

Edition 1.0 2018-08

INTERNATIONAL STANDARD



Internet of Things (IoT) – Reference architecture





THIS PUBLICATION IS COPYRIGHT PROTECTED Copyright © 2018 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 Central Office 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 corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad

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 It also gives information on projects, replaced and withdrawn publications.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 also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing 21 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

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.



Edition 1.0 2018-08

INTERNATIONAL STANDARD



Internet of Things (IoT) - Reference architecture

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ICS 35.020 ISBN 978-2-8322-5972-6

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

CONTENTS

Г	JREWUR	XU	o			
IN	ITRODUC	CTION	7			
1	Scope		9			
2	Norma	Normative references				
3	Terms and definitions					
4	Abbre	Abbreviated terms				
5		Internet of Things Reference Architecture (IoT RA) conformance				
6	IoT RA goals and objectives					
		General				
		Characteristics				
		Conceptual Model				
		Reference Model and architecture views				
7	Chara	cteristics of IoT systems	12			
	7.1	General	12			
	7.2	oT system trustworthiness characteristics	13			
	7.2.1	General				
	7.2.2	Availability	14			
	7.2.3	Confidentiality	14			
	7.2.4	Integrity	15			
	7.2.5	Protection of personally identifiable information (PII)	15			
	7.2.6	Reliability	16			
	7.2.7	Resilience				
	7.2.8	Safety				
		oT system architecture characteristics				
	7.3.1	Composability				
	7.3.2	Functional and management capability separation				
	7.3.3	Heterogeneity				
	7.3.4	Highly distributed systems				
	7.3.5	Legacy support				
	7.3.6 7.3.7	Modularity				
	_	Network connectivity				
	7.3.8 7.3.9	ScalabilityShareability				
	7.3.9	•				
	7.3.10	•				
		oT system functional characteristics				
	7.4.1	Accuracy				
	7.4.2	Auto-configuration				
	7.4.3	Compliance				
	7.4.4	Content-awareness				
	7.4.5	Context-awareness				
	7.4.6	Data characteristics – volume, velocity, veracity, variability and variety				
	7.4.7	Discoverability				
	7.4.8	Flexibility				
	7.4.9	Manageability				
	7 4 10	•	29			

	7.4.11	Network management and operation	30
	7.4.12	Real-time capability	31
	7.4.13	Self-description	31
	7.4.14	Service subscription	32
8	IoT Cond	eptual Model (CM)	32
	8.1 Mai	n purpose	32
	8.2 Cor	ncepts in the IoT CM	33
	8.2.1	IoT entities and domains	33
	8.2.2	Identity	35
	8.2.3	Services, network, IoT device and IoT gateway	36
	8.2.4	IoT-User	38
	8.2.5	Virtual entity, Physical Entity and IoT device	39
	8.3 Hig	h level view of CM	41
9	IoT Refe	rence Model (RM)	42
	9.1 The	e IoT Reference Model context	42
	9.2 IoT	RMs	42
	9.2.1	Entity-based RM	42
	9.2.2	Domain-based RM	44
	9.2.3	Relation between entity-based RM and domain-based RM	46
10	IoT Refe	rence Architecture (RA) views	46
	10.1 Gei	neral description	46
		RA functional view	
	10.2.1	General	
	10.2.2	Intra-domain functional components	
	10.2.3	Cross-domain capabilities	
	10.3 loT	RA system deployment view	
	10.3.1	General	
	10.3.2	Systems/sub-systems in Physical Entity Domain (PED)	
	10.3.3	Systems/sub-systems in Sensing & Controlling Domain (SCD)	
	10.3.4	Systems/sub-systems in Application & Service Domain (ASD)	
	10.3.5	Systems/sub-systems in Operation & Management Domain (OMD)	
	10.3.6	Systems/sub-systems in User Domain (UD)	53
	10.3.7	Systems/sub-systems in Resource Access & Interchange Domain (RAID)	
	10.4 IoT	RA networking view	
	10.4.1	Communications networks	
	10.4.2	Communication networks implementation	55
	10.5 IoT	RA usage view	
	10.5.1	General description	
	10.5.2	Description of the roles, sub-roles and related activities	
	10.5.3	Mapping activities, roles and IoT systems in domains	
11	IoT trustv	vorthiness	
	11.1 Gei	neral	64
		ety	
		curity	
	11.3.1	General	
	11.3.2	IoT system Information Security Management System (ISMS)	
	11.3.3	IoT system & product Security Life Cycle Reference Model	
		vacy and PII Protection	69

11.5 Reliability		72			
11.6 Resilience		73			
11.7 Trustworthiness and the	Reference Architecture	74			
Annex A (informative) Interpreting	UML Class diagram for Conceptual Model	76			
Annex B (informative) Entity relationship tables for the CM					
B.1 IoT entities and domains	·	77			
	evice and IoT gateway				
	ntity and IoT device				
	tween CM, RMs and RAs				
Bibliography		83			
		_			
	Architecture to context specific architecture				
•					
	ws				
	epts of the CM				
Figure 5 – Domain interactions of t	he CM	34			
Figure 6 – Identity concept of the C	CM	35			
Figure 7 – Service, network, IoT de	evice and IoT gateway concepts of the CM	36			
Figure 8 – IoT-User concepts of the	e CM	38			
Figure 9 – Virtual entity, Physical E	Entity, and IoT device concepts of the CM	39			
Figure 10 – High level view of CM.		41			
Figure 11 – Entity-based IoT RM		42			
	tionship, and representative conceptual entities in	44			
Figure 13 – Domain-based IoT RM		44			
_	y-based RM and domain-based RM				
•	, -decomposition of IoT RA functional components				
•	ment view				
• • • • • • • • • • • • • • • • • • • •	N				
•	e system is in use				
·	b-roles and activities				
-	sub-roles and activities				
-	I activities				
•	d application development				
•	security-related analytics and operations				
•	fe Cycle Reference Model				
	Te Cycle Reference Moder				
•					
•					
rigure C.1 – Relation between 101	CM, RM, and RA	02			
Table 1 – Characteristics of IoT sys	stems	13			
·	d roles				

Table B.1 – Entity	77
Table B.2 – Domain	77
Table B.3 – Digital Entity	77
Table B.4 – Physical Entity	77
Table B.5 – IoT-User	77
Table B.6 – Network	78
Table B.7 – Identifier	78
Table B.8 – Endpoint	78
Table B.9 – IoT gateway	78
Table B.10 – IoT device	79
Table B.11 – Service	79
Table B.12 – Human user	79
Table B.13 – Digital user	79
Table B.14 – Application	80
Table B.15 – Sensor	80
Table B.16 – Actuator	80
Table B.17 – Virtual entity	80