



TECHNICAL REPORT

SmartM2M; IoT Standards landscape and future evolutions

iTeh STANDARDS PREVIEW
(standards.iteh.ai)
Full standard/sist/dec4921e-
<https://standards.iteh.ai/catalog/standards/sist/dec4921e-cb1b-4d1d-bbba-ae67e048dd72/etsi-tr-103-375-v1.1.1-2016-10>

ReferenceDTR/SmartM2M-103375

KeywordsIoT, M2M

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

The present document can be downloaded from:

<http://www.etsi.org/standards-search>

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the only prevailing document is the print of the Portable Document Format (PDF) version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status.

Information on the current status of this and other ETSI documents is available at

<https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx>

If you find errors in the present document, please send your comment to one of the following services:

<https://portal.etsi.org/People/CommiteeSupportStaff.aspx>

Copyright Notification

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.

The content of the PDF version shall not be modified without the written authorization of ETSI.

The copyright and the foregoing restriction extend to reproduction in all media.

© European Telecommunications Standards Institute 2016.

All rights reserved.

DECT™, **PLUGTESTS™**, **UMTS™** and the ETSI logo are Trade Marks of ETSI registered for the benefit of its Members.
3GPP™ and **LTE™** are Trade Marks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners.
GSM® and the GSM logo are Trade Marks registered and owned by the GSM Association.

Contents

Intellectual Property Rights	6
Foreword.....	6
Modal verbs terminology.....	6
Introduction	6
1 Scope	7
2 References	7
2.1 Normative references	7
2.2 Informative references.....	7
3 Definitions and abbreviations.....	8
3.1 Definitions	8
3.2 Abbreviations	8
4 Overview of the IoT Standards Landscape	13
4.0 Introduction	13
4.1 Vertical domains covered.....	14
5 A Proposed Enterprise View of the IoT Framework.....	15
5.0 Introduction	15
5.1 IoT Domains for Standards Landscape	16
5.2 Standards Information Database.....	16
5.2.0 Introduction.....	16
5.2.1 Overview of the Knowledge Areas.....	17
5.3 Reference Library.....	18
5.4 Governance Repository	18
5.5 Architecture Reference Model.....	18
5.6 Summary	19
6 Common Standards Across Vertical Domains.....	19
6.0 Introduction	19
6.1 Communication and Connectivity.....	20
6.2 Integration/Interoperability.....	28
6.3 Application.....	31
6.4 Infrastructure	32
6.5 IoT Architecture	34
6.6 Devices and Sensor Technology	36
6.7 Security and Privacy.....	43
6.8 Conclusion.....	47
7 Smart Cities Standards Landscape	47
7.0 Introduction	47
7.1 Communication and Connectivity.....	47
7.2 Integration/Interoperability.....	47
7.3 Application	48
7.4 Infrastructure	48
7.5 IoT Architecture	48
7.6 Devices and Sensor Technology	48
7.7 Security and Privacy.....	49
7.8 Summary of Smart Cities Standards Landscape.....	49
8 Smart Living Standards Landscape	49
8.0 Introduction	49
8.1 Communication and Connectivity.....	49
8.2 Integration/Interoperability.....	52
8.3 Application.....	55
8.4 Infrastructure	55
8.5 IoT Architecture	55

8.6	Devices and Sensor Technology	56
8.7	Security and Privacy.....	56
8.8	Summary of Smart Living Landscape	56
9	Smart Farming Standards Landscape	56
9.0	Introduction	56
9.1	Communication and Connectivity.....	56
9.2	Integration/Interoperability.....	56
9.3	Application	57
9.4	Infrastructure	57
9.5	IoT Architecture	57
9.6	Devices and Sensor Technology	57
9.7	Security and Privacy.....	58
9.8	Summary of Smart Farming Standards Landscape	58
10	Smart Wearables Standards Landscape.....	58
10.0	Introduction	58
10.1	Communication and Connectivity.....	58
10.2	Integration/Interoperability.....	60
10.3	IoT Architecture	60
10.4	Security and Privacy.....	60
10.5	Summary of Smart Wearables Standards Landscape	60
11	Smart Mobility Standards Landscape.....	61
11.0	Introduction	61
11.1	Communication and Connectivity.....	61
11.2	Integration/Interoperability.....	63
11.3	Application	66
11.4	Infrastructure	66
11.5	IoT Architecture	68
11.6	Devices and Sensor Technology	69
11.7	Security and Privacy.....	70
11.8	Summary of Smart Mobility Standards Landscape	70
12	Smart Environment Standards Landscape.....	71
12.0	Introduction	71
12.1	Communication and Connectivity.....	71
12.1.1	Smart Space	71
12.1.2	Smart Water/Energy	72
12.2	Integration/Interoperability.....	72
12.2.1	Smart Space	72
12.3	Application	72
12.3.1	Smart Space	72
12.3.2	Smart Water/Energy	73
12.4	IoT Architecture	73
12.4.1	Smart Water/Energy	73
12.5	Devices and Sensor Technology	74
12.5.1	Smart Water/Energy	74
12.6	Security and Privacy.....	75
12.7	Summary of Smart Environment Standards Landscape	75
13	Smart Manufacturing Standards Landscape.....	75
13.0	Introduction	75
13.1	Communication and Connectivity.....	75
13.2	Integration/Interoperability.....	77
13.3	Application	78
13.4	Infrastructure	78
13.5	IoT Architecture	78
13.6	Security and Privacy.....	78
13.7	Summary of Smart Manufacturing Standards Landscape	79
14	Conclusions and Recommendations.....	79
14.1	Applying the IoT Enterprise Framework.....	79
14.2	Proposed Recommendations	80

Annex A: List of SDOs involved in IoT Standardization	81
A.1 SDOs, SSOs and IoT Standardization.....	81
A.2 List of SDOs.....	81
Annex B: Change History	86
History	87

iTeh STANDARD PREVIEW
(standards.iteh.ai)

Full standard:
<https://standards.iteh.ai/catalog/standards/sist/dec4921e-cb1b-4d1d-bbba-ae67e048dd72/etsi-tr-103-375-v1.1.1-2016-10>

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (<https://ipr.etsi.org>).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Smart Machine-to-Machine communications (SmartM2M).

Modal verbs terminology

In the present document **"should"**, **"should not"**, **"may"**, **"need not"**, **"will"**, **"will not"**, **"can"** and **"cannot"** are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

"must" and **"must not"** are **NOT** allowed in ETSI deliverables except when used in direct citation.

Introduction

The Internet of Things requires and triggers the development of standards and protocols in order to allow heterogeneous devices to communicate and to leverage common software applications. Several standardization initiatives currently co-exist, in individual SDOs or partnerships (e.g. ETSI SmartM2M, ITU-T, ISO, IEC, ISO/IEC JTC 1, oneM2M, W3C®, IEEE™, OASIS®, IETF®, etc.) and also in conjunction with a number of industrial initiatives (e.g. All Seen Alliance, Industrial Internet Consortium (IIC), Open Connectivity Foundation (OCF), Platform Industrie 4.0, Thread group, etc.).

It is therefore necessary to understand the global dynamics of IoT standardization in order to leverage on existing standardization activities, if relevant, vis-à-vis existing initiatives and to ensure a thorough understanding of market needs and requirements.

The essential objective of the present document is to analyse the status of the current IoT standardisation; to assess the degree of industry and vertical market fragmentation; and to point towards actions that can increase the effectiveness of IoT standardisation, to improve interoperability, and to allow for the building of IoT ecosystems.

A specific objective of the present document is to develop a set of recommendations that are aimed at supporting material for the Large Scale Pilots (LSPs) the set of EU funded projects that address the large-scale deployment of IoT in certain "vertical" domains, such as Smart Cities or Smart Mobility. Those recommendations are a supporting material for the LSPs that take into account the needs of the vertical domains that they are targeting. These include the Standards landscape for IoT (who does what, what are the next milestones) and identification of potential interworking frameworks (e.g. oneM2M).

1 Scope

The scope of the present document is to provide an overview of the IoT standards landscape: requirements, architecture, protocols, tests, etc. to provide the roadmaps of the IoT standards, when they are available.

The essential objectives are:

- To analyse the status of current IoT standardisation.
- To assess the degree of industry and vertical market fragmentation.
- To point towards actions that can increase the effectiveness of IoT standardisation, to improve interoperability, and to allow for the building of IoT ecosystems.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] AIOTI WG03: "IoT LSP Standard Framework Concepts", Release 2.0, October 2015".
- [i.2] ETSI TR 103 376: "SmartM2M IoT LSP Use Cases and Standards gaps".
- [i.3] ANSI/ISA 95: "Enterprise-Control System Integration".
- [i.4] Recommendation ITU-T Y.2238: "Overview of Smart Farming based on networks".
- [i.5] European Commission White Paper: "Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system".
- [i.6] TOGAF model for Enterprise Architecture.
- [i.7] AIOTI WG09: "Report on Smart Mobility".
- [i.8] AIOTI WG03: "Reports on IoT Standards".
- [i.9] AIOTI WG06: "Report on Smart Farming and Food Safety Internet of Things Applications".
- [i.10] ITU-T Technology Watch Report: "ICT as an Enabler for Smart Water Management".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

H2020 ICT-30: grouping IoT research and innovation projects and coordination & supporting actions (CSA)

NOTE: The STF will liaise with this group of research projects via the IERC and the selected H2020 ICT-30 IoT CSA selected proposal.

H2020 SCC3: Smart Cities CSA is in H2020 "Secure, clean and efficient energy", Call - Smart Cities and Communities (SCC) with SCC 3 - 2015 on "Development of system standards for smart cities and communities solutions".

NOTE: The STF will liaise with these projects via the selected H2020 SCC3 CSA.

IoT European Research Cluster (IERC): cluster on the Internet of Things research (and innovation) projects)

NOTE: The IERC is now totally integrated in WG1 as part of AIOTI.

oneM2M: Partnership Project (EPP) on M2M launched by a number of SSOs including ETSI

Functional Safety: standards defining safety as freedom from unacceptable risk

NOTE: The most effective way to eliminate risks is to design them away. The purpose of safety is to protect people from harm. Functional safety achieves this via systems that lower the probability of undesired events, thereby minimizing mishaps.

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

2G	Second generation of wireless mobile telecommunications technology
3G	Third generation of wireless mobile telecommunications technology
3GPP	Third Generation Partnership Project
4G	Fourth generation of wireless mobile telecommunications technology
6LoWPAN	IPv6 over Low power Wireless Personal Area Networks
ACE	Authorization for Constrained Environments
ACEA	European Automobile Manufacturers Association
ACS	Auto Configuration Servers
ADASIS	Advanced Driver Assistance System Interface Specifications
ADSL	Asymmetric Digital Subscriber Line
AIDC	Automatic Identification and Data Capture
AIOTI	Alliance for IoT Innovation

NOTE: In particular AIOTI WG3 on IoT Standardization.

AIOTI WG03	Alliance for IoT Innovation Working Group 3
AMI	Advanced Metering Infrastructure
API	Application Programming Interface
APT	Asian Pacific Telecommunity
ARIB	Association of Radio Industries and Businesses
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ATIS	Alliance for Telecommunications Industry Solutions
AV	Audio-Video
AVB	Audio Video Bridging
B2B	Business to Business
B2C	Business to Customer
BACS	Building Automation and Control Systems
BBF	BroadBand Forum

BLE	Bluetooth Low Energy
BR/EDR	basic rate/enhanced data rate
BSS	Base Station Subsystem
C2C-CC	Car 2 Car Communication Consortium
C-ACC	Cooperative Adaptive Cruise Control
CALM	Communications Access for Land Mobiles
CAN	Controller Area Network
CCC	Car Connectivity Consortium
CCSA	China Communications Standards Association
CDD	Common Data Dictionary
CDMA	Code division multiple access
CEN	Comité Européen de Normalisation (European Committee for Standardization)
CI	Common Interface
CIM	Common Information Model
CIP	Common Industrial Protocol
CLEPA	European Association of Automotive Suppliers
CMS	Central Management System
CoAP	Constrained Application Protocol
COSEM	Companion Specification for Energy Metering
CPE	Customer-Premises Equipment
CSA	Coordination and Support Actions
CSCG	Cyber Security Co-ordination Group

NOTE: Which will provide input regarding security standardization for Europe.

CT	Core Network & Terminals
CTA	Cordless Terminal Adapter
CWMP	CPE WAN Management Protocol
D2D	Device-to-Device
DDS	Data Distribution Service
DECT	Digital Enhanced Cordless Telecommunications
DICOM®	Digital Imaging and Communications in Medicine
DIN	German Institute for Standardization
DM	Device Management
DNP	Distributed Network Protocol
DSL	Digital Subscriber Line
DSRC	Dedicated short-range communications
DTLS	Datagram Transport Layer Security
EASA®	European Aviation Safety Agency
EDGE	Enhanced Data rates for GSM Evolution
EIP-SCC	European Innovation Partnership on Smart Cities and Communities
EN	European Norm
EPB	Energy Performance of Buildings
EPBD	Energy Performance of Buildings Directive
ERM	Electromagnetic compatibility and Radio spectrum Matters
ETSI	European Telecommunication Standards Institute
EU	European Union
EUC	Equipment Under Control
FAA	Federal Aviation Administration
FEC	Forward Error Correction
FG	Focus Group
FHIR®	Fast Healthcare Interoperability Resources
FI-PPP	Future Internet Public-Private Partnership
FOTS	Field Operational Tests
FP	Fixed Part
FSK	Frequency-shift keying
GAA	Generic Authentication Architecture
GBLS	GNSS-Based Location System
GNSS	Global Navigation Satellite System
GPRS	General Packet Radio Service
GS	Group Specification
GSM	Global System for Mobile Communications

HAN FUN	Home Area Network Functional protocol
HAN	Home Automation Network or Home Area Network
HART®	Highway Addressable Remote Transducer protocol
HCD	Hardcopy Device
HDLC	High-Level Data Link Control
HG	Home Gateway
HGI	Home Gateway Initiative
HIMSS	Healthcare Information and Management Systems Society
HL7®	Health Level Seven International
HLA	High Level Architecture
HLAP	High Level Application Protocol
HMI	Human Machine Interface
HRN	Health Records Network
HSPA	High Speed Packet Access
HTTP	HyperText Transfer Protocol
HyP	Hybrid Part
I2V	Infrastructure-to-Vehicle
IACS	Industrial Automation and Control Systems
ICT	Information and Communication Technology
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IERC	IoT European Research Cluster
IETF	Internet Engineering Task Force
IHE	Integrating the Healthcare Enterprise
IIC	Industrial Internet Consortium
IIRA	Industrial Internet Reference Architecture
IMT	International Mobile Telecommunications
IoT	Internet of Things
IoT LSP	Internet of Things Large Scale Pilots

NOTE: Part of the H2020 Work Program 2016-2017.

IP	Internet Protocol
IPSO	Internet Protocol for Smart Object
IPv6	Internet Protocol version 6
ISA	International Society of Automation
ISCI	ISA Security Compliance Institute
ISCI	ISA Security Compliance Institute
ISG	Industry Specification Group
ISM	Industrial, Scientific and Medical
ISMS	Information Security Management System
ISO	International Organization for Standardization
ITS	Intelligent Transportation System
ITS-S	ITS Station
ITU-R	International Telecommunication Union - Radio Sector
ITU-T	International Telecommunication Union - Telecommunication Sector
JSON-RPC	Remote Procedure Call protocol encoded in JavaScript Object Notation
KA	Knowledge Areas
LAN	Local Area Network
LLN	Low power and Lossy Network
LON	Local Operator Network
LPWAN	Low Power Wide Area Network
LR-WPAN	Low-Rate Wireless Personal Area Network
LSP	Large Scale Pilot
LTE	Long Term Evolution
LTN	Low Throughput Network
M2M	Machine-to-Machine
MAC	Media Access Control
MAN	Metropolitan Area Network
MBMS	Multimedia Broadcast/Multicast Service
MFD	Multifunction Device
MQTT	MQ Telemetry Transport

MTC	Machine Type Communications
NFC	Near Field Communication
NWK	Network
OAA	Open Automotive Alliance
OAG	Open Applications Group
OAGIS	Open Applications Group Integration Specification
OASIS	Advancing Open Standards for the Information Society
OBU	On-Board Units
OCF	Open Connectivity Foundation
OGC	Open Geospatial Consortium
OIC	Open Interconnect Consortium
OLE	Object Linking and Embedding
OLN	Outdoor Lighting Network
OMA	Open Mobile Alliance
OMG	Object Management Group
OPC	OLE for Process Control
OS	Operating System
OUI	Organizationally Unique Identifier
PAN	Personal Area Network
PAS	Publicly Available Specification
PCHA®	Personal Connected Health Alliance
PDA	Personal Digital Assistant
PHD	Personal Health Device
PHY	Physical layer
PII	Personally Identifiable Information
PKI	Public Key Infrastructure
PLC	Power Line Communications
PP	Portable Part
PSA	Protocol Standards Association
PSID	Provider Service Identifier
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RAN	Radio Access Networks
REST	Representational State Transfer
RFID	Radio-frequency identification
RSU	Road Side Units
RTPS	Real-Time Publish-Subscribe
SA	Services & Systems Aspects
SAE	Society of Automotive Engineers
SAML	Profile of Security Assertion Markup Language
SAREF	Smart Appliance Reference ontology
SC	Smart Cities
SCIM	System for Cross-domain Identity Management
SCN	Satellite Communications and Navigation
SDO	Standards Developing Organisation
SE	Smart Environment
SEG-CG	Smart Energy Grid Co-ordination Group
SERCOS®	Serial Real-time Communications System
SF	Smart Farming
SIB	Standards Information Base
SL	Smart Living
SN	Sensor Network
SNRA	Sensor Network Reference Architecture
SOAP	Simple Object Access Protocol
SRD	Short Range Devices
SSC	Smart Sustainable Cities
SSCC-CG	Smart and Sustainable Cities and Communities Coordination Group
SSO	Standards Setting Organisation
SW	Smart Wearables
TCP	Transmission Control Protocol
TEDS	Transducer Electronic Data Sheets
TETRA	Terrestrial trunked Radio

TIM	Transducer Interface Module
TISA	Traffic and Traveller Information
TLS	Transport Layer Security
TM	Traffic Management
TOGAF®	The Open Group Architecture Framework
TR	Technical Report
TS	Technical Specification
TSDSI	Telecommunications Standards Development Society India
TSG	Technical Specification Group
TTA	Telecommunications Technology Association
TTC	Telecommunications Technology Committee
UA	Unified Architecture
UDP	User Datagram Protocol
UI	User Interface
ULE	Ultra Low Energy
UMTS	Universal Mobile Telecommunications System
UPnP	Universal Plug and Play
USP	Universal Service Platform
UWB	Ultra Wide Band
V2X	Vehicle-to-Everything
VGP	Vehicle Gateway Platform
VMS	Video Management System
VoIP	Voice over Internet Protocol
W3C	Worldwide Web Consortium
WAN	Wide Area Network
WAVE	Wireless Access in Vehicular Environments
WBAN	Wireless Body Area Network
WG	Working Group
WITS	Water Industry Telemetry Standards
WLAN	Wireless Local Area Network
WMAN	Wireless Metropolitan Area Networks
WPAN	Wireless Personal Area Network
WRC	World Radio Communication Conference
WRS	Wireless Relay Station
WSN	Wireless sensor networks
WSP	Wireless Short-Packet
XACML	eXtensible Access Control Markup Language
xDSL	x Digital Subscriber Line
XKMS	XML Key Management Specification
XML	Extensible Markup Language
XMPP	Extensible Messaging and Presence Protocol
XSD	XML Schema Language
XSF	XMPP Standards Foundation
XSPA	Cross-Enterprise Security and Privacy Authorization

