

ISO/IEC 30141:2018-08 (E)

Internet of Things (IoT) - Reference Architecture

CONTENTS

- FOREWORD 6
- INTRODUCTION 7
- 1 Scope 9
- 2 Normative references 9
- 3 Terms and definitions 9
- 4 Abbreviated terms 9
- 5 Internet of Things Reference Architecture (IoT RA) conformance 10
- 6 IoT RA goals and objectives 10
 - 6.1 General 10
 - 6.2 Characteristics 11
 - 6.3 Conceptual Model 11
 - 6.4 Reference Model and architecture views 11
- 7 Characteristics of IoT systems 12
 - 7.1 General 12
 - 7.2 IoT system trustworthiness characteristics 13
 - 7.2.1 General 13
 - 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 17
 - 7.2.8 Safety 17
 - 7.3 IoT system architecture characteristics 18
 - 7.3.1 Composability 18
 - 7.3.2 Functional and management capability separation 18
 - 7.3.3 Heterogeneity 19
 - 7.3.4 Highly distributed systems 20
 - 7.3.5 Legacy support 20
 - 7.3.6 Modularity 21
 - 7.3.7 Network connectivity 21
 - 7.3.8 Scalability 22
 - 7.3.9 Shareability 22
 - 7.3.10 Unique identification 23
 - 7.3.11 Well-defined components 23
 - 7.4 IoT system functional characteristics 24
 - 7.4.1 Accuracy 24
 - 7.4.2 Auto-configuration 25
 - 7.4.3 Compliance 25
 - 7.4.4 Content-awareness 26
 - 7.4.5 Context-awareness 26
 - 7.4.6 Data characteristics – volume, velocity, veracity, variability and variety 27

7.4.7	Discoverability	27
7.4.8	Flexibility	28
7.4.9	Manageability	29
7.4.10	Network communication.....	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 Conceptual Model (CM).....	32
8.1	Main purpose	32
8.2	Concepts 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	High level view of CM	41
9	IoT Reference Model (RM).....	42
9.1	The 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 Reference Architecture (RA) views	46
10.1	General description.....	46
10.2	IoT RA functional view	47
10.2.1	General	47
10.2.2	Intra-domain functional components	47
10.2.3	Cross-domain capabilities.....	50
10.3	IoT RA system deployment view	51
10.3.1	General	51
10.3.2	Systems/sub-systems in Physical Entity Domain (PED)	52
10.3.3	Systems/sub-systems in Sensing & Controlling Domain (SCD)	52
10.3.4	Systems/sub-systems in Application & Service Domain (ASD)	52
10.3.5	Systems/sub-systems in Operation & Management Domain (OMD).....	53
10.3.6	Systems/sub-systems in User Domain (UD).....	53
10.3.7	Systems/sub-systems in Resource Access & Interchange Domain (RAID)	53
10.4	IoT RA networking view	54
10.4.1	Communications networks	54
10.4.2	Communication networks implementation	55
10.5	IoT RA usage view.....	56
10.5.1	General description	56
10.5.2	Description of the roles, sub-roles and related activities	56
10.5.3	Mapping activities, roles and IoT systems in domains	61

11	IoT trustworthiness	64
11.1	General.....	64
11.2	Safety	65
11.3	Security	66
11.3.1	General	66
11.3.2	IoT system Information Security Management System (ISMS)	66
11.3.3	IoT system & product Security Life Cycle Reference Model	68
11.4	Privacy 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	77
B.1	IoT entities and domains	77
B.2	Identity.....	78
B.3	Services, network, IoT device and IoT gateway.....	78
B.4	IoT-User	79
B.5	Virtual entity, Physical Entity and IoT device.....	80
Annex C (informative)	Relation between CM, RMs and RAs	81
Bibliography	83
Figure 1	– From generic Reference Architecture to context specific architecture	8
Figure 2	– IoT RA structure.....	11
Figure 3	– RM and architecture views	12
Figure 4	– Entity and domain concepts of the CM	33
Figure 5	– Domain interactions of the CM	34
Figure 6	– Identity concept of the CM.....	35
Figure 7	– Service, network, IoT device and IoT gateway concepts of the CM.....	36
Figure 8	– IoT-User concepts of the CM.....	38
Figure 9	– Virtual entity, Physical Entity, and IoT device concepts of the CM	39
Figure 10	– High level view of CM.....	41
Figure 11	– Entity-based IoT RM.....	42
Figure 12	– Domain and entity relationship, and representative conceptual entities in IoT systems	44
Figure 13	– Domain-based IoT RM.....	44
Figure 14	– Relation between entity-based RM and domain-based RM	46
Figure 15	– IoT RA functional view –decomposition of IoT RA functional components.....	47
Figure 16	– IoT RA system deployment view.....	52
Figure 17	– IoT RA networking view.....	54
Figure 18	– Roles present when the system is in use	57
Figure 19	– IoT service provider sub-roles and activities.....	59
Figure 20	– IoT service developer sub-roles and activities	60
Figure 21	IoT User sub roles and activities	61

Figure 22 – Activities of device and application development	63
Figure 23 – Using device data for security-related analytics and operations	64
Figure 24 – IoT product Security Life Cycle Reference Model	69
Figure A.1 – Generalization	76
Figure A.2 – Association	76
Figure C.1 – Relation between IoT CM, RM, and RA.....	82
Table 1 – Characteristics of IoT systems.....	13
Table 2 – Overview of activities and roles	62
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