PD IEC PAS 63441:2022

BSI Standards Publication

Functional architecture of industrial internet system for industrial automation applications

Documents
Document Sharing Hub

Full document details: PD IEC PAS 63441:2022

National foreword

This Published Document is the UK implementation of IEC 63441:2022.

The UK participation in its preparation was entrusted to Technical Committee GEL/65, Measurement and control.

A list of organizations represented on this committee can be obtained on request to its committee manager.

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

This publication is not to be regarded as a British Standard.

© The British Standards Institution 2023
Published by BSI Standards Limited 2023

ISBN 978 0 539 22374 3

ICS 25.040

Compliance with a Published Document cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 January 2023.

Amendments/corrigenda issued since publication

Date	Text affected

Documents
Document Sharing Hub

Full document details: PD IEC PAS 63441:2022

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.

® Registered trademark of the International Electrotechnical Commission

Documents
Document Sharing Hub

Full document details: PD IEC PAS 63441:2022

CONTENTS

FOREWORD 4
INTRODUCTION 6
1 Scope 7
2 Normative references 7
3 Terms, definitions, abbreviated terms, and acronyms 7
3.1 Terms and definition 7
4 General 9
4.1 Function and architecture 9
4.1.1 Hierarchy 9
4.1.2 Activities of End Layer (Layer 0) 10
4.1.3 Activities of Edge Layer (Layer 1) 11
4.1.4 Activities of IaaS Layer (Layer 2) 11
4.1.5 Activities of PaaS Layer (Layer 3) 11
4.1.6 Activities of SaaS Layer (Layer 4) 11
4.1.7 Security 11
4.2 Functional Model 11
5 End layer 13
5.1 Overview 13
5.2 Model and architecture 13
5.3 Activities of End Layer 14
5.4 End Supports to Edge 14
6 Edge Layer 15
6.1 Overview 15
6.2 Model and architecture 15
6.3 Activities of Edge Layer 16
6.4 Edge Supports to IaaS 16
6.5 Edge Supports to PaaS 16
7 IaaS Layer 17
7.1 Overview 17
7.2 Model and architecture 17
7.3 Activities of IaaS Layer 18
7.4 IaaS Supports to PaaS 18
8 PaaS Layer 18
8.1 Overview 18
8.2 Model and Architecture 19
8.3 Activities of PaaS Layer 20
8.4 PaaS Supports to SaaS 20
9 SaaS Layer 20
9.1 Overview 20
9.2 Model and architecture 21
9.3 Activities of SaaS 21
Annex A (informative) Architecture Case of Industrial Internet System 22
A.1 Overview 22
A.2 Application cases 22
A.2.1 End and Edge Layer 22
A.2.2 IaaS Layer 23

AVA Documents
Document Sharing Hub

A.2.3 PaaS Layer 24
A.2.4 SaaS Layer 25
A.2.5 Smart Application Implementation of SaaS Platform 26
Annex B (informative) Architecture of Mass Customization Platform 29
Bibliography 31

Figure 1 – Overall architecture of industrial Internet system 10
Figure 2 – Functional model of industrial Internet 12
Figure 3 – Structure of end layer 14
Figure 4 – Functional model of edge layer 15
Figure 5 – Functional structure of IaaS 17
Figure 6 – Functional model of PaaS layer 19
Figure 7 – Functional model of SaaS 21
Figure A.1 – Overall architecture of the industrial Internet system in this case 22
Figure A.2 – Full lifecycle service framework of the end and edge layer 23
Figure A.3 – IaaS framework 24
Figure A.4 – PaaS service architecture 25
Figure A.5 – Service pattern framework of SaaS 26
Figure A.6 – Equipment management application architecture 27
Figure A.7 – Energy management application architecture 28
Figure B.1 – Overall technical architecture of mass customization platform 29

Documents
Document Sharing Hub

Full document details: PD IEC PAS 63441:2022

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.

Documents
Document Sharing Hub

Full document details: PD IEC PAS 63441:2022

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.

Documents
Document Sharing Hub

Full document details: PD IEC PAS 63441:2022

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.

Documents
Document Sharing Hub

Full document details: PD IEC PAS 63441:2022

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

AVA Documents
Document Sharing Hub

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]

Documents
Document Sharing Hub

Full document details: PD IEC PAS 63441:2022

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.

Documents
Document Sharing Hub

Full document details: PD IEC PAS 63441:2022