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TECHNICAL REPORT

IIoT applications in power distribution systems management: Architecture and functional requirements

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IIoT applications in power distribution systems management: Architecture and functional requirements

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1 Scope

This technical report provides the general architecture and system components for applying the IoT technology in power distribution networks. It describes the system architecture, system components and several typical applications in integration and intelligent management of power distribution networks.

2 Normative references

There are no normative references in this document.

Bibliography

[1] ISO/IEC 20924:2024, *Internet of Things (IoT) and digital twin - Vocabulary*

[2] ISO/IEC 17788:2014, *Information technology - Cloud computing - Overview and vocabulary*

[3] ISO/IEC 23188:2020, *Information technology - Cloud computing - Edge computing landscape*

[4] ISO/IEC/IEEE 42010, *Systems and software engineering - Architecture description*

[5] ISO/IEC 30141:2018, *Internet of Things (IoT) - Reference Architecture*

[6] IEC TR 62357-1, *Power systems management and associated information exchange - Part 1: Reference architecture*

[7] IEC 60870-5-101, *Telecontrol equipment and systems - Part 5-101: Transmission protocols - Companion standard for basic telecontrol tasks*

[8] IEC 62351 (all parts), *Power systems management and associated information exchange - Data and communications security*

[9] IEC 60870-5-104, *Telecontrol equipment and systems - Part 5-104: Transmission protocols - Network access for IEC 60870-5-101 using standard transport profiles*

[10] IEC 62056 (all parts), *Electricity metering data exchange*

[11] IEC 61850 (all parts), *Communication networks and systems for power utility automation*

[12] IEC TR 61850-90-6:2018, *Communication networks and systems for power utility automation - Part 90-6: Use of IEC 61850 for Distribution Automation Systems*

[13] IEEE 1815, *Standard Profile for Communications with Distributed Energy Resources (DERs) using IEEE Std 1815 [Distributed Network Protocol (DNP3)]*

[14] IEEE 1815-1, *IEEE Standard for Exchanging Information Between Networks Implementing IEC 61850 and IEEE Std 1815(TM) [Distributed Network Protocol (DNP3)]*

[15] IEC 61850-8-1, *Communication networks and systems for power utility automation - Part 8-1: Specific communication service mapping (SCSM) - Mappings to MMS (ISO 9506-1 and ISO 9506-2) and to ISO/IEC 8802-3*

[16] IEC 61850-8-2, *Communication networks and systems for power utility automation - Part 8-2: Specific communication service mapping (SCSM) - Mapping to Extensible Messaging Presence Protocol (XMPP)*

[17] IEC TS 61850-80-1, *Communication networks and systems for power utility automation - Part 80-1: Guideline to exchanging information from a CDC-based data model using IEC 60870-5-101 or IEC 60870-5-104*

[18] IEC 61850-7-2, *Communication networks and systems for power utility automation - Part 7-2: Basic information and communication structure - Abstract communication service interface (ACSI)*

[19] IEC 61850-7-3, *Communication networks and systems for power utility automation – Part 7-3: Basic communication structure - Common data classes*

[20] IEC TR 61850-90-5, *Communication networks and systems for power utility automation - Part 90-5: Use of IEC 61850 to transmit synchrophasor information according to IEEE C37.118*

[21] IEC 61850-7-4:2010, *Communication networks and systems for power utility automation - Part 7-4: Basic communication structure - Compatible logical node classes and data object classes*

[22] IEC 61850-7-420, *Communication networks and systems for power utility automation - Part 7-420: Basic communication structure - Distributed energy resources and distribution automation logical nodes*

[23] IEC TR 61850-90-3, *Communication networks and systems for power utility automation - Part 90-3: Using IEC 61850 for condition monitoring diagnosis and analysis*

[24] IEC 62271-3, *High-voltage switchgear and controlgear - Part 3: Digital interfaces based on IEC 61850*

[25] IEC 62271 (all parts), *High-voltage switchgear and controlgear*

[26] IEC 61869-9, *Instrument transformers - Part 9: Digital interface for instrument transformers*

[27] IEC TR 62689-100, *Current and voltage sensors or detectors, to be used for fault passage indication purposes - Part 100: Requirements and proposals for the IEC 61850 series data model extensions to support fault passage indicators applications*

[28] ISO/IEC 30101, *Information technology - Sensor networks: Sensor network and its interfaces for smart grid system*

[29] ISO/IEC 30144, *Internet of things (IoT) - Wireless sensor network system supporting electrical power substation*

[30] IEEE 1366, *IEEE Guide for Electric Power Distribution Reliability Indices*

[31] IEC 60255 (all parts), *Measuring relays and protection equipment*

[32] IEC 61000-4-30, *Electromagnetic compatibility (EMC) - Part 4-30: Testing and measurement techniques - Power quality measurement methods*

[33] IEC 60870-5 (all parts), *Telecontrol equipment and systems*

[34] IEC 61968 (all parts), *Application integration at electric utilities - System interfaces for distribution management*

[35] IEC 61970 (all parts), *Energy management system application program interface (EMS-API)*

[36] IEC 62325 (all parts), *Framework for energy market communications*

[37] *Reduction of technical and non-technical losses in distribution networks*, CIRED, 2015 (http://www.cired.net/files/download/188)

[38] IEC 61588, *Precision Clock Synchronization Protocol for Networked Measurement and Control Systems*

[39] IEC 61968-1:2020, *Application integration at electric utilities - System interfaces for distribution management - Part 1: Interface architecture and general recommendations*

[40] IEC 61968-3:2021, *Application integration at electric utilities - System interfaces for distribution management - Part 3: Interface for network operations*

[41] IEC 61968-9:2024, *Enterprise business function interfaces for utility operations - Part 9: Interfaces for meter reading and control*

[42] IEC 61968-11:2013, *Application integration at electric utilities - System interfaces for distribution management - Part 11: Common information model (CIM) extensions for distribution*

[43] IEC 61970-301:2020, *Energy management system application program interface (EMS-API) - Part 301: Common information model (CIM) base*

[44] IEC 61970-302:2024, *Energy management system application program interface (EMS-API) - Part 302: Common information model (CIM) dynamics*

[45] IEC 62055 (all parts), *Electricity metering - Payment systems*

[46] ISO/IEC/IEEE 42010, *Systems and software engineering - Architecture description*

[47] ISO/IEC 20922:2016, *Information technology - Message Queuing Telemetry Transport (MQTT) v3.1.1*

[48] ISO/IEC 21823-1:2019, *Internet of things (IoT) - Interoperability for internet of things systems — Part 1: Framework*

[49] ISO/IEC 29161:2016, *Information technology - Data structure - Unique identification for the Internet of Things*

[50] ISO/IEC 30118-1:2018, *Information technology - Open Connectivity Foundation (OCF) Specification -- Part 1: Core specification*

[51] ISO/IEC 30118-4:2018, *Information technology - Open Connectivity Foundation (OCF) Specification - Part 4: Resource type specification*

[52] IEC TS 62351-1:2007, *Power systems management and associated information exchange - Data and communications security - Part 1: Communication network and system security - Introduction to security issues*

[53] ISO/IEC 30165:2019, *Internet of Things (IoT) - Real-time IoT framework*

[54] ISO/IEC 30164:2019, *Internet of things (IoT) - Edge Computing*

[55] ISO/IEC 30160, *Internet of Things (IoT) - Application framework for industrial facility demand response energy management*

[56] ISO/IEC 30161, *Internet of Things (IoT) - Requirements of IoT data exchange platform for various IoT services*

[57] ISO/IEC 30162, *Internet of Things (IoT) - Compatibility requirements and model for devices within industrial IoT systems*

[58] ISO/IEC 30101:2014, *Information technology - Sensor networks: Sensor network and its interfaces for smart grid system*

[59] ISO 15118-3:2015, *Road vehicles - Vehicle to grid communication interface - Part 3: Physical and data link layer requirements*

[60] ISO/IEC 12139-1:2009, *Information technology - Telecommunications and information exchange between systems - Powerline communication (PLC) - High speed PLC medium access control (MAC) and physical layer (PHY) - Part 1: General requirements*

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