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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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UK Vote

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



JTC1-SC41/126/CD

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SECRETARIAT:

Korea, Republic of

SECRETARY:

Ms Jooran Lee

OF INTEREST TO THE FOLLOWING COMMITTEES:

PROPOSED HORIZONTAL STANDARD:



Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.

FUNCTIONS CONCERNED:

☐ EMC

☐ ENVIRONMENT

☐ QUALITY ASSURANCE

☐ SAFETY

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Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

TITLE:

Internet of Things (IoT) - Compatibility requirements and model for devices within industrial IoT systems

NOTE FROM TC/SC OFFICERS:

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ISO/IEC 30162 INTERNET OF THINGS (IoT) – COMPATIBILITY REQUIREMENTS AND MODEL FOR DEVICES WITHIN INDUSTRIAL IoT SYSTEMS

FOREWORD

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

FDIS	Report on voting
XX/XX/FDIS	XX/XX/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

116 The committee has decided that the contents of this document will remain unchanged until the
117 stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to
118 the specific document. At this date, the document will be

- 119 • reconfirmed,
- 120 • withdrawn,
- 121 • replaced by a revised edition, or
- 122 • amended.

123

124 The National Committees are requested to note that for this document the stability date
125 is 20XX.

126 THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE
127 DELETED AT THE PUBLICATION STAGE.

128

129

INTRODUCTION

130 Dynamic growth and embracing of digital technologies in all spheres of human life has
131 created the conducive basis for transitioning toward the Digital Economy, while adoption of
132 Industrial Internet of Things (IIoT) is one of the major technology directions of the digital
133 economy growth. As it is essential to implement IIoT technologies in enterprises worldwide,
134 the issue of practical aspects in the realization of the IIoT concepts has gained vital
135 importance. In particular, one of the existing problems is unavailability of transparent
136 mechanisms in terms of how and in what way to establish connections of industrial equipment
137 to cloud platforms designed for data collection and analysis.

138 As soon as numerical programmable tools became widely available, the development of
139 technologies and protocols enabling management and control of the industrial equipment
140 control software utility within an enterprise network became necessary. At that time,
141 management of such control utility over Internet was out of question. In parallel, a number of
142 concerns initiated due to the design and development of proprietary technologies and
143 protocols; in most cases, they are incompatible ones with another. Since such technologies
144 and protocols were the intellectual property (IP) of the relevant enterprise, no legal framework
145 describing structure and operation principles of such technologies and protocols existed. As
146 the IIoT concept started to appear, activities aimed to standardize and document the
147 previously developed technologies and protocols began. As a result of the analysis of existing
148 protocols elements, a document having a general list or register of protocols was developed.
149 Notwithstanding, the compiled document, it contained just descriptions of the existing set of
150 technologies and protocols, without the information about their compatibility of interacting
151 between them, or about the methods of connecting to cloud-based platforms. Each
152 manufacturer built the systems based on those protocols that the manufacturer considered to
153 be the most suitable for solving specific tasks. Numerous manufacture's equipment use
154 specific protocols that were specially developed by the manufactures for the management and
155 data delivery tasks for different industrial solutions. For instance, the protocols described in
156 IEC 60870-5-101/103/104, Modbus, DNP3, etc. were widely used. Protocols without any
157 reference to standards could not exploit the same data transmission mechanisms.

158 At the initial stages, developers and large enterprises insisted on using their own proprietary
159 protocols arguing that their protocols were designed and developed for executing specific
160 functions. For instance, IEC 61850 standard (describing some protocols) is widely applied for
161 power substations while Modbus is used for transmitting raw data from pressure sensors.
162 CAN technology is mostly adopted in the automotive industry and robotics. As a variety of
163 protocol versions started to emerge, different version and metadata format incompatibility
164 became apparent. A majority of production hardware supports Modbus-RTU and Modbus-
165 ASCII, while a more advanced version of Modbus-TCP protocol no longer requires such
166 complications as RTU and ASCII. The major problems are data conversion from one protocol
167 to another and protocol identification using certain attributes (semantic) for seamless
168 interoperability of the IIoT devices and platforms. The interoperability issues can be resolved
169 by defining particular compatibility requirements for the IIoT devices, applications, systems,
170 components, and other IIoT entities.

171 This standard describes compatibility requirements for various entities of the IIoT solutions
172 that can be used as guidance for connecting, configuring and testing of industrial hardware.

ISO/IEC 30162 INTERNET OF THINGS (IoT) – COMPATIBILITY REQUIREMENTS AND MODEL FOR DEVICES WITHIN INDUSTRIAL IoT SYSTEMS

1 Scope

This document specifies network models for IIoT connectivity and general compatibility requirements for devices and networks within IIoT systems in terms of:

- data transmission protocols interaction;
- distributed data interoperability & management;
- connectivity framework;
- connectivity transport;
- connectivity network;
- best practices and guidance to use in IIoT area.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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>

Industrial Internet of Things (IIoT)

An Internet of things based enabling approach for industrial transformation, by taking advantage of existing and emerging information and communication technologies.

[SOURCE: ITU-T Y.4003]

Compatibility

Degree to which a product, system or component can exchange information with other products, systems or components, and/or perform its required functions, while sharing the same hardware or software environment. This characteristic is composed of the following subcharacteristics: co-existence, interoperability.

[SOURCE: ISO/IEC 25010:2011]

Co-existence

Degree to which a product can perform its required functions efficiently while sharing a common environment and resources with other products, without detrimental impact on any other product.

[SOURCE: ISO/IEC 25010:2011]

Interoperability

Degree to which two or more systems, products or components can exchange information and use the information that has been exchanged.

[SOURCE: ISO/IEC 25010:2011]

IloT Compatibility

Degree to which an industrial system, information resource or other IloT entity¹ that can exchange information with any other IloT entities, through the special IloT services or without it, and/or perform its required functions, while sharing the same hardware/software environment and network.

[SOURCE: Modified from ISO/IEC 25010:2011, modified]

4 Classification

As defined in ISO/IEC 30141, the physical entities of IoT and IloT devices are:

- Sensors;
- Actuators.

5 IloT compatibility

5.1 Compatibility aspects

The compatibility requirements aspect is a separate part of the requirements combined at different technological levels.

Compatibility aspects for the IloT entities are represented by both functional and non-functional aspects.

5.1.1 Functional compatibility requirements for the IloT entities

To determine functional compatibility requirements for the IloT entities, the appropriate aspects should be defined as follows:

- Physical aspect. Ensuring the IloT entities' compatibility with regard to data transmission media should address the issues of using the same media for exchanging signals between physical interfaces of data transceivers, of the format for transmitting the signals over the physical channel (analogue, digital) as well as of ensuring the electro-magnetic compatibility [ISO/IEC 7498-1, IEC 61000-1-2:2016, IEC 60950-1:2005 + AMD1:2009 + AMD2:2013, IEC 62368-1:2014];
- Media Access Control (MAC) aspect. Ensuring the IloT entities' compatibility at MAC layer should agree on the implementation of controlling the access to data transmission media; addressing possible issues, including the detection and resolution of the network frame collisions; assigning addresses to the nodes in the local area network (LAN) [IEEE 802.1AC-2012, IETF RFC 2637, IETF RFC 2341, IETF RFC 2661].
- Logical Link Control (LLC) aspect. Ensuring the IloT entities' compatibility with regard to data transmission over the provisioned logical link should: (1) help with combining networks of different topologies; (2) support network frame generation and efficient error correction when errors occur during data transmission at MAC level; and (3) facilitate proper data transmission control over the established communications channel [IEEE 802.2-1994];
- Network aspect. Ensuring the IloT entities' compatibility at the network layer should be required for the support of unified addressing scheme and routing of messages. It also helps with quality control, managing and reconfiguring the network logical topology [ISO/IEC 7498-1, IETF RFC 791];
- Transport aspect. Ensuring the IloT entities' compatibility should consider the multiplexing/de-multiplexing compatibility and support of matching options, e.g., for the data transmission over the established connection, control of this transmission, and others [ITU-T X.224, ITU-T X.225, ITU-T X.234, IETF RFC 1122];
- Session aspect. Ensuring the IloT entities' compatibility should consider the mechanism for communications session set-up and completion over global networks and maintaining and synchronizing sessions [ITU-T X.224, ITU-T X.225, ITU-T X.234, IETF RFC 1122];

1 Further referred as "IloT entity"

- Data Presentation aspect. Ensuring the compatibility at data presentation layer should address possible issues related to different data formats by using special-purpose protocols, covers data coding/decoding according to these protocols and data compression prior to its transmission over a network [W3C Extensible Markup Language (XML) 1.0 (Fifth Edition), IETF RFC 4506, IETF RFC 7303];
- Application aspect. Ensuring the compatibility at the application layer should address possible issues of accessing the network services, exchanging application specific service messages, error detection and correction [ISO/IEC 7498-1];
- Measuring and automation aspect. Ensuring the compatibility of measuring and automation of the IIoT devices (sensors, actuators), and application and services, it should guarantee the compatibility of the physical interfaces of IIoT sensors/actuators to address issues of interoperating heterogeneous sensors, actuators, and IIoT applications and services [ITU-T H.810, ITU-T H.811]; and
- Semantic aspect. Ensure the semantic compatibility should address the issues of correct interpretation of the information which IIoT devices exchange among each other [ITU-T Y.4111/Y.2076];

5.1.2 Non-functional compatibility requirements for the IIoT entities

To determine non-functional compatibility requirements for the IIoT entities, the appropriate aspects should be defined as follows:

- Version aspect. Ensuring the version compatibility should aim at providing the capability of interoperation of any earlier or later version of the same software (backward and forward compatibility, respectively) [ISO/IEC/IEEE 9945];
- QoS management aspect. Ensuring the compatibility of QoS management methods should address possible issues of timely processing data, processing data of various types, optimization factors such as selection of data delivery route, etc. [ITU-T G.1010, IETF RFC 4594];
- Security aspect. Ensuring the compatibility of methods supporting security of IIoT entities should address the gaps in design and implementation of protection mechanisms and ensures the trustworthiness aspects of these solutions such as data confidentiality and integrity, availability and reliability of service provision, privacy, safety, and resilience of systems and overall IIoT infrastructure [ISO/IEC 27000-27009, ITU-T X.1362, ITU-T Y.4806].
- Compliance aspect. Ensuring the compatibility to international, national, and industry standards, guidelines, laws and regulation should facilitate the creation of the global informational environment which is used in conformity with a law and boost the transfer of technologies in a way that is considered appropriate for the particular state, administrative unit, community, or industrial sector.

5.2 Compatibility levels

The following compatibility levels for the different aspects of the IIoT entities should be defined.

- Fully compatible. In the industrial systems, information resources or other IIoT entities shall be capable of exchanging information and performing their required functions in a shared environment without any needs in modifying their input and/or output interfaces, protocols, software and hardware means or introducing converting devices (adapters, gateways, etc.).
- Compatible. In the industrial systems, information resources or other IIoT entities shall be capable of exchanging information and performing their required functions in a shared environment by adapting their input and/or output interfaces, used protocols, software and hardware means to each other or to the environment, or introducing converting devices (adapters, gateways, etc.).
- Partially compatible. The industrial systems, information resources or other IIoT entities shall be capable of exchanging information to some extent and performing a constrained set of their required functions in a shared environment, probably with a help of additional tools unifying or converting their input and/or output interfaces, used

protocols, procedures implemented by their software and hardware means. The partial compatibility may be reached by negotiating the acceptable constraints on functionality among the parties.

- Incompatible. The industrial systems, information resources or other IIoT entities are not capable of exchanging information and performing even a constrained set of their required functions in a shared environment due to the drastic differences in technology, functional or non-functional requirements.

6 Compatibility level definition and requirements per aspect

6.1 Physical aspect

In order to ensure compatibility of IIoT entities with regard to the physical aspect the following requirements should be met:

- Data transmission media compatibility. Any network node should support data transmit/receive over the same transmission media or have in place devices ensuring interoperation of segments transmitting data over different media (wireline: electrical line, copper wire, fiber-optic; wireless: radio-channels, laser, etc.). Compatibility levels in regard to data transmission media support:
 1. Fully compatible. Nodes use one and the same data transmission media.
 2. Incompatible. Special adaptors should be employed for compatibility of nodes in the network.
- Data transmit/receive system compatibility. Physical interfaces of nodes connected to the network should support data transmit/receive based on the selected format of information transmission in the network (analogue, digital). Compatibility levels:
 1. Fully compatible. Network nodes use identical data transmission formats (Example: PSTN device-PSTN device, radio transmitter – radio receiver).
 2. Compatible, if digital-to-analog, analog-to-digital converters are used.
- Electromagnetic compatibility. If wireless data transmission media is used for data transmission in a given network, it is required to ensure network devices' electromagnetic compatibility according to IEC 61000 Electromagnetic Compatibility (EMC) group of standards.

6.2 MAC aspect

To ensure IIoT solution compatibility with regard to the media access the following requirements should be met:

- Media access compatibility. To correctly access data transmission media (DTM), transmit/receive network interfaces of network nodes connected to the common media should have common DTM access synchronization system. Compatibility levels:
 1. Fully compatible. Nodes having access to data transmission media operate on the basis of the same DTM access control technology (Example: CSMA/CA — CSMA/CA).
- Incompatible. Nodes having access to data transmission media operate on the basis of various DTM access control technologies (Example: DTDMA — CSMA/CA).
- Addressing framework compatibility. To ensure correct data exchanges in the MAC layer it is required to provide a common single addressing framework for all the nodes connected to the network. Compatibility levels:
 1. Fully compatible. Network nodes adhere to the common single link layer addressing framework (Example: MAC-48 — MAC-48).
 2. Compatible. Network nodes have different link layer addressing frameworks, but translation mechanisms are provided (Example: EUI-48 — EUI-64).
 3. Incompatible. Network nodes follow different incompatible link layer addressing frameworks (Example: IAB — EUI-64).