MONITORING

FOREWORD

1) ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.
2) The formal decisions or agreements of IEC and ISO on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC and ISO National bodies.
3) IEC and ISO documents have the form of recommendations for international use and are accepted by IEC and ISO National bodies in that sense. While all reasonable efforts are made to ensure that the technical content of IEC and ISO documents is accurate, IEC and ISO cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC and ISO National bodies undertake to apply IEC and ISO documents transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC and ISO document and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC and ISO do not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC and ISO marks of conformity. IEC and ISO are not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this document.
7) No liability shall attach to IEC and ISO or their directors, employees, servants or agents including individual experts and members of its technical committees and IEC and ISO National bodies for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this ISO/IEC document or any other IEC and ISO documents.
8) Attention is drawn to the Normative references cited in this document. Use of the referenced publications is indispensable for the correct application of this document.
9) Attention is drawn to the possibility that some of the elements of this ISO/IEC document may be the subject of patent rights. IEC and ISO shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 30179 has been prepared by subcommittee 41: Internet of Things and Digital Twin, of ISO/IEC joint technical committee 1: Information technology. It is an International Standard.

The text of this International Standard is based on the following documents:

Draft	Report on voting
JTC1/SC41/316/FDIS	JTC1/SC41/329/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1, available at www.iec.ch/members_experts/refdocs and www.iso.org/directives.

INTRODUCTION

The IoT-based ecological environment monitoring system is mainly for collecting data and monitoring the ecological environment entities (i.e. physical things in the IoT sense – air, water, soil, and living organisms) using various types of sensing devices. Such sensing devices include but are not limited to the following: growth meters for plant growth; infrared digital cameras and video cameras for identifying animal movements; tracking devices for position and location reporting; and physical, biological or chemical sensors for air, water, and soil monitoring. The collected data are transmitted via a network infrastructure, analysed for their relationships and evaluated for the trends of the eco-environment being monitored. With the current IoT and related technologies, for example, information and communication technologies, all these capabilities can be performed in real-time. Therefore, the IoT-based monitoring system satisfies the requirement of the real-time eco-environment monitoring and management in terms of data capture, data analytics, early warning services, and disaster management and emergency management. This system supports the decision-makers, for example, eco-environment managers, government agencies, and citizens, in the maintenance of the ecosystem and in correcting and restoring the ecosystem when damaged or polluted ecological environment is detected.

Eco-environment has been greatly altered with the development of the economy and humanity. The alteration of the eco-environment endangers the health of all living organisms including humans. More efforts to monitor and protect the earth's eco-environment will improve understanding and support corrective actions.

A number of regional scale eco-environment observation networks are constructed to monitor the ecosystem of air, water, soil, plants, animals. Examples of these regional eco-environment observation networks are GEMS (Global Environment Monitoring System), GTOS (Global Terrestrial Observing System), and ILTER (International Long Term Ecological Research). National scale eco-environment observation stations also exist to monitor water, forest, grassland, farmland, lakes, rivers and coastline. These national scale observation stations are parts of global eco-environment observation networks.

The trends of the eco-environment observation stations require united data sharing and networking, being standardized and automated, and likely to become intelligent. These trends are likely to become the requirements of eco-environment monitoring systems. Therefore, IoT-based systems can be applied to the eco-environment observation systems and networks to meet these requirements. The IoT-based eco-environment monitoring system can provide the accurate and comprehensive sensing of the physical entities (i.e. air, water, soil, and living organisms), reliable data transmission and reception, and intelligent information processing.

Since the 1990s, sensor network systems, which transitioned to the most essential part of the IoT-based systems in the 2000s, have been used for monitoring the environment quality, pollution, and living organisms. For example: the CitySense system in the US was developed for real-time monitoring of the environmental pollution in the city; multitudes of air quality monitoring systems have been deployed to monitor air quality and pollution all over the world; China has initiated the sandstorm and acid rain monitoring system; UC Berkeley is monitoring the birds in Great Duck Island; and Australia monitors underwater temperature and brightness of light to protect the coral reef.

Using the IoT technologies for ecological environment monitoring brings the following advantages in the ecosystem monitoring and management:

1) transforming from a single-point monitoring station to a multi-point network monitoring application through networking and data sharing;
2) ensuring the real-time and dynamic observation and measurements by effectively adapting to the monitored objects' complexity and variability compared to the measurements made manually and by legacy systems;
3) enabling pro-active actions toward ecological events in advance rather than reacting after the events take place;

4) realizing a multi-level and unified management of the observation stations and systems;
5) observing the entire ecosystem rather than geographically divided areas or regions (i.e. by using a single point observation) in both macro and micro perspectives; and
6) analysing the relationships among ecological entities to ensure the sustainable ecosystem and its development.

Standardizing the IoT-based eco-environment monitoring systems brings the benefits such as the enablement of on-demand, real-time monitoring for eco-environment, the improvement in the interoperability among all standardized eco-environmental monitoring systems which include hardware and software to realize the EEM worldwide, the full utilization of the observed data for various kinds of eco-environment applications referring to comprehensive functions and services of EEM system including analysis of the relationships between various ecological entities, and the study of the changing trends of the ecosystem.

IoT-based monitoring systems also bring benefits for relevant stakeholders, including the users and builders of the IoT-based eco-environment monitoring systems. The users include the following:

– public users, citizens, data scientists for eco-environment;
– the monitoring organizations such as city environment monitoring organizations and wild area ecosystem monitoring organizations; and
– government agencies responsible for managing the entire ecosystem.

The builders are the developers of the communication modules and integrated devices, sensing devices, and monitoring service platforms for the IoT-based eco-environment monitoring systems.

INTERNET OF THINGS (IoT) – OVERVIEW AND GENERAL REQUIREMENTS OF IoT SYSTEM FOR ECOLOGICAL ENVIRONMENT MONITORING

1 Scope

This document specifies the Internet of Things system for ecological environment monitoring in terms of the following:

– system infrastructure and system entities of the IoT system for ecological environment monitoring for natural entities such as air, water, soil, living organisms; and

– the general requirements of the IoT system for ecological environment monitoring.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 9834-8:2014, *Information technology – Procedures for the operation of object identifier registration authorities – Part 8: Generation of universally unique identifiers (UUIDs) and their use in object identifiers*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1
ecological environment monitoring
EEM
process or activity that uses physical, chemical, biochemical, ecological and other technologies for the purpose of reflecting accurately, comprehensively, and in a timely manner the various elements of the ecological environment, the relationship between organisms and the environment, and the change trend of the ecosystem

Note 1 to entry: Elements of the ecological environment include air, water, soil, and living things.

4 Symbols and abbreviated terms

ASD	Application and Service Domain
EEM	ecological environment monitoring
GDPR	General Data Protection Regulation
GIS	geographic information service
HMI	human–machine interface