IEC PAS 63441

Edition 1.0 2022-10

PUBLICLY AVAILABLE SPECIFICATION

colour inside

Functional architecture of industrial internet system for industrial automation applications

IEC PAS 63441:2022-10(en)

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 It also gives information on projects, replaced and withdrawn publications.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.

IEC PAS 63441

Edition 1.0 2022-10

PUBLICLY AVAILABLE SPECIFICATION

colour inside

Functional architecture of industrial internet system for industrial automation applications

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 25.040

ISBN 978-2-8322-3964-3

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

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

FUNCTIONAL ARCHITECTURE OF INDUSTRIAL INTERNET SYSTEM FOR INDUSTRIAL AUTOMATION APPLICATIONS

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC 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 National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC 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 National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees 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 IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

A PAS is an intermediate specification made available to the public and needing a lower level of consensus than an International Standard to be approved by vote (simple majority).

IEC PAS 63441 has been processed by IEC technical committee 65: Industrial-process measurement, control and automation.

The text of this PAS is based on the following document:	This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document
Draft PAS	**Report on voting**
65/927/DPAS	65/933/RVDPAS

Following publication of this PAS, which is a pre-standard publication, the technical committee or subcommittee concerned may transform it into an International Standard.

This PAS shall remain valid for an initial maximum period of 2 years starting from the publication date. The validity may be extended for a single period up to a maximum of 2 years, at the end of which it shall be published as another type of normative document, or shall be withdrawn.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

For traditional plants, each piece of equipment is isolated, and the production data of equipment is collected manually, while the efficiency of manual statistics is also very low. With the continuous development of industrial automation, digitalization, and intelligent technologies, the intelligent and connected plant combined with "end-edge-cloud" collaboration extends the scope of the original plant and builds close ties between people and production equipment via data. In this way, it realizes the whole process with real-time interconnection between users, equipment and products, achieving zero distance between them, with transparent visibility of the whole process. In addition, the in-depth application of artificial intelligence and big data technologies in the industrial field contributes a large number of algorithms for intelligent optimization and decision-making, thus providing critical solutions for upgrading toward intelligent industrial systems.

FUNCTIONAL ARCHITECTURE OF INDUSTRIAL INTERNET SYSTEM FOR INDUSTRIAL AUTOMATION APPLICATIONS

1 Scope

This document defines the functional architecture and functional model of the industrial internet system for industrial applications. It presents the models, structures, activities, and interaction contents between layers of the end, edge, and cloud: infrastructure as a service (IaaS), platform as a service (PaaS), and software as service (SaaS), respectively.

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.

IEC 62264-1:2013, *Enterprise-control system integration – Part 1: Models and terminology*

IEC 62264-2:2013, *Enterprise-control system integration – Part 2: Object and attributes for enterprise-control system integration*

IEC 62264-3:2016, *Enterprise-control system integration – Part 3: Activity models of manufacturing operations management*

3 Terms, definitions, abbreviated terms, and acronyms

3.1 Terms and definition

For the purposes of this document, the terms and definitions given in IEC 62264-1, IEC 62264-2 and IEC 62264-3 as well as the following apply.

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

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

3.1.1
industrial application
software which is based on the industrial internet, carries industrial know-how and experience, and meets specific needs

3.1.2
industrial big data
generic term of industrial data including enterprise informatization data, industrial IoT data, and external cross-field data

3.1.3
industrial internet system
industrial cloud system that builds a service system based on massive data collection, aggregation, and analysis, and supports the ubiquitous connection of manufacturing resources, flexible supply, and efficient allocation

3.1.4
platform as a service
PaaS
business model providing the operation and development environment of application services as a cloud service

Note 1 to entry: PaaS is located between the IaaS and SaaS models and provides the development and operating environment for applications.

3.1.5
software as service
SaaS
model of providing software through the internet

Note 1 to entry: The vendor deploys applications on its own servers. Customers may order the required application services from vendors via the internet according to their actual needs, pay the vendor according to the number of services ordered and the period of services, and obtain the services through the internet.

3.1.6
infrastructure as a service
IaaS
model of utilization of all computing infrastructure as a service, including processing CPU, memory, storage, network, and other basic computing resources

Note 1 to entry: In this model, users are able to deploy and run any software, including operating systems and applications. Customers do not manage or control any cloud computing infrastructure, but are able to control the choice of operating system, storage space, deployed applications, and potentially obtain the control of restricted network components (such as routers, firewalls, and load balancers).

3.1.7
data management
process of efficiently collecting, storing, processing, and applying data using computer hardware and software technologies

3.1.8
microservice
independently deployable artifact providing a service implementing a specific functional part of an application

[SOURCE: ISO/IEC TS 23167:2020, 3.15]

3.1.9
microservices architecture
design approach that divides an application into a set of microservices

[SOURCE: ISO/IEC TS 23167:2020, 3.16]

3.1.10
cloud service
one or more capabilities offered via cloud computing invoked using a defined interface

[SOURCE: ISO/IEC 20924:2018, 3.1.8]

3.1.11
software defined networking
set of techniques that enables to directly program, orchestrate, control and manage network resources, which facilitate the design, delivery and operation of network services in a dynamic and scalable manner

[SOURCE: ISO/IEC TR 22417:2017, 3.9]

3.1.12
data processing
systematic performance of operations upon data

[SOURCE: ISO/IEC 2382-1:1993]

3.2 Abbreviated terms and acronyms

For the purposes of this document, the abbreviated terms and acronyms given the following apply.

API	Application Programming Interface
DCS	Distributed Control System
EAL	Edge Application Layer
ECS	Elastic Container Service
EFL	Edge Foundation Layer
EIP	Elastic IP
IaaS	Infrastructure as a Service
IP	Internet Protocol
LAN	Local Area Network
LoP	List of Properties
OPC UA	OPC Unified Architecture
PaaS	Platform as a Service
PLC	Programmable Logic Controller
PLM	Product Lifecycle Management
SaaS	Software as a Service
SLB	Server Load Balancer
SDN	Software Defined Networking
TSD	Time series data
TSN	Time Sensitive Networking
VPC	Virtual Private Cloud
VPN	Virtual Private Network

4 General

4.1 Function and architecture

4.1.1 Hierarchy

The overall functions of the industrial internet system include:

– Synchronous collection and transmission of multi-source heterogeneous data, such as industrial process data, video, and audio;

– Edge data processing and real-time condition perception: Use edge equipment to realize the connection and unified management of industrial process related equipment;

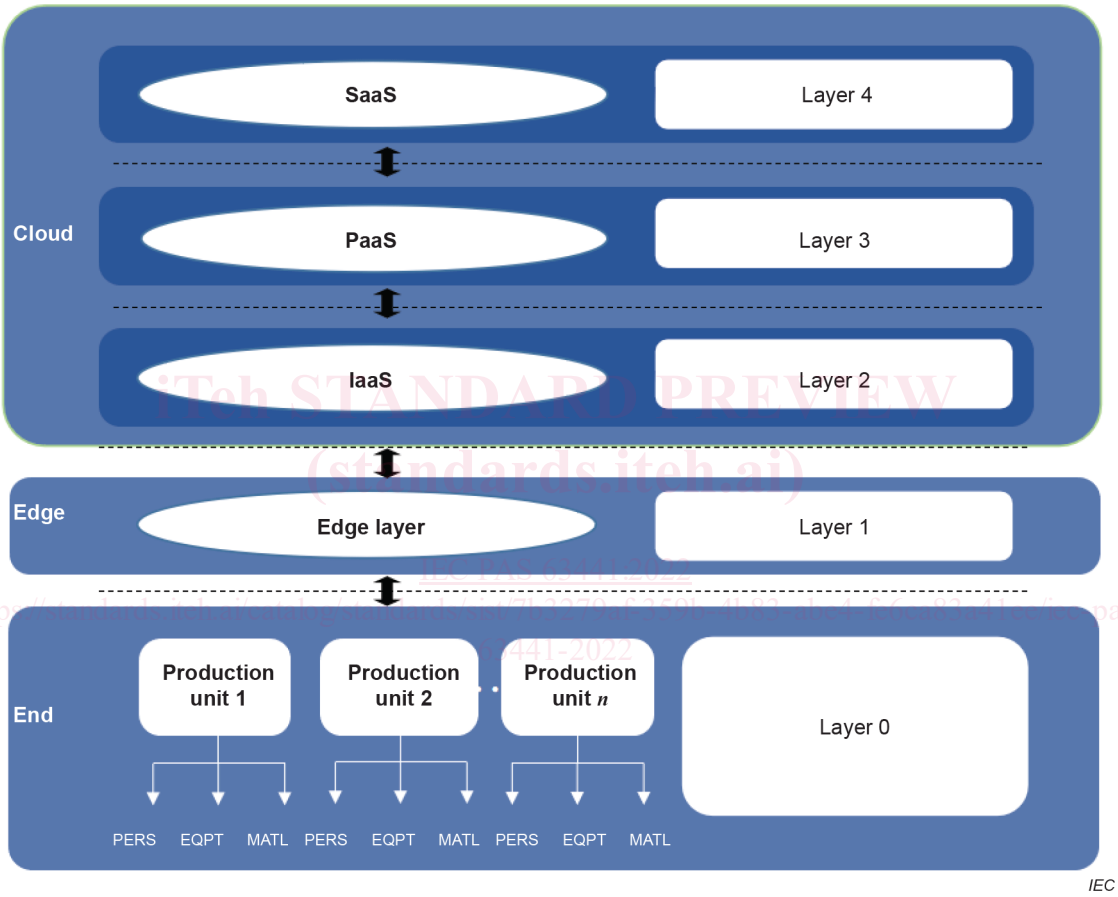
– Visual analysis and know-how database construction combining industrial mechanism with big data, so as to ensure data association analysis;

– Design, management and decision-making based on industrial data analysis to support personalized service requirements.

The industrial internet system includes end, edge, and cloud architecture. It is divided into 5 layers:

– Layer 0: end layer;
– Layer 1: edge layer;
– Layer 2: IaaS layer;
– Layer 3: PaaS layer;
– Layer 4: SaaS layer.

See Figure 1.



Key

PERS persons
EQPT equipment
MATL material

Figure 1 – Overall architecture of industrial internet system

4.1.2 Activities of End Layer (Layer 0)

Main activities of end layer:

– Provide data perception, collection, and storage in the process of industrial production activities;
– Provide equipment connection and network transmission environment in industrial production activities;
– Perform the tasks of production units in industrial production activities.