Internet of Things

Position Paper on Standardization for IoT technologies

EUROPEAN RESEARCH CLUSTER ON THE INTERNET OF THINGS

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"Innovation is the specific instrument of entrepreneurship... the act that endows resources with a new capacity to create wealth."

Peter F. Drucker

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Executive Summary

The purpose of the position paper is to draft a technically oriented reference document with the strategic goal to represents the standardization requirements for the IoT applications presenting the state of play, the existing standards, while analysing the gaps and provide recommendations for future standardisation activities in the area of IoT.

The position paper presents an inventory of existing standards and provides an overview of past and current activity in relation to standardization in the area of Internet of Things, and assembles a series of examples of standardization activities in this area. The document is an appropriate mechanism through which is intended to accelerate the development and use of standards in the area of IoT, thereby facilitating wider and faster deployment of IoT applications.

Several stakeholders (SDOs, industrial companies, research, academia and projects) are actively collaborating to review existing IoT standards, determine how they can be improved, identify the standardization gaps and propose 5-6 areas and topics for being address by the standardization bodies.

The IERC initiated this mapping exercise in 2013, to better understand the breadth and diversity of current IoT standardization initiatives identify the standardization gaps between actual standards and future requirements and propose solutions and recommendations for addressing these gaps in a number of selected areas. Specific objectives are:

- The identification and presentation of the major activities undertaken in the SDOs that have a focus on IoT and IoT technologies with reference to the other areas (cloud computing, networks, wireless protocols, identification, naming, addressing, etc.)
- Map out the most significant IoT standardization initiatives from the main SDOs
- Analyze where there are similarities and differences between these initiatives
- Consider where there are significant gaps and overlaps and current lack of specific activity on IoT as identified by SDOs and the involved stakeholders.
- Present a recommendation/position on few areas where the IoT standardization has to be addressed in the next period, and propose to address these through standardization mandates.

The final goal is to use the position paper as basis for making recommendations for future IoT standardization activities such as:

- Work items promoted in the SDOs (eg, through a mandate) to support the specification of metrics and supporting test and validation criteria to be used in the assessment of IoT.
- Work items promoted in the SDOs (eg, through the means of a mandate) to support the development of a taxonomy for IoT.
- As a very large part of system of systems IoT is enabled by features and capabilities not covered by the conventional telecommunications SDOs, those SDOs should be encouraged to build links from their work to the

output of bodies dealing with those ancillary features (eg, power, heat, light, flood control, environmental control, and access, ie, transport links to get maintenance staff to site for repairs) and the applications in different sectors (smart grid, transport, healthcare, smart cities, etc.)

The position paper is a living document that will be subject to future changes, modifications and additions, and updated once per year.

The work is done in cooperation with European and international groups in order to present a truly global point of view.

Introduction

The Information and Communication Technology development generates more and more things/objects that are becoming embedded with sensors and having the ability to communicate with other objects, that is transforming the physical world itself into an information and knowledge system.

Internet of Things (IoT) enables the things/objects in our environment to be active participants, i.e., they share information with other stakeholders or members of the network; wired/wireless, often using the same Internet Protocol (IP) that connects the Internet. In this way the things/objects are capable of recognizing events and changes in their surroundings and are acting and reacting autonomously largely without human intervention in an appropriate way.

The growth of interconnected things is expending, and they use wireless and 2G/3G/4G mobile networks and 5G in the future.

The Internet of Things is bridging the virtual world with the physical world and the mobile networks need to scale to match the demands of 25-50 billion things. In this context is needed to address the developments in the virtual world and the physical world in order to address the challenges of Internet of Things applications. In the virtual world, network virtualization, software defined networks, device management platforms, cloud computing and big data science are developing fast and need to be address as enabling technologies for Internet of Things.

In the physical world, the new wireless technologies for personal, home area networks, metropolitan and regional area networks all promise to deliver better economies of scale in terms of cost, energy and number of connections. Bringing the “Internet of Things” to life requires a comprehensive systems approach, inclusive of intelligent processing and sensing technology, connectivity, software and services, along with an ecosystem to address the smart environments applications.

The elements related to mobile networks, enabling scalability, large sensor (and actuator) networks, network virtualization, software defined networks, device management platforms, service oriented networks, cloud computing and big data to address the challenges related to standardisation.

These future IoT developments need to see acceleration and a maturing of common standards, more cross-sector collaboration and creative approaches to business models.

General

The Internet of Things (IoT) concept/paradigm is broad in its scope and the potential standards landscape is very large and complex. Technology is evolving and do not represent a barrier to adoption.

In the area of IoT, Europe is addressing the competitiveness in the context of globalisation. The technological specialisations built up over decades are transforming rapidly. In the area of IoT the IERC- Internet of Things

European Research Cluster is focusing on increasing the link of projects, companies, organizations, people and knowledge at European level as a way of making projects more innovative and competitive.

Standards are needed for interoperability both within and between domains. Within a domain, standards can provide cost efficient realizations of solutions, and a domain here can mean even a specific organization or enterprise realizing an IoT. Between domains, the interoperability ensures cooperation between the engaged domains, and is more oriented towards a proper "Internet of Things". There is a need to consider the life-cycle process in which standardization is one activity. Significant attention is given to the "pre-selection" of standards through collaborative research, but focus should also be given to regulation, legislation, interoperability and certification as other activities in the same life-cycle. For IoT, this is of particular importance.

IERC is working to create a reference for pre-standardisation activities of EC IoT research projects that is the base for the position paper and the IoT standardisation roadmap. This effort has as goal to increase overall efficiency and raise mutual awareness, defragment and synergize in one unique place important information for stakeholders: Industry, Standard Development Organisations (SDOs), European Commission (EC).

A complexity with IoT comes from the fact that IoT intends to support a number of different applications covering a wide array of disciplines that are not part of the ICT domain. Requirements in these different disciplines can often come from legislation or regulatory activities. As a result, such policy making can have a direct requirement for supporting IoT standards to be developed. It would therefore be beneficial to develop a wider approach to standardization and include anticipation of emerging or on-going policy making in target application areas, and thus be prepared for its potential impact on IoT-related standardization. IoT implementation costs are expected to follow Moore's law. Targeting $1 chip sets by 2014, with a 15 year life for low bandwidth M2M apps such as smart meter reading. In this context standardisation has to be in place in order to gain full deployment potential.

A typical example is the standardization of vehicle emergency call services called eCall driven from the EC [5]. Based on the objective of increased road safety, directives were established that led to the standardization of solutions for services and communication by e.g. ETSI, and subsequently 3GPP. Another example is the Smart Grid standardization mandate M/490 [6] from the EC towards the European Standards Organisations (ESOs), and primarily ETSI, CEN and CENELEC.

The standardization bodies are addressing the issue of interoperable protocol stacks and open standards for the IoT. This includes as well expending the HTTP, TCP, IP stack to the IoT-specific protocol stack. This is quite challenging considering the different wireless protocols like ZigBee, RFID, Bluetooth, BACnet 802.15.4e, 6LoWPAN, RPL, CoAP, AMQP and MQTT. Some of these protocols use different transport layers. HTTP relies on the Transmission Control Protocol (TCP). TCP's flow control mechanism is not appropriate for LLNs and its overhead is considered too high for short-lived transactions. In addition, TCP does not have multicast support and is rather sensitive to mobility. CoAP is built on top of the User Datagram Protocol

(UDP) and therefore has significantly lower overhead and multicast support [8].

Any IoT related standardization must pay attention to how regulatory measures in a particular applied sector will eventually drive the need for standardized efforts in the IoT domain.

Agreed standards do not necessarily mean that the objective of interoperability is achieved. The mobile communications industry has been successful not only because of its global standards, but also because interoperability can be assured via the certification of mobile devices and organizations such as the Global Certification Forum [7] which is a joint partnership between mobile network operators, mobile handset manufacturers and test equipment manufacturers. Current corresponding M2M efforts are very domain specific and fragmented. The emerging IoT and M2M dependant industries should also benefit from ensuring interoperability of devices via activities such as conformance testing and certification on a broader scale.

To achieve this very important objective of a "certification" or validation programme, we also need non ambiguous test specifications which are also standards. This represents a critical step and an economic issue as this activity is resource consuming. As for any complex technology, implementation of test specifications into cost-effective test tools should also to be considered. A good example is the complete approach of ETSI using a methodology (e.g. based on TTCN-3) considering all the needs for successful certification programmes.

The conclusion therefore is that just as the applied sector can benefit from standards supporting their particular regulated or mandated needs, equally, these sectors can benefit from conforming and certified solutions, protocols and devices. This is certain to help the IoT- supporting industrial players to succeed.

It is worth noting that setting standards for the purpose of interoperability is not only driven by proper SDOs, but for many industries and applied sectors it can also be driven by Special Interest Groups, Alliances and the Open Source communities. It is of equal importance from an IoT perspective to consider these different organizations when addressing the issue of standardization.

From the point of view of standardisation IoT is a global concept, and is based on the idea that anything can be connected at any time from any place to any network, by preserving the security, privacy and safety. The concept of connecting any object to the Internet could be one of the biggest standardization challenges and the success of the IoT is dependent on the development of interoperable global standards. In this context the IERC position is very clear.

Global standards are needed to achieve economy of scale and interworking. Wireless sensor networks, RFID, M2M are evolving to intelligent devices which need networking capabilities for a large number of applications and these technologies are "edge" drivers towards the "Internet of Things", while the network identifiable devices will have an impact on telecommunications networks. IERC is focussed to identify the requirements and specifications from industry and the needs of IoT standards in different domains and to

harmonize the efforts, avoid the duplication of efforts and identify the standardization areas that need focus in the future.

To achieve these goals it is necessary to overview the international IoT standardization items and associated roadmap; to propose a harmonized European IoT standardisation roadmap; work to provide a global harmonization of IoT standardization activities; and develop a basic framework of standards (e.g., concept, terms, definition, relation with similar technologies).

The main issue today is how to organize, divide and prioritize the standardisation activities to focus on the aspects that provide the greatest customer benefit towards the goal of accelerating the rate of deployment and achieving interoperable and secure IoT applications.

Another main challenge is that IoT applications need to use standards developed separately by different groups or Technical Committees.

Finally, IoT applications interoperability (both communication and semantic) and the certification need to be addressed. Guidelines need to be developed, including mechanisms for interoperability enforcement and, where appropriate, leverage commercial certification activities.

Purpose and Scope of the Position Paper

The purpose of this position paper is to draft a technically oriented reference document with the strategic goal to represents the standardization requirements for the IoT applications presenting the state of play, the existing standards, while analysing the gaps and provide recommendations for future standardisation activities in the area of IoT.

The roadmap is based on the work of the IERC-Internet of Things European Research Cluster. The position paper is a living document that will be subject to future changes, modifications and additions, and updated once per year. The position paper presents an inventory of existing standards, and puts them into perspective regarding the different Internet of Things applications. Gaps between actual standards and future requirements are analysed and recommendations for evolution are proposed.

The work is done in cooperation with European and international groups in order to present a truly global point of view.

IoT Vision

In the area of IoT, Europe is addressing the competitiveness in the context of globalisation. The technological specialisations built up over decades are transforming rapidly. In the area of IoT the IERC is focusing on increasing the link of projects, companies, organizations, people and knowledge at European level as a way of making projects more innovative and competitive.

This new approach is visible across a number of different policy fields implemented by the IoT Cluster. One of them is the creation of common activity chains (ACs) to favour close cooperation between the IoT Cluster

projects and to form an arena for exchange of ideas and open dialog on important research challenges.

The activity chains are defined as work streams that group together partners or specific participants from partners around well-defined technical activities that will result into at least one output or delivery that will be used in addressing the IERC objectives.

Evolutions in the global environment and evolutions in national policy, science and technology policy and industrial/enterprise policy are converging on the objective of supporting these linkages at the national level.

IoT is a global paradigm and the standardisation issues have to be addressed in the global view.

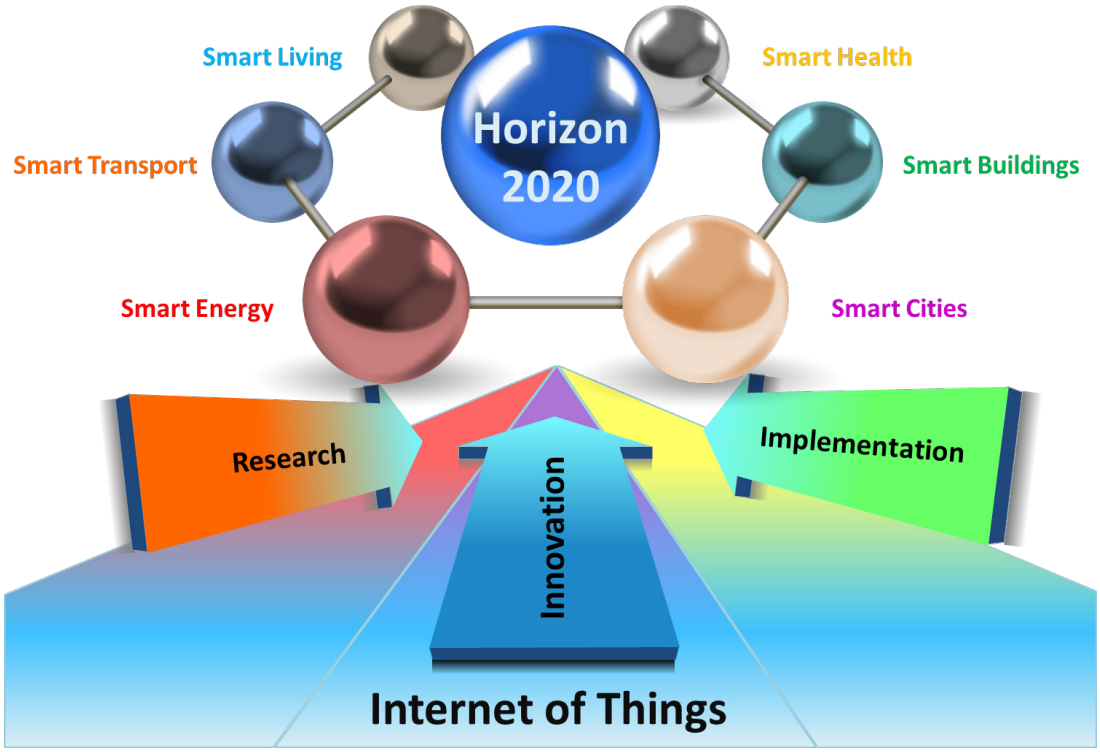

Figure 1 IoT Development Horizon 2020

This liaison concept with the stakeholders and the SDOs working in the area of IoT is of paramount importance and will help strengthen promote exchange of ideas, solutions, results and validation of these among different standardisation activities.

Standards enable innovation, and are key for interoperability, may improve safety and security, are drivers for emergence of new markets, facilitate introduction of technologies (such as IoT), enhance competition and can help to „de-verticalize“ industry by sharing and inter-operation of tools and technology, reducing the development and deployment costs for IoT applications.

Standardization is a complex process that needs to involve customers, suppliers and competitors and sometimes “competes” by different committees

and standardization bodies, addressing separates domains, technologies, communities (vertical and horizontal fragmentation).

As presented in Figure 2 standardisation is a time-lagged and long-term process, usually fixes 1 - 5 years old state of the art rather than state of science and technology and can take up to three years to complete.

Figure 2 IEC Standardisation process cycle

IoT is considered in the global context and in order to compete globally Europe has to use the enormous potential existing in the synergies among the standardisation activities in different organisations.

This approach provides a more transparent, inclusive and competitive framework for efforts to strengthen European IoT research efforts and will allow easier the work on common standards.

IoT Drivers

Internet of Things gives semiconductor growth opportunity with possibilities for the billions of M2M (Machine-to-Machine) connected devices and the smart devices that provide the man-machine user experience.

Internet of Things offers opportunities to semiconductor and system companies as the implementation of applications occurs at multiple levels: object with individual IoT devices based on MCU's with network connectivity that sense and control. The value of the IoT is realized at the sensing/actuating, internetworking and at the solution level, where the big data from the IoT object is used in solving specific problems and creating new services.

The next generation of Smart Connected Homes, Smart Connected Vehicles or Internet of Vehicles, Internet of Energy, Smart Grids, Smart Manufacturing and Smart Health will enable new apps that use the IoT real time sourced big data while improving users' lives.

Wireless IoT connectivity range from cellular M2M modules from cellular providers, to specific chips for WiFi , Zigbee, 6LoWPAN (IPv6 over Low power Wireless Personal Area Networks), and BLE (Bluetooth Low Energy).

The IoT opportunities require aligning with the right standards and the involvement of broad technologies including SOC's, power, connectivity, software, and Big Data. This is a real challenge.

IoT Definition

The Internet of Things had until recently different means at different levels of abstractions through the value chain, from lower level semiconductor through the service providers.

The Internet of Things is a "global concept" and requires a common definition. Considering the wide background and required technologies, from sensing device, communication subsystem, data aggregation and pre-processing to the object instantiation and finally service provision, generating an unambiguous definition of the "Internet of Things" is non-trivial.

The IERC is actively involved in ITU-T Study Group 13, which leads the work of the International Telecommunications Union (ITU) on standards for next generation networks (NGN) and future networks and has been part of the team which has formulated the following definition [2]: "***Internet of things (IoT):*** *A global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies".NOTE 1 — Through the exploitation of identification, data capture, processing and communication capabilities, the IoT makes full use of things to offer services to all kinds of applications, whilst ensuring that security and privacy requirements are fulfilled. NOTE 2—From a broader perspective, the IoT can be perceived as a vision with technological and societal implications.*

The IERC definition [3] states that IoT is "*A dynamic global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols where physical and virtual "things" have identities, physical attributes, and virtual personalities and use intelligent interfaces, and are seamlessly integrated into the information network".*

IoT Standardisation Landscape

This section gives an overview of the standardisation activities related to IoT within international standard organisations, including CEN/ISO, CENELEC/IEC, ETSI, IEEE, IETF, ITU-T, OASIS, OGC, oneM2M and W3C.

CEN/ISO and CENELEC/IEC

CEN/CENELEC overview

As noted in the Introduction, the three European SDO's, CEN, CENELEC and ETSI play complementary roles in the development of IoT standards for Europe and in the liaisons they form with other SDOs and Industry SIGs across the globe.

The primary mission of CEN/CENELEC in relation to the IoT standardisation is to work in the applications zone that exists on the edge of the Internet of Things. The prime tasks are to:

- Integrate sensor data with existing (typically) barcode and RFID driven systems to enhance their performance and effectiveness
- Integrate object data concepts into existing standardised applications and ensure connectivity between "classic" data capture/storage/access systems and the Future Internet, particularly in the area of object discovery services
- Define the new application systems which ubiquitous sensor networks will enable.

The IoT is often seen from the perspective of M2M systems development. Whilst this may be appropriate in the early development of the IoT, a reality is that IoT applications are designed by people to provide new services to the citizen. The scale, abstraction and significance of such applications indicate that citizens will require that a governance framework is put in place to manage risk and resilience in such systems. CEN/CENELEC, together with their National Body members, increasingly introduces practical implementation of EC societal objectives into their standards output, in particular in the area of data protection and privacy.

Recent major EC standards programmes include EC Mandate responses M/436 "RFID" and M/490 "Smart Grids", together with project work on Smart Housing and Electro-Mobility.

CEN Technical Bodies

CEN's core business is the development of standards that meet the needs of the market.
Standardization is performed in a 'bottom-up' approach, thereby ensuring the market relevance of the resulting deliverables [36].
It is sometimes thought that standardization is no longer fit-for-purpose where new technology is concerned. The reality is that ESO Technical Specifications can be produced to the same timescale as industry SIGs may achieve.
The standardization activities of CEN are steered by the CEN Technical Board (BT), who has full responsibility for the execution of CEN's work programme.
Standards are prepared by Technical Committees (TCs). Each TC has its own field of operation (scope) within which a work programme of identified standards is developed and executed.

TCs work on the basis of national participation by the CEN Members, where

delegates represent their respective national point of view. This principle allows the TCs to take balanced decisions that reflect a wide consensus. A TC may establish one or more sub-committees in the case of large programs of work.

The actual standards development is undertaken by working groups (WGs) where experts, appointed by the CEN Members but speaking in a personal capacity, come together and develop a draft that will become the future standard. This reflects an embedded principle of 'direct participation' in the standardization activities [37].

Work is also performed by CEN together with its sister organizations CENELEC [52] and ETSI [53]. The ways and means of cooperation are laid down in the Internal Regulations Part 2 [54]. Where ETSI is also involved, the work follows the principles of the CEN-CENELEC-ETSI Basic Cooperation Agreement and the associated Modes of Cooperation [36].

The output of TC's may be:

- European Norms (EN) which are legal documents which, although not European Law in themselves, are able to be referred to by EU Regulations and Directives.
- Technical Specifications (TS) which allow rapid stabilisation of technologies and applications
- Technical Reports (TR)

Additionally, CEN/CENELEC may create Workshops, which are particularly relevant in emerging or rapidly changing technologies that require fast completion of technical specifications or research projects.

The output of a Workshop is a CEN and/or CENELEC Workshop Agreements (CWAs). It is perfectly possible to deliver TS, TR and CWA document in a year or less.

European Standards

European Standards (EN) are documents that have been ratified by one of the 3 European Standards Organizations, CEN, CENELEC or ETSI. They are designed and created by all interested parties through a transparent, open and consensual process.

European Standards are a key component of the Single European Market. Though rather technical and unknown to the general public and media, they represent one of the most important issues for business. Although often perceived as boring and not particularly relevant to some organizations, managers or users, they are actually crucial in facilitating trade and hence have high visibility among manufacturers inside and outside the European territory. A standard represents a model specification, a technical solution against which a market can trade. It codifies best practice and is usually state of the art.

In essence, standards relate to products, services or systems. Now, however, standards are no longer created solely for technical reasons but have also

become platforms to enable greater social inclusiveness and engagement with technology, as well as convergence and interoperability within a growing market across industries.

But the European Standard is something much more relevant than this. The CEN-CENELEC Internal Regulations, Part 2, states that the EN (European Standard) "carries with it the obligation to be implemented at national level by being given the status of a national standard and by withdrawal of any conflicting national standard".

The fact that European Standards must be transposed into a national standard in all member countries guarantees that a manufacturer has easier access to the market of all these European countries when applying European Standards. This applies whether the manufacturer is based in the CENELEC territory or not. Member countries must also withdraw any conflicting national standard: the EN prevails over any national standard [38].

Technical Specifications

A Technical Specification (TS) is a normative document made available by CEN/CENELEC in at least one of the three official languages (English, German, French). A TS is established and approved by a technical body by a weighted vote of CEN/CENELEC national members. The Technical Specification is announced and made available at national level, but conflicting national standards may continue to exist. A Technical Specification is not permitted to conflict with an EN or HD (Harmonization Document). A TS is reviewed every 3 years at the latest. The maximum lifetime of a TS is 6 years.

Technical Specifications are established with a view to serving, for instance, the purpose of:

- Publishing aspects of a subject which may support the development and progress of the European market.
- Giving guidance to the market on or by specifications and related test methods.
- Providing specifications in experimental circumstances and/or evolving technologies.

TSs are not amended but replaced by a new edition with a new date of edition. However, Corrigenda are possible [39].

Technical Reports

A Technical Report (TR) is an informative document made available by CENELEC in at least one of the official languages, established and approved by a technical body by simple majority vote of CENELEC national members. A Technical Report gives information on the technical content of standardization work.

Technical Reports may be established in cases when it is considered urgent or advisable to provide information to the CENELEC national members, the European Commission, the EFTA Secretariat or other governmental agencies or outside bodies, on the basis of collected data of a different kind from that

which is normally published as an EN.

The decision to develop a TR can be taken by the Technical Board (BT), by a CENELEC Technical Committee (TC), a Technical Subcommittee (SC) or by a BTTF.

The CENELEC technical body preparing the draft TR (prTR) is also responsible for its approval. TRs are approved either in a CENELEC TC voting meeting or by a vote by correspondence of the CENELEC national members. If approved, the TR is made available unchanged to CCMC. TRs are not amended but replaced by a new edition with the same number and new date of edition. However, Corrigenda are possible.

No time limit is specified for the lifetime of TRs, but it is recommended that TRs are regularly reviewed by the responsible technical body to ensure that they remain valid [40].

CENELEC Workshop Agreements (CWA)

A CENELEC Workshop Agreement (CWA) is a document made available by CENELEC in at least one of the official languages (English, German, French). It is an agreement, developed and approved by a CENELEC Workshop and owned by CENELEC as a publication, which reflects the consensus of identified individuals and organizations responsible for its content. The Workshop Agreement is announced and possibly made available at national level. Conflicting national normative documents may continue to exist. Revision of a Workshop Agreement is possible.

A CWA shall not conflict with a European Standard (EN) and a Harmonization Document (HD). A CWA shall be withdrawn if the publication of an EN and HD brings the CWA into conflict with the EN and HD.

The CWA is valid for 3 years or until its transformation into another deliverable. After 3 years, the CCMC consults the former Workshop participants to see whether a renewal for a further 3 years is appropriate; if not, the CWA should be withdrawn [41].

CEN Members

CEN's National Members are the National Standardization Bodies (NSBs) of the 28 European Union countries, the Former Yugoslav Republic of Macedonia, and Turkey plus three countries of the European Free Trade Association (Iceland, Norway and Switzerland). There is one member per country.

A National Standardization Body is the one stop shop for all stakeholders and is the main focal point of access to the concerted system, which comprises regional (European) and international (ISO) standardization. It is the responsibility of the CEN National Members to implement European Standards as national standards.

The National Standardization Bodies distribute and sell the implemented European Standard and have to withdraw any conflicting national standards [42].

Details regarding this status are given in CEN/CENELEC Guide 20 - Guide on membership criteria of CEN and CENELEC [55].

CEN/TC 225

CEN/TC 225 "Automatic Identification Technologies" is tasked with the standardization of [43]:

- Data carriers for automatic identification and data capture
- The data element architecture
- The necessary test specifications and of technical features for the harmonization of cross-sector applications.
- Establishment of an appropriate system of registration authorities, and of means to ensure the necessary maintenance of standards.

The work items of CEN/TC 225 are assigned as appropriate to Work Groups (WG), displayed in the following table:

Table 1. Work Groups in CEN/TC 225 with appurtenant work items [44]

CEN/TC 225/WG 1	Optical Readable Media
CEN/TC 225/WG 3	Security and data structure
CEN/TC 225/WG 4	Automatic ID applications
CEN/TC 225/WG 5	RFID, RTLS and on board sensors
CEN/TC 225/WG 6	Internet of Things - Identification, Data Capture and Edge Technologies

CEN/TC 225 WORK PROGRAMME

At the time of writing, the CEN/TC 225 work programme consists of the following projects shown in Table 2.

Table 2. Projects in CEN/TC 225 work programme [45]

Project reference	Status	Initial Date
FprEN 16656 (WI=00225060) Information technology - Radio frequency identification for item management - RFID Emblem (ISO/IEC 29160:2012, modified)	Published	2011-09-08
FprEN 16570 (WI=00225067) Information technology - Notification of RFID - The information sign and additional information to be provided by operators of RFID application systems	Published	2012-03-20
FprCEN/TR 16669 (WI=00225068) Information technology - Device interface to support ISO/IEC 18000-3	Published	2012-05-09

Project reference	Status	Initial Date
FprCEN/TS 16685 (WI=00225069) Information technology - Notification of RFID - The information sign to be displayed in areas where RFID interrogators are deployed	Published	2012-05-09
FprCEN/TR 16670 (WI=00225070) Information technology - RFID threat and vulnerability analysis	Published	2012-05-09
prEN 1573 rev (WI=00225077) Bar coding - Multi industry transport label	Published	2013-01-28
FprCEN/TR 16671 (WI=00225072) Information technology - Authorisation of mobile phones when used as RFID interrogators	Published	2012-05-09
FprEN 16571 (WI=00225073) Information technology - RFID privacy impact assessment process	Published	2012-05-09
FprCEN/TR 16672 (WI=00225074) Information technology - Privacy capability features of current RFID technologies	Published	2012-05-09
FprCEN/TR 16673 (WI=00225075) Information technology - RFID privacy impact assessment analysis for specific sectors	Published	2012-05-09
FprCEN/TR 16674 (WI=00225076) Information technology - Analysis of privacy impact assessment methodologies relevant to RFID	Published	2012-05-09
FprCEN/TR 16684 (WI=00225071) Information technology - Notification of RFID - Additional information to be provided by operators	Published	2012-05-09

CENELEC

CENELEC standards processes are very similar to those of CEN. CENELEC concentrates most of its work on 2 major types of deliverable:

- The European Standard (EN) and
- The Harmonization Document (HD).

These two documents are referred to commonly as "standards" and must be implemented in all CENELEC member countries, who must also withdraw any conflicting standard.

There are a few differences in the implementation process of EN's and HD's. Basically, the EN must be transposed as it is, not adding or deleting anything. The process for HD's is a bit more flexible. It is the technical content that must be transposed, no matter the wording or how many documents are made of it.

In addition to these two major deliverables, CENELEC also produces and approves Technical Specifications, Technical Reports and Workshop Agreements in a similar manner to CEN [46].

Smart grids: EC Mandate M/490

The European Standardization Organization (ESOs), i.e. CEN, CENELEC and ETSI, accepted the standardization Mandate M/490 on smart grid standardization.

The focal point addressing the ESO's response to M/490 was the CEN, CENELEC and ETSI Smart Grids Coordination Group (SG-CG), built around the membership of a previous JWG [47].

SMART GRID

A smart grid is an electricity network that can integrate in a cost efficient manner the behaviour and actions of all users connected to it - generators, consumers and those that do both - in order to ensure economically efficient, sustainable power system with low losses and high levels of quality and security of supply and safety (as per the definition given by the Expert Group 1 of the EU Commission Task Force for Smart Grids) [47].

SMART GRIDS AND STANDARDIZATION

Standardization is a key issue for smart grids due to the involvement of many different sectors along the value chain - from the generation to the appliances in the households. Because the smart grid is broad in its scope, the potential standards landscape is also very large and complex [47].

In March 2011, the European Commission and EFTA issued the Smart Grid Mandate M/490. This was accepted by the three European Standards Organizations (ESOs), CEN, CENELEC and ETSI in June 2011.

M/490 requested CEN, CENELEC and ETSI to develop a framework to enable ESOs to perform continuous standard enhancement and development in the smart grid field [48]. M/490 highlighted the following key points:

- The need for speedy action
- The need to accommodate a huge number of stakeholders and
- To work in a context where many activities are international.

In order to perform the requested mandated work, the ESOs established in July 2011, together with the relevant stakeholders, the CEN-CENELEC-ETSI Smart Grid Coordination Group (SG-CG), being responsible for coordinating the ESOs reply to M/490 (successor of the JWG on standards for smart grids).

In 2012, the SG-CG Group focussed on the following mandated aspects:

- A Technical Reference Architecture
- A Set of Consistent Standards
- Sustainable Standardization Processes

The ESOs also investigated standards for information security and data privacy [47]. These reports and additional information on the Smart Grids standardization activities are available on the CEN-CENELEC website [56].

CENELEC PROJECT SMARTHOUSE

Further co-ordination is needed for transition to a common standardisation process of all communicating home equipment and associated services, leading to coherent sets of standards and specifications of interoperability between ICT services & applications, advanced electronic devices (products), commands and controls, and networks in homes of European citizens.

The objective of the CENELEC SmartHouse Roadmap project (supported by the European Commission and the European Free Trade Association) is to provide strategic direction and co-ordination for the standardisation activities of the ESOs (ETSI, CEN and CENELEC), together with other bodies that are active in this space, in order to reflect properly the growth of the SmartHouse and all the services, applications, systems and networks associated with it and to encourage future market growth. The intention is to identify all existing initiatives or standardisation works in the area and to co-ordinate actions so that to the greatest extent existing and future work should deliver interoperable solutions for any 'SmartHouse' service or application.

SMARTHOUSE ROADMAP

The project deliverable, the Roadmap, identifies what is already available from whatever standardisation source, what is being developed, what additional work would be needed and what is redundant or duplicated was developed.

The Roadmap consists of a matrix of standardisation activities and referenced work that are clearly prioritised and sorted with regard to prerequisite activities as well as identifying specific areas where appropriate stakeholders may co-operate to identify and carry out future co-ordinated standards work.

CLC/TC 205 "Home and Building Electronic Systems" took the results of the project on board prior to the possible transfer of the SmartHouse Roadmap Project to an existing or newly established dedicated coordination group [49].

ELECTRIC VEHICLES

Standardization of electric vehicles is becoming an important issue. The need for clean energy and the support provided by smart-grids have led to new European policies that encourage the deployment of charging infrastructures for electrical vehicles.

There has been recent work internationally concerning charger and connector standards, but this work is not complete. We need to make sure that international standards meet European needs.

In 2010, CEN and CENELEC established a Focus Group on European Electro-Mobility. In October 2011, CEN/CENELEC delivered its response to European Commission Mandate M/468 (charging of electric vehicles).

The CEN/CENELEC report 'Standardization for road vehicles and associated infrastructure' defines the specific standardization requirements for European electro-mobility.

One of the main recommendations of the report was to establish a CEN-CENELEC eMobility Co-ordination Group with the aim to support coordination of standardization activities on Electro-Mobility [50].

ISO/IEC JTC 1/SWG 05 on the Internet of Things (IoT)

ISO/IEC JTC1 has established Special Working Group (SWG) 5. This group has the task of identifying the standardization gaps for the Internet of Things to allow JTC 1 to consider where work needs to be consolidated in the future in this arena.

The terms of reference of ISO/IEC JTC 1/SWG 5 are to:

- Identify market requirements and standardization gaps for IoT
- Encourage JTC 1 SCs and WGs to address the need for ISO/IEC standards for IoT
- Facilitate cooperation across JTC 1 entities
- Promote JTC 1 developed standards for IoT and encourage them to be recognized and utilized by industry and other standards setting organizations
- Facilitate the coordination of JTC 1 IoT activities with IEC, ISO, ITU, and other organizations that are developing standards for IoT
- Periodically report results and recommendations to ISO/IEC JTC 1/SWG 3 on Planning
- Provide a written report of activities and recommendations to JTC 1 in advance of each JTC 1 plenary
- Study IoT Reference Architectures/Frameworks and provide a study report. This study report should be written so it could be referenced in a possible JTC 1 New Work Item Proposal on IoT. The report shall be made available to JTC 1 no later than the 2014 JTC 1 Plenary.

The purpose of ISO/IEC JTC 1/SWG 5 is not to develop or publish IoT related standards, but to coordinate with ISO/IEC JTC 1 subcommittees, working groups, and special working groups and with other standards organizations to help better identify and convey the needs and gaps in the IoT world [51].

ISO/IEC JTC 1/SWG 5 is made up of four Ad Hoc groups, each of which carries out specific tasks in relation to IoT. The four Ad Hoc groups of ISO/IEC JTC 1/SWG 5 are:

Table 3. AD Hoc Groups of ISO/IEC JTC1/SWG 5

Ad Hoc Group	Working Area
Ad Hoc Group 1	Common understanding of IoT including IoT Mind Map and stakeholders
Ad Hoc Group 2	Identifying market requirements
Ad Hoc Group 3	Standardization gaps and roadmap for IoT
Ad Hoc Group 4	Study of IoT Reference Architectures/Frameworks

ISO/IEC JTC 1/WG 7 Sensor Networks

JTC1/WG7 is a standardization working group of the joint technical committee ISO/IEC JTC1 of the International Organization for (ISO) and the International Electrotechnical Commission (IEC), which develops and facilitates standards within the field of sensor networks.

The terms of reference for ISO/IEC JTC 1/WG 7 are [57]:
In the area of generic solutions for sensor networks, undertake standardization activities that support and can be applied to the technical work of all relevant JTC 1 entities and to other standards organizations. This includes activities in sensor networks such as the following:

- Standardization of terminology
- Development of a taxonomy
- Standardization of reference architectures
- Development of guidelines for interoperability
- Standardization of specific aspects of sensor networks

In the area of application-oriented sensor networks, identify gaps and overlaps that may impact standardization activities within the scope of JTC 1. Further, share this information with relevant entities within and outside of JTC 1. Unless better managed within another JTC 1 entity, this Working Group may pursue the following standardization activities as projects:

- Addressing the technology gaps within the scope of JTC 1 entities
- Exploiting technology opportunities where it is desirable to provide common approaches to the use of sensor networks across application domains
- Addressing emerging areas related to M2M and IoT

In order to foster communication and sharing of information between groups working in the field of sensor networks:

- Seek liaison relationships with all relevant SCs/WGs
- Seek liaison relationships with other organizations outside JTC 1
- Consider the possibility of conducting joint products with relevant ITU-T SGs
- Seek input from relevant research projects and consortia

ISO/IEC JTC 1/WG 7 currently has a number of standards published or under development within the field of sensor networks, including the ones shown in Table 4 :

Table 4. ISO/IEC JTC1/WG7 sensor networks standards [57]

ISO/IEC Standard	Title	Status	Description
ISO/IEC 29182-1	Information technology – Sensor networks: Sensor Network Reference Architecture (SNRA) – Part 1: General overview and requirements	Published (2013)	Provides a general overview of the characteristics of a sensor network and the organization of the entities that comprise such a network

ISO/IEC Standard	Title	Status	Description
ISO/IEC 29182-2	Information technology – Sensor networks: Sensor Network Reference Architecture (SNRA) – Part 2: Vocabulary and terminology	Published (2013)	Facilitates the development of International Standards in sensor networks by presenting terms and definitions for selected concepts relevant to the field of sensor networks
ISO/IEC 29182-3	Information Technology – Sensor Networks: Sensor Network Reference Architecture (SNRA) – Part 3: Reference architecture views	Under development	"Architecture views including business, operational, systems, and technical views which are presented in functional, logical, and/or physical where applicable"
ISO/IEC 29182-4	Information technology – Sensor networks: Sensor Network Reference Architecture (SNRA) – Part 4: Entity models	Published (2013)	Presents models for the entities that enable sensor network applications and services according to the SNRA
ISO/IEC 29182-5	Information technology – Sensor networks: Sensor Network Reference Architecture (SNRA) – Part 5: Interface definitions	Published (2013)	Provides the definitions and requirements of sensor network interfaces of the entities in the SNRA that covers the following aspects: • Interfaces between functional layers to provide service access for the modules in the upper layer to exchange messages with modules in the lower layer • Interfaces between entities introduced in the SNRA enabling sensor network services and applications
ISO/IEC 29182-6	Information Technology – Sensor Networks: Sensor Network Reference Architecture (SNRA) – Part 6: Application Profiles	Under development	Describes: • Functional blocks and components of a generic sensor network • Generic sensor network reference architecture incorporating the relevant sensor network-related base standards to support interoperability and data interchange
ISO/IEC 29182-7	Information Technology – Sensor Networks: Sensor Network Reference Architecture (SNRA) – Part 7: Interoperability guidelines	Under development	Provides • An overview of interoperability for heterogeneous sensor networks • Guidelines for interoperability between heterogeneous sensor networks
ISO/IEC 20005	Information technology – Sensor networks – Services and interfaces supporting collaborative information processing intelligent sensor networks	Published (2013)	Specifies services and interfaces supporting collaborative information processing (CIP) in intelligent sensor networks, which includes: • CIP functionalities and CIP functional model • Common services supporting CIP • Common service interfaces to CIP

ISO/IEC Standard	Title	Status	Description
ISO/IEC 30101	Information technology – Sensor Networks: Sensor Network and its interfaces for smart grid system	Under development	Describes: • Interfaces between the sensor networks and other networks • Sensor network architecture to support smart grid systems • Interface between sensor networks with smart grid systems • Sensor network based emerging applications and services to support smart grid systems
ISO/IEC 30128	Information technology – Sensor Networks – Generic Sensor Network Application Interface	Under development	Describes: • Generic sensor network applications' operational requirements • Sensor network capabilities • Mandatory and optional interfaces between the application layers of service providers and sensor network gateways

ISO/IEC JTC 1/SC 31 Automatic identification and data capture techniques

JTC1/SC31 is a standardization working group of the joint technical committee ISO/IEC JTC1 of the International Organization for (ISO) and the International Electrotechnical Commission (IEC), which develops and facilitates standards within the field of automatic identification technologies. These technologies include 1D and 2D barcodes, active and passive RFID for item identification and OCR.

Particular emphasis is currently being placed on devising structured security methods for RFID systems, including the use of cryptology. Data protection and authentication will be key requirements for the ubiquitous networks being proposed.

JTC1/SC31 has developed a large catalogue of barcode and RFID standards which underpin the existing AIDC applications which capture, store and provide access to data. Increasingly, these applications operate without human intervention, with both data capture and system response being automatic with private intranets providing the transport and discovery mechanisms. These systems already provide the edge of the emerging Future Internet.

A number of SC31 experts are members of SWG5. The results of that work are awaited before further IoT work items are created.

CEN/TC225 has liaison status with SC31, and from time to time ISO standards are adopted as ENs through the UAP process. A recent example has been ISO 29160 RFID Emblem.

ETSI

Figure 3 ETSI Technology Clusters (Source: ETSI [58])

ETSI is a producer of globally applicable standards for ICT, including fixed, mobile, radio, converged, broadcast and Internet technologies. The Institute is at the forefront of emerging technologies. It is building close relationships with research bodies and addressing the technical issues that will drive the economy of the future and improve life for the next generation. For many years ETSI has been a driving force behind mobile communications systems, playing a prominent role as one of the founding partners of the Third Generation Partnership Project (3GPP). As well as long-established activities, ETSI is also responding to a new challenge in which ICT is either driving or facilitating other sectors such as transportation, utilities, eHealth, Cloud, smart cities, smart manufacturing and ambient assisted living.

The nature of ICT is pervasive and drives changes affecting the economy, society and politics. Society is increasingly dependent on ICT infrastructures which drive the needs for standards. In ETSI Long Term Strategy, ETSI aims to position itself closer to the research and innovation ecosystems of its members as well as European research and development programmes. ETSI maintains close links with the research community and participate in relevant European Commission Framework Programme 7 (FP7) and Horizon 2020 projects. In this way ETSI aims to identify new technologies with a standardisation need. ETSI role in these projects varies. For example, ETSI wide ranging expertise means it can help drive innovation in diverse areas, such as improving the quality of life through eHealth and Smart Personal Health (SPH). ETSI Centre for Testing and Interoperability (CTI) works on test specifications for a vehicle to grid interface for charging electric vehicles.

ETSI is supporting the implementation and evolution of the European Union's Global Navigation Satellite System (GNSS) programmes, EGNOS and Galileo. The Institute is a partner in EC GSA Project SUNRISE [59], which runs the Open GNSS Service Interface Forum [60] for two industrial user groups of GNSS and future Galileo services, Location Based Services (LBS) and Intelligent Transport Systems (ITS). Links between LBS and the 'Internet of

Things' (IoT) have been established. Here is an opportunity for GNSS, Augmented Reality and IoT to collaborate on LBS.

An ever increasing number of everyday machines and objects are now embedded with sensors or actuators and have the ability to communicate over the Internet. These 'smart' objects can sense and even influence the real world. Collectively they make up what is known as the 'Internet of Things'. The IoT draws together various technologies including Radio Frequency Identification (RFID), Wireless Sensor Networks (WSNs) and Machine-to-Machine (M2M) service platforms. ETSI is addressing the issues raised by connecting potentially billions of these 'smart objects' into a communications network, by developing the standards for data security, data management, data transport and data processing. This will ensure interoperable and cost-effective solutions, open up opportunities in new areas and allow the market to reach its full potential.

ETSI Machine-to-Machine Communications Technical Committee (TC M2M/TC smartM2M) is addressing the application independent 'horizontal' service platform within the M2M architecture which, with its evolved functionality, is capable of supporting a very wide range of services, including smart metering, smart grids, eHealth, city automation, consumer applications and car automation. ETSI will address the second phase of work in response to the European Commission (EC) mandate on Smart Metering (M/441), which includes security, use cases and the monitoring of deployments. ETSI responded to the 'Smart Grid Mandate' (M/490) with a discussion on a view to include the architectural models developed for M/441.

After oneM2M partnership project creation, in TC M2M, the future will be at System Level. New Terms of Reference have been endorsed by the ETSI board in September 2013 with Consolidation of transfer towards oneM2M and a rename of the TC M2M into TC SmartM2M. Considering the M2M platform environment at a system level with a focus on:

- Interoperability with M2M Area Network,
- Interoperability with 3GPP Networks,
- End to End Security and
- Introducing Additional functionalities and APIs (ex: Abstraction layer, data models).

ETSI TC SmartM2M will Publicize M2M platform (Provide tutorials and developers guides), Provide matched solutions in the framework of the 20-20-20 directive and standardization mandates on key issues: Security, Authentication /Identification and Interoperability. ETSI facilitates IoT semantic interoperability in TC SmartM2M.

As machine to machine applications proliferate, the market for embedded communications modules will expand. This introduces a challenge for both module manufacturers and those who integrate modules into applications to avoid fragmentation, improve volume and scalability, and facilitate integration and evolution. To address the need for new standards in this area ETSI has created an Industry Specification Group (ISG) for specifying a form factor for embedded modules to meet the requirements of emerging non-traditional mobile devices in support of embedded mobile services across multiple vertical markets. The standard will specify electrical as well as mechanical

aspects, including the I/O interfaces, pad placement and module dimensions, targeting Surface Mount Technology (SMT) as manufacturing technology.

A large part of future IoT systems and devices will rely on wireless communication technologies deploying frequency spectrum as the main resource. In ETSI the Electromagnetic Compatibility and Radio Spectrum Matters Technical Committee (TC ERM) is responsible for the management and standardization of the spectrum usage for all wireless systems in Europe. In this sense TC ERM lays the ground for the future success of IoT by providing and managing the core resource for the communication.

TC ERM is maintaining all European Standard (EN) for spectrum usage. Some examples are given below:

- Radio LAN in 2.4GHz (ERM TG11)
- Cooperative ITS in 5.9GHz and 60GHz(ERM TG37)
- Short Range devices in 9KHz to 300GHz(ERM TG28)
- Ultra Wide Band in 3.1GHz to 100GHz(ERM TGUWB)
- RFID (ERM TG34)
- Wireless Industrial in 5.8GHZ (ERM TG41)

As part of these activities TC ERM actively identifies the spectrum requirements for existing and upcoming applications and drives the provision of the required spectrum resource by the European CEPT. This is done by providing CEPT with System Reference Documents (SRDoc) for all kinds of wireless applications like Smart Metering, Automotive, Home Automation, Smart Cities, Cooperative ITS and Alarms to guide spectrum allocations and regulation updated in Europe. The regulation results are used in TC ERM to generate Technical Specifications linking key market standards with European specific requirements and updated spectrum regulations. These harmonized standards are the basis for the market introduction of wireless devices based on the European Radio Equipment Directive.

As an important example for the work in TC ERM for the support of IoT the activities on Short Range Device (SRD) radio equipment in the 9 kHz - 300 GHz band should be mentioned. These activities are mainly managed in the TG28 (SRD), TG 34(RFID) and the TGUWB. In the scope of these activities the applications like RFIDs for national ID cards and passports, Near Field Communication (NFC) and also wireless charging are handled.
The main challenge for the future will be the identification and provisioning of the required spectrum resources for the upcoming IoT applications without scarifying existing applications.

Many of the connecting objects in M2M and the IoT need only low throughput connectivity. ETSI Industry Specification Group on Low Throughput Networks (ISG LTN) is specifying a new ultra low power network for very low data rates for ultra-long autonomy devices to provide an efficient connection that is both cost-effective and low in energy consumption. ETSI ISG LTN has begun defining use cases and a dedicated architecture for LTN.

ETSI is also developing a new application of Digital Enhanced Cordless Telecommunications (DECT) Ultra Low Energy (ULE) for use in sensors, alarms, M2M applications and industrial automation.

ETSI Satellite Earth Stations and Systems Technical Committee develops standards for all types of terminals transmitting to a satellite: satellite terminals including hand portables, VSATs as well as devices mounted on aircraft, vessels, trains and vehicles. Recently a standard has been published for Earth station on board mobile platforms operating at Ka band.

CyberSecurity is providing the means for protecting the user and creating a more secure and profitable environment for industry and commerce. ETSI security work addresses numerous aspects including mobile/wireless communications, information technology infrastructure, lawful interception and data retention, electronic signatures, smart cards, fixed communications and security algorithms.

For ETSI, Security is a key element in standardisation and affects most areas of its work. ETSI Industry Specification Group on Information Security Indicators (ISG ISI) objectives are to address the full scope of main missing security event detection issues. Currently reference frameworks in the Cyber Defence and Security Information and Event Management (SIEM) fields are often missing or are still very poor, thus hindering IT security controls benchmarking. This is why we need IT security indicators which are related to event classification models.

ETSI is looking into the possible replacement of the Terrestrial Trunked Radio (TETRA) air interface encryption algorithm, and ETSI is developing a Technical Report on security-related use cases and threats in Reconfigurable Radio Systems (RRS). ETSI liaises with CEN as new standards are developed in response to EC Mandate 436 on the privacy and security of RFID. Other ongoing activities include Quantum Key Distribution. ETSI Industry Specification Group on Identity and access management for Networks and Services (ISG INS) is developing architecture and protocol specifications for advanced identity management in the Future Internet including the Internet of Things.

Improving the quality of health care, reducing medical costs and fostering independent living for those needing care are key objectives of the Digital Agenda for Europe. Telemedicine, for example, can improve the treatment of patients both at home and away, and reduces unnecessary hospitalisation. However, figures from the World Health Organisation show that only 8% of patients today use tele-monitoring. Medical issues are currently a key focus of work in TC ERM.

ETSI signed an important new co-operation agreement with its partner European Standards Organizations, CEN and CENELEC. ETSI has had an agreement in place since 1990 and has continuously co-operated since then. However, this new agreement will, for the first time, enable the creation of joint technical committees to produce joint standards which will be published by the three bodies.

References: [15], [16], [17], [18], [19].

IEEE

Overview

It is predicted that 50 to 100 billion things will be electronically connected by the year 2020. This Internet of Things (IoT) will fuel technology innovation by creating the means for machines to communicate many different types of information with one another. With all objects in the world connected, lives will be transformed. But the success of IoT depends strongly on standardization, which provides interoperability, compatibility, reliability, and effective operations on a global scale. Recognizing the value of IoT to industry and the benefits this technology innovation brings to the public, the IEEE Standards Association (IEEE-SA) develops a number of standards, projects, and events that are directly related to creating the environment needed for a vibrant IoT [20].

The IEEE-SA has also recognized that the IoT incorporates aspects from many fields of technology. Here are some highlights from some of the fields encompassed in IoT.

The main focus of the IEEE standardisation activities are on the lower protocol layers namely the Physical layer and the MAC layer.

The IEEE laid an early foundation for the IoT with the IEEE802.15.4 standard for short range low power radios, typically operating in the industrial, scientific and medical (ISM) band. Having shown some limitations with the initial solutions such as ZigBee, the basic 15.4 MAC and PHY operations were enhanced in 2012 to accommodate the requirements of industrial automation and Smart Grid metering.

The new version of the standard introduced the 802.15.4g PHY, which allows for larger packets up to two Kilo-Octets and in particular comfortably fits the IPv6 minimum value for the maximum transmission unit (MTU) of 1280 octets, and the 802.15.4e MAC, which brings deterministic properties with the Time Slotted Channel Hopping (TSCH) mode of operation.

The value of the TSCH operation was initially demonstrated with the semi-proprietary wireless HART standard, which was further enhanced at the ISA as the ISA100.11a standard, sadly in an incompatible fashion.

IEEE ComSoc has appointed the key partners of the IoT6 project to lead the newly created IoT track within the Emerging Technologies Committee. IoT6 created a web site and attracted 400 members in the first 3 months: http://www.ipv6forum.com/iot//. IoT6 will use this platform to disseminate IoT6 solutions on a large scale basis. The Globecom IoT track is under preparation. [4].

Cloud Computing

Cloud computing offers the promise of ubiquitous, scalable, on-demand computing resources provided as a service for everything from mobile devices to supercomputers. Cloud computing offers end consumers a “pay as you go” model— a powerful shift for computing towards a utility model like the

electricity system, the telephone system, or more recently the Internet. IEEE is coordinating the support of cloud computing through its Cloud Computing Initiative, the first broad-based collaborative project for the cloud to be introduced by a global professional association.

The concept of a cloud operated by one service provider or enterprise interoperating with a cloud operated by another provider is a powerful means of increasing the value of cloud computing to industry and users. Such federation is called the "Intercloud." IEEE is creating technical standards for this interoperability. The IEEE Intercloud Testbed ("Testbed" for short) creates a global lab - to prove and improve the Intercloud, based on IEEE P2302 Draft Standard for Intercloud Interoperability and Federation. To that end, IEEE is partnering with companies, universities, and research institutions around the world to create a well-connected standards-based platform for the Intercloud. The IEEE Cloud Computing Testbed also could be used to experiment with other IEEE cloud computing products and services such as eLearning education modules [21].

eHealth

IEEE has many standards in the eHealth technology area, from body area networks to 3D modeling of medical data and personal health device communications. Another area is the IEEE 11073™ family of standards is a group of standards under Health Informatics/Personal Health Device Communication, for data interoperability and architecture. IEEE 11073 standards are designed to help healthcare product vendors and integrators create devices and systems for disease management, health and fitness and independent living that can help save lives and improve quality of life for people worldwide. IEEE is part of a larger ecosystem and has active collaborative relationships with other global organizations such as:

- Health Level Seven International (HL7), with a focus on data exchange/delivery)
- Integrating the Healthcare Enterprise (IHE), with a focus on development domain integration and content profiles
- International Health Terminology Standards Development Organisation (IHTSDO) with a focus on Systematized Nomenclature of Medicine Clinical Terms (SNOMED) Clinical Terminology
- ISO and CEN, both of which adopt many of the IEEE 11073 standards

This allows IEEE standards to be developed and used within a framework for interoperable medical device communications worldwide. The growing IEEE 11073 family of standards is intended to support interoperable communications for personal health devices and convey far-ranging potential benefits, such as reducing clinical decision-making from days to minutes, reducing gaps and errors across the spectrum of healthcare delivery, and helping to expand the potential market for the medical devices themselves [22].

eLearning

The IEEE Learning Technology Standards Committee (LTSC) is chartered by the IEEE Computer Society Standards Activity Board to develop globally

recognized technical standards, recommended practices, and guides for learning technology. The IEEE LTSC coordinates with other organizations, both formally and informally, that produce specifications and standards for learning technologies. The IEEE LTSC has activities in several eLearning areas, including Digital Rights Expression Languages, Computer Managed Instruction, Learning Object Metadata, and Resource Aggregation Models for Learning, Education and Training, Competency Data Standards [23].

Intelligent Transportation Systems (ITS)

IEEE has standards activities on many aspects of ITS, such as vehicle communications and networking (IEEE 802 series), vehicle to grid interconnectivity (IEEE P2030.1), addressing applications for electric- sourced vehicles and related support infrastructure, and communication for charging (IEEE 1901). In addition, the IEEE 1609 family of standards for Wireless Access in Vehicular Environments (WAVE) defines an architecture and a complementary, standardized set of services and interfaces that collectively enable secure vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) wireless communications. Together these standards are designed to provide the foundation for a broad range of applications in the transportation environment, including vehicle safety, automated tolling, enhanced navigation, traffic management, and many others. As part of the global technology ecosystem, IEEE VTS/ITS collaborates and coordinates with many other organizations. IEEE VTS/ITS 1609 WG experts have participated in the exchange of IEEE draft documents to facilitate the expeditious development of profiles for use of IEEE drafts for European Norms (ENs) [24].

Network and Information Security (NIS)

IEEE has standardization activities in the network and information security space, including in the encryption, fixed and removable storage, and hard copy devices areas, as well as applications of these technologies in smart grids. IEEE's largest technical society, the IEEE Computer Society, is well equipped to provide technical expertise in network and information security efforts. For over thirty years, the IEEE Computer Society has had a technical committee focused on computer security and privacy. It publishes the well-respected IEEE Security & Privacy magazine, which offers articles by top thinkers in the information security industry, and sponsors two long-established premier technical meetings, the IEEE Security and Privacy Symposium and the Computer Security Foundation Workshop. IEEE-SA's Industry Connections Security Group is another important activity, providing a flexible and nimble platform for stakeholders to respond to the new malware environment. It has three key activities [25]:

- The Malware MetaData Exchange Format (MMDEF) Working Group, which develops the MMDEF format. It is used primarily by anti-virus companies and researchers to exchange information about malware and known clean files.
- The Stop-eCrime Working Group, which develops various resources (taxonomies, protocols, guidelines, etc.) to help stop electronic crime.

- The Privilege Management Protocols Working Group, which develops new mechanisms and protocols for efficient authentication and secure determination of "who" can do "what" in applications.

Smart Grid

IEEE-SA has many smart grid standards and projects in development from the diverse fields of digital information and controls technology, networking, security, reliability, assessment, interconnection of distributed resources including renewable energy sources to the grid, sensors, electric metering, broadband over power line, and systems engineering.

IEEE has established a wide range of relationships across many geographic and SDO boundaries. Coordination and collaboration across the standards community are necessary to ensure that the smart grid can realize its full potential. IEEE has relationships with organizations that allow partnership in the development of standards. Our partners in international collaboration include:

- International Electrotechnical Commission (IEC)
- International Organization for Standardization (ISO)
- International Telecommunication Union (ITU)
- Korean Agency for Technology and Standards (KATS)
- Korea Electronics Association (KEA)
- Korean Society of Automotive Engineers (KSAE)
- State Grid Corporation of China (SGCC)
- Telecommunication Technology Committee (TTC)
- Telecommunications Technology Association (TTA)
- European Telecommunications Standards Institute (ETSI)

IEEE also participates in groups such as the India Smart Grid Forum, the Smart Grid Interoperability Panel (SGIP), and the steering committee of the European Technology Platform for the Electricity Network of the Future (ETP SmartGrids).

The IEEE 2030 series for smart grid interoperability currently consists of half a dozen standards and ongoing projects. IEEE 2030 is based on a smart grid interoperability reference model (SGIRM) and provides alternative approaches and best practices for smart grid work worldwide. Also IEEE has been involved with smart grid technologies for many years, including integrating distributed resources that incorporate renewable energy (IEEE 1547). In addition, the IEEE 1547 series of standards deals with many different facets of renewable energy, such as microgrids (IEEE 1547.4) and secondary networks for distributed resources (IEEE 1574.6).

As the smart grid evolves, IEEE is looking at the next phase of the evolution with standards projects such as time synchronization (IEEE C37.238) and cyber security (IEEE PC37.240 and IEEE P1686) [26].

IETF

The most recognizable enhancement by ISA100.11a is probably the support of IPv6, which came with the 6LoWPAN Header Compression, as defined by the IETF.

Another competing protocol, WIAPA, was developed in parallel in China, adding to fragmentation of the industrial wireless automation market, and ultimately impeding its promised rapid growth.

A strong request is now coming from the early adopters, in the industrial Process Control space, for a single protocol that will unify those existing protocols in a backward compatible fashion, and extend them for distributed routing operations. Distributed operations are expected to lower the deployment costs and scale to thousands of nodes per wireless mesh network, enabling new applications in large scale monitoring. The 6TiSCH Working Group is being formed at the IETF to address the networking piece of that unifying standard.

Based on open standards, 6TiSCH will provide a complete suite of layer 3 and 4 protocols for distributed and centralized routing operation as well as deterministic packet switching over the IEEE802.15.4e TSCH MAC. Most of the required 6TiSCH components already exist at the IETF in one form or another and mostly require adaptation to the particular case, and 6TiSCH will mostly produce an architecture that binds those components together, and provide the missing glue and blocks either as in-house RFCs, or by pushing the work to the relevant Working Groups at the IETF.

Yet, there is at least one entirely new component required. That component, 6TUS, sits below the 6LoWPAN HC layer in order to place the frames on the appropriate time slots that the MAC supports, and switch frames that are propagated along tracks that represent a predetermined sequence of time slots along a path. Centralized routing is probably a case where work will be pushed outside of the 6TiSCHWG. That component will probably leverage work that was done at the Path Computation Element (PCE) Working Group, and require additions and changes such as operation over the CoAP protocol, and new methods for advertising links and metrics to the PCE. All this work probably belongs to the PCE WG. Another example is the adaptation of the IPv6 Neighbour Discovery (ND) protocol for wireless devices (WiND) that will extend the 6LoWPAN ND operation and will probably be conducted at the 6MAN working group in charge of IPv6 maintenance.

Distributed route computation and associated track reservation, on the other hand, can probably be addressed within the 6TiSCH Working Group, as it is expected to trivially extend the existing RSVP and RPL protocols.

Same goes for PANA that may be extended to scale the authentication to the thousands of devices. The next step for this work is a so called BoF in July 2013 in Berlin. The BoF will decide whether a WG should be formed and determine the charter for that WG [4].

In November 2013 a new IETF WG, 6lo, was created. 6lo (IPv6 over Network of Resource Constrained Nodes) will continue the work of 6LoWPAN WG on IPv6-over-foo adaptation layer specifications. These specifications are based

on the 6LoWPAN specifications RFC 4944, RFC 6282, and RFC 6775, but will not embody routing, which is out of scope. The workgroup will work closely with 6man (IPv6 Maintenance), intarea (Internet Area Working Group), lwig (Light-Weight Implementation Guidance), Core, and Roll. The WG drafts, as of January 2014 are:

- draft-ietf-6lo-btle-00
- draft-ietf-6lo-ghc-00
- draft-ietf-6lo-lowpan-mib-00
- draft-ietf-6lo-lowpanz-01

ITU-T

The Telecommunication Standardization Sector of the International Telecommunication Union (ITU-T) is progressing standardization activities on Internet of Things (IoT) since 2005.

After a report on "The Internet of Things", published by the ITU in 2005, the ITU-T established a Joint Coordination Activity (JCA-NID), which aimed at sharing information and performing coordination in the field of network aspects of Identification systems, including RFID. The JCA-NID supported the work of the ITU-T Study Groups which led to the approval of initial Recommendations in the areas of tag-based identification services, Ubiquitous Sensor Networks (USN) and Ubiquitous Networking, and their application in Next Generation Networks (NGN) environment.

With the official recognition in 2011 of the centrality of IoT in the evolution of future network and service infrastructures, the JCA-NID was renamed as JCA-IoT (Joint Coordination Activity on Internet of Things) [61] and the working structure of the IoT-GSI (IoT Global Standards Initiative) [1] was formally established.

Since then, the ITU-T activities related to IoT have greatly expanded and produced additional Recommendations spanning various areas of application (e.g. networked vehicles, home networks, mobile payments, e-health, machine oriented communications, sensor control networks, gateway applications, ubiquitous applications (u - plant farming etc.), energy saving in home networks), as well as IoT framework and transversal aspects (basic concepts and terminology, IoT common requirements, ecosystem and business models, web of things, IoT security and testing etc.)[4].

Beyond the above mentioned IoT focused activities and a number of IoT work items currently under development in the IoT-GSI within various ITU-T study groups (the main ones being SG11, SG13, SG16 and SG17), other potential future IoT studies are included in the "IoT-GSI work plan" (a living list of potential studies maintained by the IoT-GSI).
In addition, it has to be noted that there have been and are other ITU-T on-going studies closely related to the IoT. It is worthwhile to mention here:

- an effort on transversal aspects (the Focus Group on M2M Service Layer - see below);
- some efforts focused on specific IoT application domains, including the Focus Group (FG) on Smart Sustainable Cities, the collaboration

initiative on Intelligent Transport Systems (ITS) communication standards, the FG on Car Communication (concluded in 2013), the FG on Smart Grid (concluded in 2011);

- ongoing studies with an indirect relationship with the IoT, related to Future Networks, Service Delivery Platforms and Cloud Computing

In parallel with the JCA-IoT's coordination efforts with external entities and its maintenance of a cross-SDO list of IoT standard specifications and associated roadmap (the "IoT Standards Roadmap", freely available from the JCA-IoT web page [62]), a remarkable milestone has been achieved by the IoT GSI via the finalization in June 2012 of the ITU-T Recommendation Y.2060 [2]. This Recommendation includes, among others, a definition of the IoT which has obtained large acceptance within the IoT community, including across different standards development organizations. It has to be noted, in this perspective, that the Machine to Machine (M2M) communication capabilities are seen as an essential enabler of the IoT, but represent only a subset of the whole set of capabilities of the IoT.

Among the various ITU-T IoT-related efforts, the Focus Group on M2M Service Layer (FG M2M) [9] deserves a special mention: established in 2012 with the key goal to study requirements and specifications for a common M2M Service Layer, it has focused its developments – from the point of view of use cases and derived requirements for the common M2M service layer - on the "e-health" application domain (specifically, on remote patient monitoring and assisted living services). The FG M2M, who had targeted the inclusion of vertical market stakeholders not part of the traditional ITU-T membership, such as the World Health Organization (WHO), and the collaboration with M2M and e-health communities and SDOs, has actually liaised with various SDOs, fora and consortia, including for the completion of an e-health standards repository.

The FG M2M work, whose last physical meeting was held in London in December 2013 and whose final electronic meeting on editorial aspects will take place at the end of March 2014, has completed five deliverables [9] dealing with, respectively, e-health use cases, e-health ecosystem, M2M service layer requirements and architectural framework, overview of M2M service layer APIs and protocols, and e-health standards repository and gap analysis.
In the context of the FG M2M service layer work, in line with the IoT Reference Model described in ITU-T Y.2060, the M2M service layer capabilities aim to include those common to the support of different application domains as well as the specific ones required for the support of each application domain [4].

Lastly, it is worthwhile to mention the recent ITU-T workshop "IoT – Trends and Challenges in Standardization", Geneva, 18 February 2014, where the main achievements and current activities of ITU-T on IoT have been presented (together with inputs from other efforts of the IoT standards, academic and open source communities) [10]:

IERC and ITU-T have entertained good relationships all along the IoT standardization activities of ITU-T, particularly in the context of JCA-IoT and IoT-GSI. IERC has liaised with ITU-T and taken an active role in the discussions which led to the finalization of the ITU-T definition of "Internet of

Things" and the approval of ITU-T Y.2060 (aspects related to IoT Reference Model, IoT Ecosystem, high-level requirements of IoT and other IoT definitions). More recently, representatives of the IERC IoT-A project have actively participated and contributed to the progress of the ITU-T studies on IoT common requirements and, in perspective, their participation is expected on the progress of the ITU-T studies on IoT capabilities and functional architecture. On the other side, representatives of ITU-T have attended over the last period some IERC meetings in order to provide updates on ongoing ITU-T work and contribute to strengthen the international collaboration on IoT standards. The ITU and IERC collaboration and coordination are expected to continue in the future: beyond the ongoing collaboration on IoT framework aspects (including that expected on semantics and big data matters), it might involve also IoT "vertical" matters, for example e-health (ITU-T SG13 and SG16), Smart Cities (FG on Smart Sustainable Cities etc.), Intelligent Transport Systems (collaboration initiative on ITS communication standards) etc.

The IoT6 and IoT Lab projects will maintain an on-going communication with the ITU-T through their Coordinator, Mandat International, which is a member of the ITU-T, following the JCA-IoT activities.

OASIS

Widely distributed networks of heterogeneous devices and sensors, as expected in the growing Internet of Things, require the agile combination of several advanced ICT methodologies, deployed together in massively scalable ways. Among other things:

- Network communications must use established basic patterns for *reliable transactional messaging and interaction*, and data protocols suitable for high-speed, high-volume transacting using vendor-neutral systems.

- Functions, services and actions must be made *modular and re-useable*, so that they can be shared and invoked by wide variety of different systems. Computing operations must be capable of being conducted across remote, distributed and parallel resources, to obtain the increased speed, easy scalability and ready availability available from *cloud computing* methodologies.

- The large volumes of data generated by these systems, which pervasively touch personal lives, businesses and locations, must have powerful and discrete *access control and cybersecurity capabilities*, so as to conform to public policy and business requirements for privacy and security.

Transactional Reliability

The basic requirements for reliable automated interaction patterns -- covering a variety of logical needs such as resolution of duplicates, acknowledgements, the handling of sequentially ordered steps and Quality-of-Service -- emerged over time as we learned how to design open, heterogeneous networked systems. Many of them were refined as part of a series of early standards

serving the evolution of open middleware systems, such as W3C's Simple Object Access Protocol (SOAP) and OASIS's WS-Reliable Messaging and ebXML Messaging.

Today, as we create much larger and more loosely-coordinated systems, using cloud computing at scale -- connecting huge numbers of often-computationally-low-powered devices and entities -- our systems require more compact and simple transactional protocols that still support those logical needs, with a very low profile of resource use, but that also still hold up under ultra-high-volume and ultra-high-speed conditions. OASIS standards projects to fulfill that requirement include the OASIS **Message Queuing Telemetry Transport (MQTT) TC,** explicitly designed for IoT networks and based on the already-industry-deployed MQTT v3.1 and the Eclipse Foundation open source framework; and the OASIS standard **Advanced Message Queuing Protocol (AMQP),** widely used in the financial industry. Each project is developing a suite of related protocols and extensions for interoperability.

Modularity, reusability, and devices in the Cloud

In created automated networks, one design choice that has persisted from the earliest days of e-commerce and web services is the need to encapsulate computing functions into re-usable and vendor-neutral services, so that they can be deployed in combinations, freely across systems and owners, like LEGO blocks that will snap together readily in multiple combinations. Early work to define and assure that outcome included OASIS's SOA Reference Model.

As the use of distributed, remote computing resources to build systems ("cloud computing") became widespread, individual services have been pressured to create endpoints which were widely useable by strangers; one method is by issuing defined instructions and calls for those functions that can be used by coders and systems, such as Application Programming Interfaces (APIs). As the degree of automation, and the number of services, has grown exponentially, the industry necessarily has developed more and more advanced methods for finding, running and coordinating those services, singly and in aggregations. IoT device networks have all those same cooperation and interoperability requirements -- but often pushed down into much less computationally-robust devices. The "things" in those networks, and the protocols that employ and drive them, may have much more need for substitution, duplication and fail-over, when random bits of far-flung, barely-smart-devices fail, or respond only intermittently.

Industry standards projects to make that possible include the OASIS **Cloud Application Management for Platforms (CAMP) TC,** an interoperable protocol for self-service provisioning, monitoring, and control of portable applications, and the OASIS standard **Topology and Orchestration Specification for Cloud Applications (TOSCA),** which can be used to describe and direct cloud infrastructure services and applications across multiple networks and different providers.

OASIS members also have developed a set of open standards web services tools for device discovery and management, including the OASIS standards **Devices Profile for Web Services** and **Web Services Dynamic Discovery (WS-Discovery).** The OASIS **Open Services for Lifecycle**

Collaboration (OSLC) projects apply the W3C's Linked Data Platform semantic methodology to describe, find parts of and help control networks of far-flung networked devices and systems, with specific application to M2M and smart devices being addressed by the OASIS **OSLC Lifecycle Integration for TC.**

Another OASIS project, the **OASIS Biometrics TC,** is defining lightweight REST protocols for biometric security sensors and controls based on US NIST's WS-BD. Finally, a suite of OASIS standards projects for remote device interaction and control ,developed in cooperation with and endorsed by the US Smart Grid Interoperability Program, provide open service scheduling, date and time, price and demand functions -- permitting dynamic two-way interactions and queries, all the way from consumer home devices to regional utility infrastructure nodes and servers -- via the **OASIS WS-Calendar** and **Energy Market Information Exchange TCs.**

All that Big Data from All Those Things: Access Control, Cybersecurity and Privacy

The sheer amount of data generated by far-flung device and sensor networks, when multiple systems are capable of being connected or jointly queried, is unprecedented in human history ... as are the privacy intrusion and security risk problems that it creates. When our technology makes it possible for external and even anonymous queries to reach sensors and servocontrols in every home, every business, and perhaps every shirt pocket in the world, our industry's policy and cybersecurity challenges are radically multiplied. This makes careful, pervasive application of deliberate methodologies for access control, rules implementations, and security on the wire essential. Privacy and security cannot be left behind, in the changing architecture of mobile and remote devices.

Access control

OASIS is the home of several of the most successful and widely-deployed open standards for access control and secure multiparty transacting. Our Security Assertion Markup Language (SAML) has been the most-widely-used and -known open standard for identity management for years, and most newer standards projects either use or duplicate its logical structure for assertions and authorization. It is widely tooled, and among other things is widely deployed in government and academic systems; SAML even drives authorization for ISO's own standards creation and document management platform. The OASIS eXtensible Access Control ML (XACML) provides advanced discrete access control capabilities including profiles for role-based access control, REST architecture, export controls and intellectual property license control.

Deploying that advanced functionality in wider networks with sparse control structures has been the subject of several advanced OASIS projects, including the OASIS Identity in the Cloud TC, whose gap analysis work has been widely used by global standards bodies to identify areas for additional standardization and the OASIS Cloud Authorization TC.

Encryption and cybersecurity

Standards bodies have produced a number of secure solutions for human-interfaced systems (such as Web sessions), going back all the way to the ITU's X.509 PKI certificates, and their use in the widely-deployed Secure Socket Layer (SSL) and IETF's HTTPS (RFC 2818). Standardized methods apply cybersecurity and authentication functions on the wire compactly in networked exchanges are a more recent development. OASIS projects that fulfil that demand include the OASIS standard Key Management Interoperability Protocol (KMIP), and the mobile and cloud computing functionality being added to the widely-used Public-Key Cryptography Standard #11 cryptography specification by the OASIS PKCS #11 TC. Both were recently demo'ed as key M2M and IoT cybersecurity tools at the 2104 RSA Conference. OASIS members also developed the OASIS standard SOAP-over-UDP, extending W3C's SOAP for use over the widely-used IETF RFC 768 User Datagram Protocol (UDP), a terse core Internet data transport method for simple systems.

Privacy

Much of the promise of the Internet of Things will be lost, if we cannot keep our promises both about functionality and the appropriate use of data. In addition to ensuring correct targeting of recipients (access control) and safety of data on the wire (e.g., encryption), systems *must* be able to accurately express and execute rules about the privacy of and limitations for the data that is exchanged. In highly-automated and networked transactions, it is essential that the legal and business rules for private and limited-access information be baked into the design of systems at the start; controls or interdictions applied afterwards as a last-minute thought have a long history of failure.

Key open standards projects for ensuring that privacy functions are native in networked systems include the OASIS **Privacy Management Reference Model (PMRM) TC,** which defines an openly-available privacy technical model and a structured, modeled set of common implementable services and interactions which can tie network functions and events to the fulfillment of policy requirements in auditable ways; and the OASIS **Privacy by Design for Software Engineers (PbD-SE) TC,** which is developing a privacy governance model for code expressed in, among other things, guidance for interface design and code tools including in OMG's UML.

OGC

The phrase “spatial is important” is almost always relevant to IoT. From a geographical information perspective, some important facts are: every sensor has a location, and location is always important. Secondly, outputs from multiple Internet-connected sensors sampling the same phenomena, such as temperature or salinity, can be aggregated to form a GIS data layer. Finally, IoT is a collection of local computational devices distributed through a physical space, in which distance matters and where the system should explicitly using the concept of space in computations. Accurate handling of location information in IoT is being built on the standards for location well established by several standards developing organizations, in particular as established by the Open Geospatial Consortium (OGC) [11].

In 2012 OGC members established the Sensor Web for Internet of Things Standards Working Group and started the development of the SensorThings API. Developed based on the existing OGC Sensor Web Enablement (SWE) standards, the SensorThings API is a new light-weight standard designed specifically for IoT devices and applications. The existing OGC SWE standards enable all types of sensors and actuators discoverable, accessible and re-useable via the Web. These standards have been widely implemented around the world. SWE standards, however, are as complex as necessary to support tasks such as controlling Earth imaging satellites and archiving national libraries of geological observation data, and thus are, too "heavyweight" for the resource-constrained IoT applications. The OGC SensorThings API can be considered as a lightweight SWE profile suited particularly for IoT applications. As a result, the OGC SensorThings API is a new and efficient API based on the proven and widely implemented SWE standard framework.

The OGC SensorThings API is currently a standard candidate and has been released for public review. A summary of the current SensorThings API is described as follows. The current SensorThings API candidate consists of two layers of standards for connecting various types of IoT sensing devices. Each standard layer deals with a 'level of interoperability' issue. The first layer is the ***IoT Resources Model Layer*** that enables the understanding and use of heterogeneous IoT devices, their sensing and control capabilities, and associated metadata. This layer consists of the standards based data model describing the entities (*i.e.*, Resources in the Resource-Oriented Architecture) and their relationships. The second layer is the ***IoT Service Interface Layer*** that defines (1) the URI patterns for IoT resource addressing, (2) the CRUD (CREATE, READ, UPDATE, and DELETE) operations capable of being performed against the IoT Resources, and (3) the available query parameters for filtering the IoT resources.

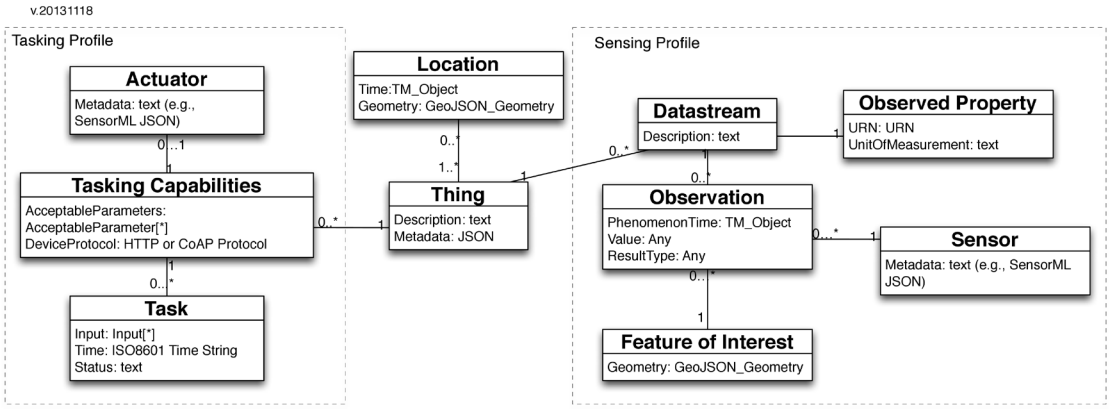

Figure 4 SensorThings IoT Resources Model

Figure 4 illustrates the SensorThings IoT Resources Model. It has two profiles, namely the sensing profile (Right figure) and the control profile (Left figure). The sensing profile consists of the resources that allow users and applications to understand the data collected by the IoT sensors. The control profile consists of the resources that allow users and applications to send tasks and control the IoT actuators.

The core of the SensorThings resource model is a ***Thing***. SensorThings API uses ITU's definition [27], *i.e.*, a ***Thing*** is an object of the physical world

(physical things) or the information world (virtual things) that is capable of being identified and integrated into communication networks. Every ***Thing*** has zero to many ***Locations***. Each ***Thing*** can have zero to many ***Datastreams***, and ***Datastream*** forms the core of the sensing profile. The sensing profile is based the standard O&M data model [28], *i.e.*, an ***Observation*** is modeled as an event performed by a ***Sensor*** (or ***Process***) at a ***Location*** and a ***Time*** that produces a result whose ***Value*** is an estimate of an ***Observed Property*** of the ***Feature of Interest***.

The left hand-side of Figure 4 illustrates the SensorThings API's control profile. A controllable ***Thing*** can have zero to many ***Tasking Capabilities*** that accept certain ***AccetableParameters*** allowing users to compose and send feasible ***Tasks*** that can be performed by an ***Actuator***. The control profile is based on the OGC Sensor Planning Service standard [29]. The main difference is that SPS uses a Service-Oriented Architecture and the SensorThings API uses a Resource-Oriented Architecture.

The SensorThings IoT service interface consists of the following three components: (1) the URI patterns for IoT resources addressing, (2) the CRUD operations capable of being performed on the IoT resources, and (3) the available query parameters for filtering the IoT resources.

In order to perform CRUD action on the Resources, the first step is to address the target resource(s) through their URI. Figure 5 shows the three URI components defined by RESTful IoT, namely the service root URI, the resource path, and the query options. The service root URI is the location of the SensorThings service. By attaching the resource path after the service root URI, users can address to the Resources available in a SensorThings service. And when users perform a READ action on Resources, users can apply query options to further process the addressed resources, such as sorting by properties and filtering with criteria.

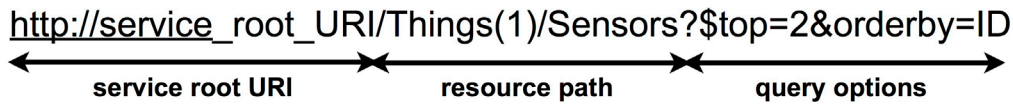

Figure 5 URI components defined by RESTful IoT

A SensorThings service will group the same types of entities into collections. Each entity has a unique identifier and one to many properties. In the case of an entity holding a relationship with entities in another collection, this entity has a navigation property (*i.e.*, a link) linking to other entities. The navigation property enables users to access the resources with a multi-facet-based structure rather than a hierarchical structure. This multi- facet-based design is based on the OASIS OData standard specification [30].

Once a resource can be identified by an URI, CRUD actions (HTTP methods of POST, GET, PUT, and DELETE) can be performed on the resource. Figure 6 shows two GET examples. The left hand side shows an example of a SensorThings service root, *i.e.*, all collections of a SensorThings service instance. The right hand side shows the instance of a ***Thing***, and it can be retrieved by issuing a GET request to the URI path of the ***Thing***.

```
GET http://../

{
"Collections": [
{"uri": "http://.../Things"},
{"uri": "http://.../Locations"},
{"uri": "http://.../Datastreams"},
{"uri": "http://.../Observations"},
{"uri": "http://.../FeaturesOfInterests"},
{"uri": "http://.../ObservedProperties"},
{"uri": "http://.../TaskingCapabilities"},
{"uri": "http://.../Tasks"}
]
}
```

```
GET http://../Things(1)

{
  Description: "This is an air quality pig.",
  Self-Link: "http://~/Things(1)",
  Locations:
  {
     Association-Link: "Things(1)/$links/Locations",
     Navigation-Link: "Things(1)/Locations"
  },
  ID: 1,
  Datastreams:
  {
     Association-Link: "Things(1)/$links/Datastreams",
     Navigation-Link: "Things(1)/Datastreams"
  },
  TaskingCapabilities:
  {
     Association-Link: "Things(1)/$links/TaskingCapabilities",
     Navigation-Link: "Things(1)/TaskingCapabilities"
  }
}
```

Figure 6 GET samples

The latest SensorThings API draft is available at http://ogcnetwork.net/sensorthings. And at the moment the SWE-IoT SWG is seeking public comments and will consider all comments when preparing a final draft of the candidate standard. The SW-IoT SWG will consider all comments when preparing a final draft of the candidate standard. The SW-IoT SWG plans to submit the final draft to the OGC Technical Committee for approval in 2014.

oneM2M

The oneM2M Partnership Project "oneM2M" [31] brings together the leading Information and Communications Technologies (ICT) Standards Development Organisations from around the world. The seven founding oneM2M partners Type1 working together with ETSI - European Telecommunications Standards Institute, are: ARIB - Association of Radio Industries and Businesses (Japan), ATIS - Alliance for Telecommunications Industry Solutions (US), CCSA - China Communications Standards Association (China), TIA - Telecommunications Industry Association (US), TTA - Telecommunications Technology Association (Korea), and TTC - Telecommunication Technology Committee of Japan (Japan).

In addition, oneM2M has welcomed other industry organizations as partners, including as partners Type2: the Broadband Forum (BBF), the Continua Health Alliance, the HGI (Home Gateway Initiative), and the Open Mobile Alliance (OMA). At the close of its first year and a half, oneM2M has over 260 member companies from around the world, and has conducted plenary meetings in Europe, China, the U.S., Korea, Canada, and Japan.

Launched in July 2012, oneM2M is committed to unifying the global M2M community by developing a cost-effective, widely available service layer that meets the needs of both the communications industry and vertical industry members. oneM2M welcomes the opportunity to collaborate with other industry organizations as well as vertical market segments in the M2M space to extend interoperability, and enhance security and reliability by reducing industry fragmentation.

oneM2M is governed by a Steering Committee (SC) made up of all Partners, and is supported by Finance, Legal and MARCOM sub-committees, as well as

a Methods and Procedures group. Technical work is progressed by a Technical Plenary, organized into five working groups: Requirements (WG1), Architecture (WG2), Protocols (WG3), Security (WG4), and Management, Abstraction, & Semantics (WG5).

Over the last year, within the Technical Plenary and Working groups, hundreds of technical contributions from member companies have been discussed, modified and agreed. The result is that the foundation of an initial set of oneM2M service layer requirements is nearly complete, a oneM2M architectural vision is underway, and work has begun on the path towards oneM2M protocol determination. Security and Management topics are being progressed in parallel and coordinated with all other working groups. The first technical reports issued by oneM2M were approved by the Technical Plenary in August 2013.

Looking toward the future, oneM2M is anticipating an initial release of oneM2M technical specifications in mid-2014. These documents can then be adopted and published by the founding partners for use in both global and regional M2M implementations. Subsequent oneM2M work will enhance the initial release with additional functionality and interoperability, and will result in future releases.

GS1

GS1 is an open, neutral, not-for-profit industry-driven standard organisation responsible for defining unique identifiers for items, parties, documents, locations, events and other "things" for more than 40 years. The GS1 standards for identification, semantics and communication are used directly by over 1.5 million companies and indirectly by billions of consumers every day. Barcodes, RFID tags and the underlying, globally-unique numbering system combined with data sharing standards offer the opportunity to dramatically enhance the efficiency of supply and demand chains.

The Role of Standards

The GS1 System is primarily concerned with raising the efficiency of business processes and providing cost savings through automation based on globally unique identification and digital information. The role of GS1 Standards is to further the following objectives [32]:

- *To facilitate interoperability in open supply chains*
  GS1 Standards include data standards and information exchange standards that form the basis of cross-enterprise exchange as well as standards for physical data carriers, i.e. bar codes and RFID tags.

- *To foster the existence of a competitive marketplace for system components*
  GS1 Standards define interfaces between system components that facilitate interoperability between components produced by different vendors or by different organisations' in-house development teams. This in turn provides choice to end users, both in implementing systems that will exchange information between trading partners and in those that are used entirely internally.

- *To encourage innovation*
  GS1 Standards define interfaces, not implementations. Implementers are encouraged to innovate in the products and systems they create, while interface standards ensure interoperability between competing systems.

GS1 Standards: Identify, Capture, Share

GS1 Standards may be divided into the following groups according to their role in supporting information needs related to real-world entities in supply chain business processes [32]:

- Standards which provide the means to **Identify** real-world entities so that they may be the subject of electronic information that is stored and/or communicated by end users. Real-world entities include trade items, logistics units, legal entities, physical locations, documents, service relationships, etc.

- Standards which provide the means to automatically **Capture** data that is carried directly on physical objects, bridging the world of physical things and the world of electronic information. GS1 data capture standards currently include definitions of bar code and radio-frequency identification (RFID) data carriers which allow GS1 Identification Keys and supplementary data to be affixed directly to a physical object, and standards that specify consistent interfaces to readers, printers, and other hardware and software components that connect the data carriers to business applications.

- Standards which provide the means to **Share** information, both between trading partners and internally, providing the foundation for electronic business transactions, electronic visibility of the physical and digital world, and other information applications. GS1 standards for information sharing include data standards for master data, business transaction data, and physical event data, as well as communication standards for sharing this data between applications and trading partners.

The following figure gives a high-level overview of GS1 standards:

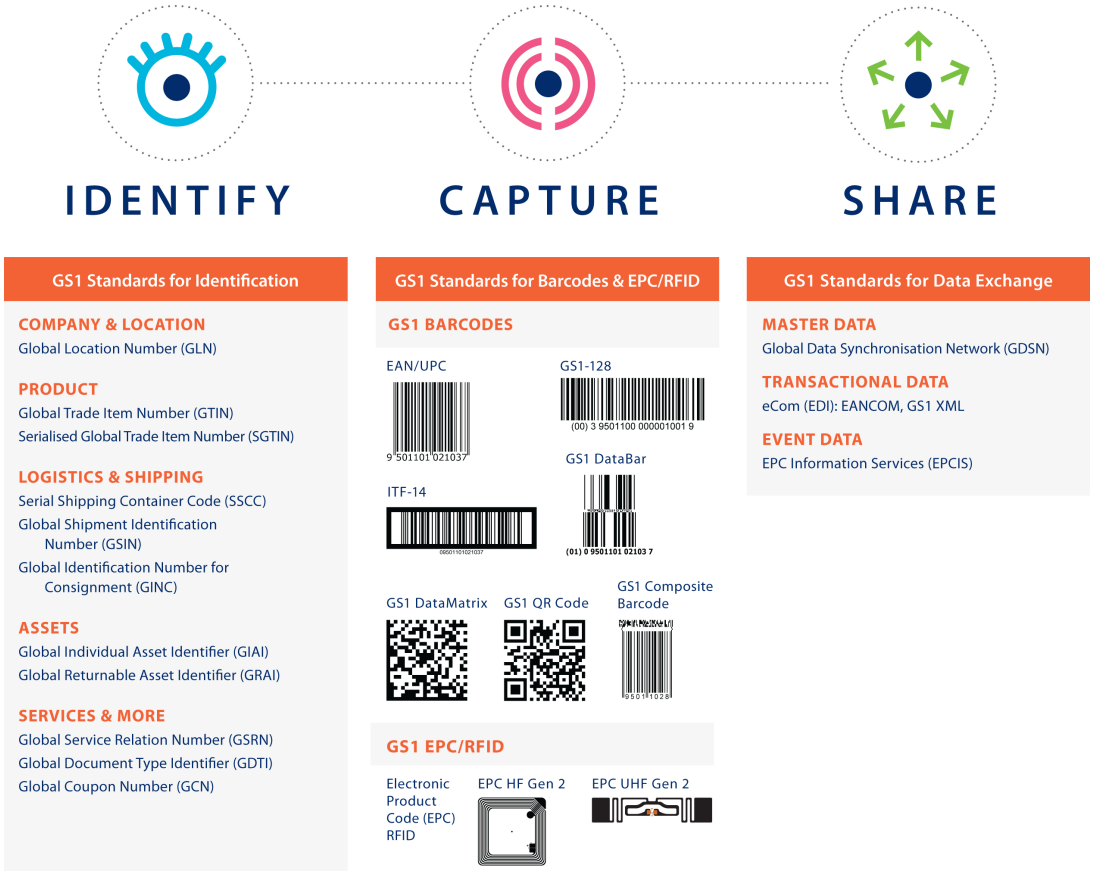

Figure 7 GS1 standards

Looking forward

GS1 has seen massive adoption of unique instance identification and EPC-enabled Radio-Frequency Identification (RFID) technologies driven by a need for inventory management accuracy and fight against theft. The recently released Gen2v2 specification for EPC-enabled RFID has set the standard for expansions of RFID tag capability from traditional locate/read applications to fully-interactive locate/read/access/write/authenticate applications. Such applications will have far-reaching implications to consumer privacy, anti-counterfeiting, security, and loss prevention.

In the fields of pharmaceuticals and medical devices, we are seeing a significant increase of item identification at the instance level (represented in both barcodes and RFID) and in plans to share information about custody of items along the supply chains using the Internet and GS1 standard applications (Electronic Product Code Information Services - EPCIS).

Such combinations of GS1 technologies are foundational examples of the power of the Internet of Things: consistent identification of things for representation on open networks, consistent communication about (and by) things, and robust discovery services for information that has been shared about things.

In the future, there will be a significant increase in web-based applications developed by industry that are focused on improving the consumer experience. Standards will be required to better enable these new

applications. A critical issue is further defining the data standards for various APIs built to provide better service for consumers. Common vocabularies are critical, but how to most clearly define the data that needs to be standardized for these applications in various domains of use is of paramount importance.

IERC Research Projects Positions

BETaaS Advisory Board Experts Position

IoT is shaping the evolution to a ubiquitous Internet connecting people and heterogeneous things, seamlessly integrated, anytime and everywhere. This require scalability, resilience, security, interworking between systems of systems, autonomous and trusted self-organizing networks of systems, ad hoc power consumption, and 'intelligence' (smart services). From applications down to real world there are two 'semantic interoperability' challenges, we hope we could start with a consensus on following two requirements (pre-standardization) [33]:

1 - at the highest level: we lack of common semantic IoT domain of definition with a common structured and a common method to describe things (real, virtual, human, aggregated), associated things and services, events and types of operations at highest semantic level

2 - at the lowest level: we lack of shared pre-build real examples of semantic things objects events operations to make the adoption of semantic things interoperability more easy to understand and to implement

If different implementers of IoT as a Service could agree on such common requirements and to evolve their own solutions to an open semantically interoperable IoTaaS then the IoT of the science fiction movies can become reality. IoTaaS social/market adoption and fair approach between technology push and market demand requires a pre-standardization to build consensus on the vision and requirements and to evolve from today's IoT/M2M legacy. BETaaS is making an effort to approach standardization, proposing a solution that tries to overcome at least the first of these two limitations. This solution is based on WordNet, a lexical database in English that groups English words into sets of synonyms, and which defines semantic relations between these sets of synonyms. Given a thing description from the IoT, BETaaS uses WordNet to infer information about its location and its type. In the same way, given an application requirement, BETaaS uses WordNet to infer information about the type of things demanded and their location.

IoT6 position

The IoT6 European research project [34] is researching the potential of IPv6 and related standards for the Internet of Things. It has disseminated its results with and contributed to several international standardizations bodies, including in the IETF, IEEE, ITU-T and OASIS. The projects' results are confirming the importance and relevance of IPv6 to enable a global Internet of Things. IPv6 is not only providing a large scale addressing scheme and a native integration with the worldwide Internet, but also a source of many relevant and useful features, including self-configuration mechanisms and

secured end-to-end connections. IoT6 clearly supports an extended use of IPv6 for the Internet of Things interconnections.

The public IPv4 address space managed by IANA [12] has been completely depleted by Feb 1st, 2011. This creates by itself an interesting challenge when adding new things and enabling new services on the Internet. Without public IP addresses the Internet of Things capabilities would be greatly reduced. Most discussions about IoT have been based on the illusionary assumption that the IP address space is an unlimited resource or it is even taken for granted that IP is like oxygen produced for free by nature. Hopefully, the next generation of Internet Protocol, also known as IPv6 brings a solution. In early 90s, IPv6 was designed by the IETF IPng (Next Generation) Working Group and promoted by the same experts within the IPv6 Forum since 1999. Expanding the IPv4 protocol suite with larger address space and defining new capabilities restoring end to end connectivity, and end to end services, several IETF working groups have worked on many deployment scenarios with transition models to interact with IPv4 infrastructure and services. They have also enhanced a combination of features that were not tightly designed or scalable in IPv4, such as IP mobility and ad-hoc services, catering for the extreme scenario where IP becomes a commodity service enabling lowest cost networking deployment of large scale sensor networks, RFID, IP in the car, to any imaginable scenario where networking adds value to commodity. For that reason, IPv6 makes feasible the new conception of extending Internet to consumer devices, physical systems and any imaginable thing that can be benefited of the connectivity. IPv6 spreads the addressing space in order to support all the emerging Internet-enabled devices. In addition, IPv6 has been designed to provide secure communications to users and mobility for all devices attached to the user; thereby users can always be connected. This work provides an overview of our experiences addressing the challenges in terms of connectivity, reliability, security and mobility of the Internet of Things through IPv6.

The Position Paper "Internet of Everything through IPv6" [35] has been used as a reference for this section. This paper describes the key challenges, how they have been solved with IPv6, and finally, presents the future works and vision that describe the roadmap of the Internet of Things in order to reach an interoperable, trustable, mobile, distributed, valuable, and powerful enabler for emerging applications such as Smarter Cities, Human Dynamics, Cyber-Physical Systems, Smart Grid, Green Networks, Intelligent Transport Systems, and ubiquitous healthcare.

Main Guidelines and Overview of IoT Standards

The guidelines for the development of IoT standards builds on the ideas put forward by the Cluster Strategic Research and Innovation Agenda and extensive discussions among the Cluster projects on overall priorities for standardisation to support the research and innovation objectives of the Europe 2020 strategy and the Framework Programme for Research and Innovation and connects/coordinates the new framework programme with global initiatives.

The concept creates a real integrated standardisation and coordination of technical standardisation activities and addresses them in the technical committees of different SOs.

IoT Standardisation Roadmap

IERC is working to create a reference for pre-standardisation activities of EC IoT research projects that is the base for the position paper and the IoT standardisation roadmap. This effort has as goal to increase overall efficiency and raise mutual awareness, defragment and synergize in one unique place important information for stakeholders: Industry, Standard Development Organisations (SDOs), European Commission (EC).

Before enforcing EC priorities using EU Regulation (Communications, Recommendations, Mandates or Directives) the EU funded programs are giving indication to proposers on EC priorities and domains, SDO/pre-standardisation activities to use, other on-going projects, actions and deliverables to coordinate with.

The IERC exists exactly for that, it allows exchanges between IERC, other EC clusters and projects like Future Networks, Cloud, FI-PPP, and FIA. This helps to detect standards gaps and overlaps and to link with regulation.

Conclusions

Most Internet standards are too complex for the constrained devices in the IoT and many of these devices are designed to run proprietary protocols, creating data silos. In the short run the vertical integration of sensors and business services will dominate IoT. As wireless sensors are deployed, each of them using different standards/protocols, services providers arise to collect and interpret disparate data, and standards are need to ensure that is possible. More and more hardware companies push for standardization so they can capitalize on services revenue since many of them see beyond the “things” and focus on the services built on the “Internet of Things”.

There is a good momentum on IoT standardisation and IERC and its participating projects are seen as a catalyst and an European IoT coordination platform facilitating international world-wide dialog. IoT Workshops co-organised between the European Commission, IoT Research and Innovation projects, IoT Industry Stakeholders and IoT Standard Organisation groups are continuing. These workshops facilitate interoperability testing events to stimulate IoT community building to reach consensus on IoT standards common developments on all protocol layers.

New domains have to be integrated into the overall view like the standardisation development in ITS (Intelligent Transport Systems) in ETSI and ISO. A significant effort will be required to come to an overall cross vertical IoT vision and interoperable standards environments. In this section an overview over the European and world-wide IoT standardization landscape has been given. It represents only a part of the activities in the domain and is by no mean a comprehensive full coverage of all IoT related standards

activities. Several additional groups are active in the domain or started to enter the IoT working field.

But already this overview depicts the vast number of different organizations and applications related to the future IoT. It also demonstrates the significant need of strong coordination between these activities in order to push for a horizontally integrated IoT ecosystem. IoT is not a single system and not only one standard will define IoT in the future. Interoperability between the domains and systems will be a key factor for the sustainable success of IoT.

Annex 1: List of Internet of Things relevant organizations and forums

The following list is a non-comprehensive list of organizations identified as having work relevant to the standardization of Internet of Things (IoT).

- **International Organizations**
  - ITU
    - ITU-T Study Groups (SG2; SG3; SG11; SG13; SG16; SG17)
    - Global Standards Initiative on Internet of Things (IoT-GSI)
    - Joint Coordination Activity on Internet of Things (JCA-IoT)
    - ITU-R Study Groups (WP1A; WP1B; WP5A)
  - ISO (TC 122/104 JWG; TC 204)
  - IEC
  - IEEE
  - ISO/IEC JTC1 (SC6; SC31; WG7 on Sensor Networks)
- **Regional and National Organizations**
  - ARIB
  - CCSA
  - CEN
    - TC225: Automatic Identification and Data Capture, WG6:
  - ETSI (ERM TG34 and TG 28; TC M2M; TC SES; TC DECT; ISG LTN; ISG ISI; ISG INS; TC NTECH and EP E2NA)
  - GISFI
  - TIA
  - TTA
  - TTC
- **Global Standards Collaboration**
  - M2M Standardization Task Force (MSTF)
- **Forums, consortia**
  - 3GPP
  - oneM2M
  - ECMA
  - GS1 / EPC Global
  - NFC
  - Open Geospatial COnsortium (OGC)
  - OMA
  - W3C
  - IPv6 Forum
  - IoT Forum
  - YRP Ubiquitous Networking Laboratory
  - eeBUS Initiative e.V.
- **Clusters, project consortia**
  - IERC – Internet of Things European Research Cluster

Annex 2: Table of IoT related Standards maintained by ITU-T JCA-IoT

This table contains a collection of IoT related Standards from various standards development organizations. This table is maintained by the ITU-T JCA-IoT (based on inputs from the various organizations). The ITU-T Standards include ITU-T Recommendations related to network aspects of identification systems (including RFID (NID) and ubiquitous sensor networks (USN)), Machine to Machine communications and Internet of Things. Reference: JCA-IoT-D-2 Rev.7 (30 October 2013)

Activity domain	Entity	Title of deliverable	Scope of deliverable	Current status	Target date
General	ITU-T SG2 Q1	**ITU-T E.101**, Definitions of terms used for identifiers (names, numbers, addresses and other identifiers) for public telecommunication services and networks in the E-series Recommendations	This Recommendation provides terms and definitions for use in the field of identifiers (e.g., names, numbers, addresses and other identifiers (IDs)) for public telecommunication services and networks.	Recommendation	2009-11-24
NID	ITU-T SG13 Q2	**ITU-T Y.2213**, NGN service requirements and capabilities for network aspects of applications and services using tag-based identification	This Recommendation covers: - description and scope of tag-based identification applications and services with some example scenarios; - high-level service requirements of tag-based identification applications and services; and - extended or new NGN capabilities based on the high-level service requirements. Functional requirements and related NGN architecture extensions for support of the described capabilities are out of scope of this Recommendation.	Recommendation	2008-09-12
USN	ITU-T SG13 Q3	**ITU-T Y.2221**, Requirements for support of Ubiquitous Sensor Network (USN) applications and services in NGN environment	The scope of this Recommendation includes: - Description and general characteristics of USN and USN applications and services; - Service requirements to support USN applications and services;	Recommendation	2010-01-13

			- Requirements of extended or new NGN capabilities based on the service requirements.		
NID	ITU-T SG13 Q5	**ITU-T Y.2016**, Functional requirements and architecture of the NGN for applications and services using tag-based identification	This Recommendation describes functional requirements, functional architecture and functional entities in order to support the NGN service requirements and capabilities defined in [ITU-T Y.2213]. This Recommendation covers: - Support of capabilities defined in [ITU-T Y.2213] from an architectural viewpoint; - Functional requirements of the NGN architecture to support applications and services using tag-based identification; - Functional architecture and entities extensions for applications and services using tag-based identification in NGN.	Recommendation	2009-08-22
NID	ITU-T SG16 Q22	**ITU-T H.621**, Architecture of a system for multimedia information access triggered by tag-based identification	This Recommendation defines the following issues to cover multimedia information access services triggered by tag-based identification as defined in [ITU-T F.771]: - a functional architecture reference model with descriptions of corresponding elements; - interface protocols between communication elements; and - a generic work flow to support multimedia information access triggered by tag-based identification. Moreover, this Recommendation describes implementation examples with work flows.	Recommendation	2008-08-06
NID	ITU-T SG16 Q22	**ITU-T F.771**, Service description and requirements for multimedia information access triggered by tag-based identification	This Recommendation specifies the service description and the requirements for multimedia information access triggered by tag-based identification. This	Recommendation	2008-08-06

			service enables users to access multimedia information through users' electronic devices equipped with ID tag readers and communication functions.		
NID	ITU-T SG16 Q25	**ITU-T H.642.1**, Identification scheme for multimedia information access triggered by tag-based identification – Part 1: Identification scheme"	This Recommendation defines an Identifier (ID) scheme for the multimedia information access triggered by tag-based identification. This ID scheme is mainly used in the multimedia information system architecture defined in ITU-T H.621. It also satisfies the requirements defined in ITU-T F.771. This Recommendation does not define encoding rules to store the identifier value into data carriers such as barcode tags and RFID tags.	Recommendation	2012-06
NID	ITU-T SG16 Q25	**ITU-T H.642.2**, Identification scheme for multimedia information access triggered by tag-based identification – Part 2: Registration procedure	This Recommendation defines registration procedures of identification scheme defined by ITU-T Recommendation H.IDscheme. The identification scheme consists of High Level Code (HLC), Top Level Code (TLC), Class and elements such as Second Level Organization Code (SLOC), and Serial Code (SC). TLC is allocated by RA and then SLOC is allocated by the registrant of TLC which is called second level RA. The mechanism is meant for distributed RA hierarchy.	Recommendation	2012-07
MIIM	ISO/IEC JTC 1/SC 31/WG 6	**ISO/IEC 29174-1**, Information technology -- UII scheme and encoding format for Mobile AIDC services -- Part 1: Identifier scheme for multimedia information access triggered by tag-based identification	ISO/IEC 29174-1 defines an identifier scheme for Mobile AIDC services and Registration Authority (RA) and registration procedures of the ID that was developed to support service requirements of an identifier scheme for Mobile AIDC services. This standard consists of two parts. Part 1 (ISO/IEC 29174-1) defines requirements, structure and encoding formats of the ID.	DIS posted 31n3564 2011-08-26 to 2012-02-24	2012-07-01
MIIM	ISO/IEC JTC 1/SC 31/WG 6	**ISO/IEC 29174-2**, Information technology -- UII scheme and encoding format for Mobile AIDC services -- Part 2: Registration procedures	ISO/IEC 29174-2 defines an identifier scheme for Mobile AIDC services and Registration Authority (RA) and registration procedures of the ID that was developed to support service requirements of an identifier scheme for Mobile AIDC services. This standard consists of two parts. Part 2 (ISO/IEC 29174-2) defines procedures	DIS ballot passed DoC meeting 2012-03-12	2012-07-01

			of ID scheme, obligations and requirements of Registration Authority (RA) as managing the ID.		
NID/ MIIM	ITU-T SG16 Q22 | ISO/IEC JTC 1/SC 31/WG 6	**ITU-T H.642.3 | ISO/IEC 29177**, Information technology – Automatic identification and data capture technique – Identifier resolution protocol for multimedia information access triggered by tag-based identification	This Recommendation | International Standard defines the identifier (ID) resolution protocol for multimedia information access triggered by tag-based identification which is described in ITU-T Recommendations F.771 and H.621.	Recommendation | FDIS to ISO/CS (2012-01-17)	2012-06
USN	ITU-T SG16 Q25	**ITU-T F.744**, Service description and requirements for ubiquitous sensor network middleware	This Recommendation describes USN services and requirements for ubiquitous sensor network (USN) middleware. This Recommendation covers: - description of the USN services; - description of the USN middleware; - use cases of USN services that use USN middleware; - functional model of USN middleware; - – requirements for USN middleware to support functions commonly required by USN services.	Recommendation	2009-12-14
USN	ITU-T SG16 Q25	**ITU-T H.641**, SNMP-based sensor network management framework	This Recommendation provides an SNMP-based sensor network management framework. The primary purpose of this Recommendation is to describe the framework of integrated sensor network management which can be used to manage heterogeneous sensor networks. The scope of this Recommendation includes: - Overall architecture of framework - Functional entities of framework - Object identifier allocation for MIB - Object identifier translation between SNMP and sensor network management protocol	Recommendation	2012-02
General	ITU-T SG17 Q10 | ISO/IEC JTC 1/SC	**ITU-T X.660 | ISO/IEC 9834-1**, Information technology –	This Recommendation | International Standard: - specifies a tree structure for	Recommendation | International Standard	2011-07-29

	6/WG 9	Procedures for the operation of Object Identifier Registration Authorities: General procedures and top arcs of the International Object Identifier tree	allocations made by a hierarchical structure of Registration Authorities, called the international OID tree, which supports the ASN.1 OBJECT IDENTIFIER type and the ASN.1 OID IRI type (see Rec. ITU-T X.680 | ISO/IEC 8824-1); - registers top-level arcs of the international object identifier tree; - specifies procedures which are generally applicable to registration at any level of the international OID tree; - provides guidelines for the establishment and operation of International Registration Authorities for use, when needed, by other ITU-T Recommendations and/or International Standards; - provides guidelines for additional ITU-T Recommendations and/or International Standards which choose to reference the procedures in this Recommendation | International Standard; - provides a recommended fee structure for lower-level Registration Authorities.		
NID	ITU-T SG17 Q12 | ISO/IEC JTC 1 SC 6/WG 9	**ITU-T X.668 | ISO/IEC 9834-9**, Information technology – Open Systems Interconnection – Procedures for the operation of OSI Registration Authorities: Registration of object identifier arcs for applications and services using tag-based identification	This Recommendation | International Standard specifies the procedures for operating the Registration Authority for object identifiers under the arc {joint-iso-itu-t(2) tag-based(27)}, that supports tag-based applications and services.	Recommendation | International Standard	2008-05-29
RFID	ITU-T SG17 Q10	**ITU-T X.1275**, Guidelines on protection of personally identifiable information in the	This Recommendation provides guidance to radio frequency identification (RFID) users and vendors (including RFID service	Recommendation	2010-12-17

		application of RFID technology	providers and manufacturers) in protecting personally identifiable information for the privacy of individuals in the context of RFID technology. These guidelines can be applied to cases wherein the RFID system may be used to invade individual privacy; e.g., personally identifiable information is recorded in an RFID tag and subsequently collected, or the object information collected by means of RFID is linked to personally identifiable information. However, it does not apply to such cases where the object information is collected and used without any risk of disclosure of personally identifiable information and invasion of privacy. These guidelines seek to protect personally identifiable information for the privacy of individuals potentially affected by an RFID system and to promote a safe environment for RFID use. These guidelines are intended to provide the basic rules for the RFID service provider and guidance to the RFID service provider, manufacturers and user with regard to privacy in RFID and are subject to local and national laws.		
NID	ITU-T SG17 Q6	**ITU-T X.1171**, Threats and requirements for protection of personally identifiable information in applications using tag-based identification	The scope of this Recommendation covers the following objectives including threats and requirements for protection of personally identifiable information (PII) in applications using tag based identification as described below: - To describe PII threats in a business-to-customer (B2C)-based environment of applications using tag based identification; - To identify requirements for PII protection in a B2C-based environment of applications using tag based identification.	Recommendation	2009-02-20
USN	ITU-T SG17 Q6 | ISO/IEC JTC 1/SC	**ITU-T X.1311 | ISO/IC 29180**, Security framework for ubiquitous sensor	This draft Recommendation describes the security threats to and security requirements of the	Recommendation | International Standard	2011-02-13

	6	network	Ubiquitous Sensor Network. In addition, this draft Recommendation categorizes the security technologies according to the security functions that satisfy said security requirements and by the place to which the security technologies are applied in the security model of USN. Finally, the security requirements and security technologies for USN are presented.		
USN	ITU-T SG17 Q6	**ITU-T X.1312**, Ubiquitous sensor networks (USN) middleware security guidelines	This Recommendation provides guidelines for USN middleware security and also covers the following: - overview of USN middleware security; - the functional model of USN middleware; - security threats on USN middleware; - security requirements for USN middleware; - guidelines for USN middleware security.	Recommendation	2011-02-13
USN	ITU-T SG17 Q6	**ITU-T X.13.13**, Security requirements for wireless sensor network routing	This Recommendation provides security requirements for wireless sensor network routing and also covers as follow; - Overview of USN architecture - General network topologies and routing protocols for WSN - Security threats of WSN routing - Security requirements for WSN routing	Recommendation	Expecte 2012-10-14
	ITU-T SG17 Q6	**ITU-T X.1311**, Security requirements and framework of ubiquitous networking	This Recommendation describes security threats and security requirements to the Ubiquitous Sensor Network. In addition, this Recommendation categorizes security technologies by security functions that satisfy above security requirements and by the place to which the security technologies are applied in the security model of the Ubiquitous Sensor Network. Finally, the security function requirements for each entity in the network and possible implementation layer for security function are presented.	Recommendation	2011-02-13
NID	ITU-T	**ITU-T X.520 AMD**	X.520 defines attribute	Draft	

	SG17 Q2	**3**, Information technology – Open Systems Interconnection – The Directory: Selected attribute types	types for Directory Services. The amendment 3 to X.520 will extend it to support identification management in Directory Services	Recommendation	
NID	ITU-T SG17 Q12 | ISO/IEC JTC 1/SC 6	**ITU-T X.672 | ISO/IEC 29168-1**, Information technology – Open systems interconnection – Object identifier resolution system (ORS)	This Recommendation | International Standard specifies the OID resolution system, including the overall architecture and a DNS-based resolution mechanism. It specifies the means for inserting any application-defined information associated with an OID node into the DNS and the means of retrieval of that information using the ORS. It does not restrict the number of applications it can support. It specifies the required operation of an ORS client, including the mapping of an OID-IRI value by the ORS client into a DNS name to produce a DNS query for the specified application information and the processing of any returned information. The ORS has no role in the allocation or registration of OID nodes. The required behavior of an ORS client is specified, but the interfaces to it are specified only in terms of the semantics of the interaction. A bit-level application program interface is platform and software dependent, and is not in the scope of this Recommendation | International Standard. It does not include a tutorial or complete specification on the management of DNS zone files (for that, see IETF RFC 1035 and IETF RFC 3403); it specifies (only) the DNS resource records that need to be inserted in the zone files in order to support ORS access to the information associated with an OID node. This Recommendation | International Standard specifies required DNS zone file resource records, and prohibits the use of other resource records of a similar form but with different semantics (in DNS zone files in the .oid-res.org domain). It does not otherwise restrict the general use of DNS zone files.	Recommendation | International Standard	2010-08-29 | 2011-09-12

NID	ISO/IEC JTC 1/SC 6	ISO/IEC 29168-2, Information technology – Open Systems Interconnection – Procedures for the Object Identifier Resolution System Operational Agency	This International Standard specifies the mechanisms and criteria that shall be applied for the selection and approval of the operational agency, and includes procedures that the operational agency shall follow. It also addresses any future modification of the procedures, and the procedures for any change of the operational agency. It lists the OID nodes for which the operational agency is required to provide ORS support. It gives the required level of support for these nodes. It gives the procedures by which lower level nodes can apply for ORS support (class A, class B, or class C), and the role of the operational agency in providing these levels of support. It determines the basis for charges that might be levied for these levels of support.	International Standard	2011-09-12
AIDC	ISO TC 104/SC 4	ISO 6346, Freight containers – Coding, identification and marking	Provides a system for general application for the identification and presentation of information about freight containers. Specifies an identification system with mandatory marks for visual interpretation and optional features for automatic identification and electronic data interchange and a coding system for data on container size and type. Replaces the second edition, which has been technically revised.	International Standard	1998-01-22
RFID	ISO TC 104/SC 4	ISO 10374, Freight containers – Automatic identification	Specifies all necessary user requirements. Includes: a container identification system, data coding systems, description of data, performance criteria and security features.	International Standard	2007-02-24
RFID	ISO TC 104/SC 4	ISO/TS 10891, Freight containers – Radio frequency identification (RFID) – Licence plate tag	ISO/TS 10891:2009 establishes: - a set of requirements for container tags, which allow the transfer of information from a container to automatic processing systems by electronic means; - a data coding system for container identification and permanent related information which	International Standard	2009-01-30

			resides within a container tag; - a data coding system for the electronic transfer of both container identification and permanent related information from container tags to automatic data processing systems; - the description of data to be included in container tags for transmission to automatic data processing systems; - performance criteria necessary to ensure consistent and reliable operation of container tags within the international transportation community; - the physical location of container tags on containers; - features to inhibit malicious or unintentional alteration and/or deletion of the information content of container tags when installed on a freight container. It is intended to be applicable to freight containers as defined in ISO 668 as well as to other containers not defined in ISO 668 and container ancillary equipment such as road and terminal chassis, generator sets and power packs . The use of container tags and the equipping of containers for automatic identification are optional. The purpose of ISO/TS 10891:2009 is to optimise the efficiency of equipment control systems and to assist in container security initiatives and programs, including the optional usage of electronic seals in accordance with ISO 18185, and any subsequent International Standard. For this reason, any container tag system used for identifying containers shall be non-proprietary and conform to and be		

			compatible with ISO/TS 10891:2009.		
RFID	ISO TC 104/SC 4	ISO 18185-1, Freight containers – Electronic seals – Part 1: Communication protocol	ISO 18185-1:2007 provides a system for the identification and presentation of information about freight container electronic seals. The identification system provides an unambiguous and unique identification of the container seal, its status and related information. The presentation of this information is provided through a radio-communications interface providing seal identification and a method for determining whether a freight container's seal has been opened. ISO 18185-1:2007 specifies a read-only, non-reusable freight container seal identification system, with an associated system for verifying the accuracy of use, having - a seal status identification system, - a battery status indicator, - a unique seal identifier including the identification of the manufacturer, - seal (tag) type. ISO 18185-1:2007 is used in conjunction with the other parts of ISO 18185. It applies to all electronic seals used on freight containers covered by ISO 668, ISO 1496-1 to ISO 1496-5, and ISO 8323. Wherever appropriate and practicable, it also applies to freight containers other than those covered by these International Standards.	International Standard	2011-05-13
RFID	ISO TC 104/SC 4	ISO 18185-2, Freight containers – Electronic seals – Part 2: Application requirements	ISO 18185-2:2007 specifies a freight container seal identification system, with an associated system for verifying the accuracy of use, having: - a seal status identification system; - a battery status indicator; - a unique seal identifier including the identification of the manufacturer;	International Standard	2011-01-20

			- a seal (tag) type. ISO 18185-2:2007 is used in conjunction with the other parts of ISO 18185.		
RFID	ISO TC 104/SC 4	ISO 18185-3, Freight containers – Electronic seals – Part 3: Environmental characteristics	ISO 18185-3:2006 specifies the minimum environmental characteristics for electronic seals. ISO 18185-3:2006 describes the environmental requirements for the ISO 18185 series, for ISO 10374 (Freight containers -- RF automatic identification) and for ISO 17363 (Supply chain applications of RFID -- Freight containers), since it is expected that the implementation of these International Standards will face the same environmental conditions. However, each of these International Standards has its own unique requirements other than environmental conditions.	International Standard	2009-09-18
RFID	ISO TC 104/SC 4	ISO 18185-4, Freight containers – Electronic seals – Part 4: Data protection	ISO 18185-4:2007 specifies requirements for the data protection, device authentication and conformance capabilities of electronic seals for communication to and from a seal and its associated reader. These capabilities include the accessibility, confidentiality, data integrity, authentication and non-repudiation of stored data.	International Standard	2011-05-13
RFID	ISO TC 104/SC 4	ISO 18185-5, Freight containers – Electronic seals – Part 5: Physical layer	ISO 18185-5:2007 specifies the air interface between electronic container seals and Reader/Interrogators of those seals. It is to be used in conjunction with the other parts of ISO 18185. ISO 18185-5:2007 describes the physical layer for supply chain applications of RFID for freight containers in accordance with the ISO 18185 series and ISO 17363, since it is expected that the implementation of these standards will face the same international conditions. However, each of these standards has its own unique requirements other than the physical layer. It is expected that RFID Freight Container Identification (as specified in ISO 10374 and ISO 17363), and electronic seals (as specified in the ISO	International Standard	2011-05-13

			18185 series) will be able to use the same infrastructure, while recognizing that that there may be requirements for different frequencies for passive devices as opposed to the active devices identified in ISO 18185-5:2007.		
MIIM	ISO/IEC JTC 1/SC 31/WG 6	ISO/IEC TR 29172, Information technology – Mobile item identification and management – Reference architecture for Mobile AIDC services	ISO/IEC 29172 defines an overall service architecture to provide Mobile AIDC services. It describes various architectural configurations enabled by a set of Mobile AIDC-relevant standards such as ISO/IEC 18004, 15424, 16480, 29143, 18000-3 Mode 3, 18000-6, 29173, 29174, 29175, 29176, 29177, 29178, 29179, 29168, and 9834-9, in terms of relevant standards and their roles and positions in various implementations. The overall service architecture deals with all of the relevant standards, their interface relationships and how to incorporate them to develop Mobile AIDC services based on resulting Mobile AIDC technologies.	International Standard	2011-11-08
MIIM	ISO/IEC JTC 1/SC 31/WG 6	ISO/IEC 29173-1, Information technology – Mobile item identification and management – Part 1: Mobile RFID interrogator device protocol for ISO/IEC 18000-6 Type C	ISO/IEC 29173-1 defines an interface protocol between a device driver of a mobile AIDC application platform and a mobile RFID interrogator within a mobile AIDC terminal. In accordance to the ISO/IEC 18000-6 type C and ISO/IEC 29143 RFID air interface standard, this standard will include: types of command / response / notification protocol messages and their usages; protocol message format; and protocol message exchange procedures, as the communication protocol between an interrogator and phone.	International Standards	2012-11-30
MIIM	ISO/IEC JTC 1/SC 31/WG 6	ISO/IEC 29175, Information technology – Mobile item identification and management – User data for Mobile AIDC services	ISO/IEC 29175 defines user data for the purpose of encoding and identifying user data in Mobile AIDC services using ISO/IEC 29143 RF tags, ISO/IEC 18000-6, REV1 Type C RF tags, and ISO/IEC 15434-applied ORM such as linear bar codes and two-dimensional symbols. Identifiers for user data follow ASC MH10 Data Identifiers, which are given in ANSI MH10.8.2, hereafter referred to as the	International Standard	2012-03

			"ASC MH10 Data Identifiers", are standardized in ANSI MH10.8.2 and ISO/IEC 15418.		
MIIM	ISO/IEC JTC 1/SC 31/WG 6	ISO/IEC 29176, Information technology – Mobile item identification and management – Consumer privacy-protection protocol for Mobile RFID services	ISO/IEC 29176 defines a privacy protocol between a Mobile RFID interrogator and a Mobile RFID tag. This international standard does not deal with security issues such as mutual authentication method, data encryption method, and cipher algorithm suite. This international standard does cover the operation procedure of the interrogator for the protection of the consumer's privacy. This international standard can be applied to tags and interrogators conforming to ISO/IEC 18000-6 Type C and ISO/IEC 18000-3 MODE 3 RFID air interfaces without any modification of hardware and additional commands.	International Standards	2012-10-06
MIIM	ISO/IEC JTC 1/SC 31/WG 6	ISO/IEC 29178, Information technology – Mobile item identification and management – Service broker for Mobile AIDC services	ISO/IEC 29178 defines the functions of a service broker supporting service control, MII recognition and MII resolution related functions in Mobile AIDC service architecture, which uses MII (ISO/IEC 29174) as an identifier. For the use of a service broker by a Mobile AIDC terminal, definition is required of the interface between a terminal and a service broker. This standard describes that interface.	International Standard	2012-03
MIIM	ISO/IEC JTC 1/SC 31/WG 6	ISO/IEC 29179, Information technology – Mobile item identification and management – Mobile AIDC application programming interface	ISO/IEC 29179 defines the Mobile AIDC application programming interface to give a standardized functional view over different Mobile AIDC application platforms. In addition, ISO/IEC 29179 provides a description of Mobile AIDC applications and specifies the functional requirements of Mobile AIDC application interfaces.	International Standard	2012-01-20
Sensor and actuator	ISO/IEC JTC 1/SC 31/WG 6	ISO/IEC/IEEE 21450 - Information technology – Smart Transducer Interface for Sensors and Actuators – Common Functions, Communication Protocols, and Transducer Electronic Data Sheet (TEDS)	ISO/IEC/IEEE 21450:2010 provides a common basis for members of the ISO/IEC/IEEE 21451 series of International Standards to be interoperable. It defines the functions that are to be performed by a transducer interface module (TIM) and the common characteristics for all	Published by ISO/IEC/IEEE	2011-12-15

		Formats	devices that implement the TIM. It specifies the formats for Transducer Electronic Data Sheets (TEDS). It defines a set of commands to facilitate the setup and control of the TIM as well as reading and writing the data used by the system. Application programming interfaces (APIs) are defined to facilitate communications with the TIM and with applications.		
Sensor and actuator	ISO/IEC JTC 1/SC 31/WG 6	ISO/IEC/IEEE 21451-1 - Information technology – Smart Transducer Interface for Sensors and Actuators – Network Capable Application Processor (NCAP) Information Model	ISO/IEC/IEEE 21451-1:2010 defines an object model with a network-neutral interface for connecting processors to communication networks, sensors, and actuators. The object model contains blocks, services, and components; it specifies interactions with sensors and actuators and forms the basis for implementing application code executing in the processor.	PSDO Standard	2010-05-20
Sensor and actuator	ISO/IEC JTC 1/SC 31/WG 6	ISO/IEC/IEEE 21451-2 - Information technology – Smart Transducer Interface for Sensors and Actuators – Transducer to Microprocessor Communication Protocols and Transducer Electronic Data Sheet (TEDS) Formats	ISO/IEC/IEEE 21451-2:2010 defines a digital interface for connecting transducers to microprocessors. It describes a Transducer Electronic Data Sheet (TEDS) and its data formats. It defines an electrical interface, read and write logic functions to access the TEDS, and a wide variety of transducers. ISO/IEC/IEEE 21451-2:2010 does not specify signal conditioning, signal conversion, or how the TEDS data is used in applications.	PSDO Standard	2010-05-20
Sensor and actuator	ISO/IEC JTC 1/SC 31/WG 6	ISO/IEC/IEEE 21451-4 - Information technology – Smart Transducer Interface for Sensors and Actuators – Mixed-Mode Communication Protocols and Transducer Electronic Data Sheet (TEDS) Formats	ISO/IEC/IEEE 21451-4:2010 defines the protocol and interface that allows analog transducers to communicate digital information with an ISO/IEC/IEEE 21451 object. It also defines the format of the Transducer Electronic Data Sheet (TEDS), which is based on the ISO/IEC/IEEE 21451-2 TEDS. It does not specify the transducer design, signal conditioning, or the specific use of the TEDS.	PSDO Standard published	2010-05-20

Sensor and actuator	ISO/IEC JTC 1/SC 31/WG 6	ISO/IEC/IEEE 21451-5 - Information technology – Smart Transducer Interface for Sensors and Actuators – Wireless Communication Protocols and Transducer Electronic Data Sheet (TEDS) Formats	ISO/IEC/IEEE 21451-5 defines a wireless interface for sensors. It specifies radio-specific protocols for this wireless interface. It defines communication modules that connect the wireless transducer interface module (WTIM) and the network capable applications processor (NCAP) using the radio-specific protocols. It also defines the transducer electronic data sheets (TEDS) for the radio-specific protocols.	2011-10-03 Corrigendum to IEEE Standard 1451.5-2007 PAR approved 17-Jun-2010. In final approval "pre-ballot" Once approved to WG 6 FDIS ballot	B4 2014-12-31
Sensor and actuator	ISO/IEC JTC 1/SC 31/WG 6	ISO/IEC/IEEE 21451-7 - Information technology – Standard for a Smart Transducer Interface for Sensors and Actuators - Transducers to Radio Frequency Identification (RFID) Systems Communication Protocols and Transducer Electronic Data Sheet Formats	ISO/IEC/IEEE 21451-7 defines data formats to facilitate communications between radio frequency identification (RFID) systems and smart RFID tags with integral transducers (sensors and actuators). The standard defines new transducer electronic data sheet (TEDS) formats based on the ISO/IEC/IEEE 21451 family of standards. This standard also defines a command structure and specifies the communication methods with which the command structure is designed to be compatible.	PSDO Standard published 2010-05-20	2010-05-20
Sensor and actuator	ISO/IEC JTC 1/SC 31/WG 6	ISO/IEC/IEEE 8802-15-4 - Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 15-4: Wireless medium access control (MAC) and physical layer (PHY) specifications for low-rate wireless personal area networks (WPANs)	ISO/IEC/IEEE 8802-15-4 defines the protocol and compatible interconnection for data communication devices using low-data-rate, low-power, and low-complexity short-range radio frequency (RF) transmissions in a wireless personal area network (WPAN).	PSDO Standard published 2010-10-13	2010-10-13
WSN	ISO/IEC JTC 1/WG 7	ISO/IEC 29182-1, Reference architecture for sensor network applications and services	General overview and the requirements identified for the reference architecture	IS	2013-05
WSN	ISO/IEC JTC 1/WG 7	ISO/IEC 29182-2, Reference architecture for sensor network applications and services – Part 2: Vocabulary/Terminology	Definitions of all the terminology and vocabulary used in the sensor network reference architecture	IS	2013-06
WSN	ISO/IEC JTC 1/WG 7	ISO/IEC 29182-3, Reference architecture for sensor network	Reference architecture from various viewpoints, such as business, operational,	DIS	2015-09

		applications and services – Part 3: Reference architecture views	system, technical, functional, and logical views		
WSN	ISO/IEC JTC 1/WG 7	ISO/IEC 29182-4, Reference architecture for sensor network applications and services – Part 4: Entity models	Categorizes entities comprising a sensor network into two categories of physical and functional entities and presents models for all such entities	DIS	
WSN	ISO/IEC JTC 1/WG 7	ISO/IEC 29182-5, Reference architecture for sensor network applications and services – Part 5: Interface definitions	Detailed information on the interfaces among various entities in the reference architecture	FDIS	2015-09
WSN	ISO/IEC JTC 1/WG 7	ISO/IEC 29182-6, Reference architecture for sensor network applications and services – Part 6: Application Profiles	Application profiles that are derived from studies of use cases, scenarios, etc., for sensor network-based applications and services	CD	2015-09
WSN	ISO/IEC JTC 1/WG 7	ISO/IEC 29182-7, Reference architecture for sensor network applications and services – Part 7: Interoperability guidelines	Design principles for the reference architecture that take the interoperability requirements into account	CD	2015-09
WSN	ISO/IEC JTC 1/WG 7	ISO/IEC 20005 Services and Interfaces Supporting Collaborative Information Processing in Intelligent Sensor Networks	Services and interfaces supporting collaborative information processing (CIP) in intelligent sensor networks	DIS	2013-10
WSN	ISO/IEC JTC 1/WG 7	ISO/IEC 30101, Sensor Network and its Interface for Smart Grid System	Interfaces between the sensor networks and other networks for smart grid system applications, Sensor network architecture to support smart grid systems, Interface between sensor networks with smart grid systems	CD	2016-02
WSN	ISO/IEC JTC 1/WG 7	ISO/IEC 30128, Generic Sensor Network Application Interface	This international standard specifies generic (specific application neutral and specific sensor network protocol neutral) sensor network application interface which is used between any sensor network client (application, or sensor network integration platform) and any sensor network gateway. The scope of this interface is entitled as Protocol A of Interface 3 in Clause 7.4 of ISO/IEC 29182 Part 5. This international standard covers: - Overview of sensor network applications - Overview of sensor	CD	2015

			network capabilities - Generic sensor network application interface specification		
AIDC	ISO/IEC JTC 1/SC 31	ISO/IEC 19762-1, Information technology – Automatic identification and data capture (AIDC) techniques – Harmonized vocabulary – Part 1: General terms relating to AIDC	ISO/IEC 19762-1:2008 provides general terms and definitions in the area of automatic identification and data capture techniques on which are based further specialized sections in various technical fields, as well as the essential terms to be used by non-specialist users in communication with specialists in automatic identification and data capture techniques.	International Standard NP for a single part document & translation to French, German, and Russian	2008-06-11
AIDC	ISO/IEC JTC 1/SC 31	ISO/IEC 19762-2, Information technology – Automatic identification and data capture (AIDC) techniques – Harmonized vocabulary – Part 2: Optically readable media (ORM)	ISO/IEC 19762-2:2008 provides terms and definitions unique to optically readable media (ORM) in the area of automatic identification and data capture techniques. This glossary of terms enables the communication between non-specialist users and specialists in ORM through a common understanding of basic and advanced concepts.	International Standard NP for a single part document & translation to French, German, and Russian	2008-06-11
AIDC	ISO/IEC JTC 1/SC 31	ISO/IEC 19762-3, Information technology -- Automatic identification and data capture (AIDC) techniques – Harmonized vocabulary – Part 3: Radio frequency identification (RFID)	ISO/IEC 19762-3:2008 provides terms and definitions unique to radio frequency identification (RFID) in the area of automatic identification and data capture techniques. This glossary of terms enables the communication between non-specialist users and specialists in RFID through a common understanding of basic and advanced concepts.	International Standard NP for a single part document & translation to French, German, and Russian	2008-06-11
AIDC	ISO/IEC JTC 1/SC 31	ISO/IEC 19762-4, Information technology – Automatic identification and data capture (AIDC) techniques – Harmonized vocabulary – Part 4: General terms relating to radio communications	ISO/IEC 19762-4:2008 provides general terms and definitions relating to radio communications in the area of automatic identification and data capture techniques. This glossary of terms enables the communication between non-specialist users and specialists in radio communications through a common understanding of basic and advanced concepts.	International Standard NP for a single part document & translation to French, German, and Russian	2008-06-11
AIDC	ISO/IEC JTC 1/SC 31	ISO/IEC 19762-5, Information technology – Automatic identification and data capture (AIDC) techniques –	ISO/IEC 19762-5:2008 provides terms and definitions unique to locating systems in the area of automatic identification and data capture techniques. This glossary of	International Standard NP for a single part document & translation to French, German, and Russian	2008-06-11

		Harmonized vocabulary – Part 5: Locating systems	terms enables the communication between non-specialist users and specialists in locating systems through a common understanding of basic and advanced concepts.		
AIDC	ISO/IEC JTC 1/SC 31	ISO/IEC 15459-1, Information technology – Automatic identification and data capture techniques – Unique identification – Part 1: Individual transport units	This standard provides unique identification at the transport unit level. This standard serves as the basis for identification in ISO 15394 (for bar codes) and ISO 17365 (for RFID)	FDIS	
AIDC	ISO/IEC JTC 1/SC 31	ISO/IEC 15459-2, Information technology – Automatic identification and data capture techniques – Unique identification – Part 2: Registration procedures	Unique identification can occur at many different levels in the supply chain, at the transport unit, at the item level, and elsewhere. Such distinct entities are often handled by several parties: the sender, the receiver, one or more carriers, customs authorities, etc. Each of these parties must be able to identify and trace the item so that reference can be made to associated information such as address, order number, contents of the item, weight, sender, batch or lot number, etc. There are considerable benefits if the identity of the item is common between all the relevant parties. ISO/IEC 15459-2:2006 specifies the procedural requirements to maintain a non-significant, unique identifier for item management applications, and outlines the obligations of the Registration Authority and Issuing Agencies. ISO/IEC 15459-2:2006 excludes those items where ISO has designated Maintenance Agencies or Registration Authorities to provide identification schemes. It does not apply to - freight containers, because their unique coding is specified in ISO 6346, Freight containers -- Coding, identification and marking; - vehicles, because their unique identification is specified in ISO 3779, Road vehicles -- Vehicle identification	International Standard	2009-06-29

			number (VIN) -- Content and structure; - car radios, because their unique identification is specified in ISO 10486, Passenger cars -- Car radio identification number (CRIN). The exclusion also applies to ISO 2108, Information and documentation -- International standard book number (ISBN) and ISO 3297, Information and documentation -- International standard serial number (ISSN).		
AIDC	ISO/IEC JTC 1/SC 31	ISO/IEC 15459-3, Information technology – Automatic identification and data capture techniques – Unique identification – Part 3: Common rules for unique	Unique identification can occur at many different levels in the supply chain, at the transport unit, at the item level, and elsewhere. Such distinct entities are often handled by several parties - the sender, the receiver, one or more carriers, customs authorities, etc. Each of these parties must be able to identify and trace the item so that reference can be made to associated information such as configuration, maintenance history, address, order number, contents of the item, weight, sender, batch or lot number, etc. The information is often held on computer systems, and may be exchanged between parties involved via EDI (Electronic Data Interchange) and XML (eXtensible Markup Language) messages. There are considerable benefits if the identity of the item is represented in bar code format, or other AIDC (Automatic Identification and Data Capture) media and attached to or made a constituent part of that which is being uniquely identified so that - it can be read electronically, thus minimising errors; - one identity can be used by all parties; - each party can use the identity to look up its computer files to find the data associated with the item; - the identifier is unique	International Standard	2009-06-29

			within the class and cannot appear on any other item of the class during the lifetime of the item. ISO/IEC 15459-3:2006 specifies the common rules that apply for unique identifiers for item management that are required to ensure full compatibility across classes of unique identifiers.		
AIDC	ISO/IEC JTC 1/SC 31	ISO/IEC 15459-4, Information technology – Automatic identification and data capture techniques – Unique identification – Part 4: Individual items	Unique identification can occur at many different levels in the supply chain, at the transport unit, at the item level, and elsewhere. Such distinct entities are often handled by several parties: the sender, the receiver, one or more carriers, customs authorities, etc. Each of these parties must be able to identify and trace the item so that reference can be made to associated information such as configuration, maintenance history, address, order number, contents of the item, weight, sender, batch or lot number, etc. The information is often held on computer systems, and may be exchanged between parties involved via EDI (Electronic Data Interchange) and XML (eXtensible Markup Language) messages. There are considerable benefits if the identity of the item is represented in bar code format, or other AIDC (Automatic Identification and Data Capture) media and attached to or made a constituent part of that which is being uniquely identified so that - it can be read electronically, thus minimising errors; - one identity can be used by all parties; - each party can use the identity to look up its computer files to find the data associated with the item; - the identifier is unique within the class and cannot appear on any other item of the class during the lifetime of the item. The unique identifier for	International Standard	2009-06-29

			individual items defined in ISO/IEC 15459-4:2008 and represented in a bar code label, two-dimensional symbol, radio-frequency identification tag, or other AIDC media attached to the item meets these needs. All AIDC technologies have the potential to encode a unique identifier. It is expected that application standards for items, using various automatic identification technologies, will be developed based upon the unique identifier as a prime key. These application standards may be made available from the Issuing Agency. ISO/IEC 15459-4:2008 specifies a unique, non-significant string of characters for the unique identifier for individual items. The character string is intended to be represented in a bar code label or other AIDC media attached to the item to meet supply chain needs. To address management needs, different classes of items are recognized in the various parts of ISO/IEC 15459, which allows different requirements to be met by the unique identifiers associated with each class. The rules are defined for the individual items to identify the unique occurrence of an item, understood to mean the layers zero and one as will be defined in two future International Standards (ISO 17367 and ISO 17366, respectively).		
AIDC	ISO/IEC JTC 1/SC 31	ISO/IEC 15459-5, Information technology – Automatic identification and data capture techniques – Unique identification – Part 5: Unique identifier for returnable transport items (RTIs)	ISO/IEC 15459-5:2007 specifies a unique, non-significant string of characters for the unique identification of returnable transport items (RTIs). The character string is intended to be represented in a radio frequency identification (RFID) transponder, bar code label or other automatic identification and data capture (AIDC) media attached to the item to meet supply chain management needs. To address management needs different classes of RTI are recognised in the various parts of ISO/IEC 15459, which allows different requirements to be met by	International Standard	2009-06-29

			the unique identifiers associated with each class. The rules for the unique identifier for RTIs, to identify the unique occurrence of an item, with the identity being relevant for the complete life cycle of the item, are defined and supported by an example.		
AIDC	ISO/IEC JTC 1/SC 31	ISO/IEC 15459-6, Information technology – Automatic identification and data capture techniques – Unique identification – Part 1: Individual transport units	ISO/IEC 15459-6:2007 specifies a unique, non-significant string of characters for the unique identifier of product groupings. The character string is intended to be represented in linear bar code and two-dimensional symbols, radio frequency identification (RFID) transponder or other automatic identification and data capture (AIDC) media attached to the product and/or material to meet the management needs in a batch or lot unit. To address management needs, different classes of item are recognised in the various parts of ISO/IEC 15459. This allows different requirements to be met by the unique identifiers of each class. The unique identifier for product grouping enables a product grouping defined by a batch or lot number to be uniquely identified from all other lots and batches compliant with ISO/IEC 15459-6:2007. Encoding this unique identifier in a data carrier enables information about the quality of product and end-of-life processing to be clearly identified. The rules for the unique identifier for product grouping, to identify the unique occurrence of that quality, are defined and supported by an example.	International Standard	2009-06-29
AIDC	ISO/IEC JTC 1/SC 31	ISO/IEC 15459-8, Information technology – Automatic identification and data capture techniques – Unique identification – Part 8: Grouping of transport units	ISO/IEC 15459-8:2009 specifies a unique, non-significant, string of characters for the unique identifier for grouping of transport units. The character string might be represented in a bar code label or other AIDC media associated with the items that make up the grouping to meet supply chain needs and regulatory needs (e.g. customs clearance). An individual instance of an	International Standard	2009-08-31

			entity is aptly identified by a unique identifier defined in other parts of ISO/IEC 15459. This relationship has to be communicated to the business partners according to the business need and the unique identifier for the grouping might be used as a reference number only or marked in addition to the existing identifier. To address management needs, different classes of items are recognized in the various parts of ISO/IEC 15459, which allows different requirements to be met by the unique identifiers associated with each class. ISO/IEC 15459-8:2009 defines the rules for the grouping of transport units to identify the multiple physical units that make up a single shipment from a consignor and are treated as a single logical grouping for customs and other shipping requirements.		
RFID	ISO/IEC JTC 1/SC 31	ISO/IEC 18000-3, Information technology – Radio frequency identification for item management – Part 3: Parameters for air interface communications at 13,56 MHz	ISO/IEC 18000 has been developed in order to: - provide a framework to define common communications protocols for Internationally useable frequencies for radio frequency identification (RFID), and, where possible, to determine the use of the same protocols for all frequencies such that the problems of migrating from one to another are diminished; - minimize software and implementation costs; - enable system management and control and information exchange to be common as far as is possible. ISO/IEC 18000-1 provides explanation of the concepts behind ISO/IEC 18000-3:2010. ISO/IEC 18000-3:2010 has 3 MODES of operation, intended to address different applications. The detailed technical differences between the modes are shown in parameter tables. ISO/IEC 18000-3:2010 provides physical layer,	International Standard	2010-11-04

			collision management system and protocol values for RFID systems for item identification operating at 13,56 MHz in accordance with the requirements of ISO/IEC 18000-1. It provides definitions for systems for each MODE determined in ISO/IEC 18000-3:2010. It defines three non-interfering MODES. - The MODES are not interoperable. - The MODES, whilst not interoperable, are non-interfering.		
RFID	ISO/IEC JTC 1/SC 31	ISO/IEC 18000-63, Information technology – Radio frequency identification for item management – Part 63: Parameters for air interface communications at 860 MHz to 960 MHz	ISO/IEC 18000-6:2010 defines the air interface for radio frequency identification (RFID) devices operating in the 860 MHz to 960 MHz Industrial, Scientific, and Medical (ISM) band used in item management applications. It provides a common technical specification for RFID devices that can be used by ISO committees developing RFID application standards. ISO/IEC 18000-6:2010 is intended to allow for compatibility and to encourage inter-operability of products for the growing RFID market in the international marketplace. It defines the forward and return link parameters for technical attributes including, but not limited to, operating frequency, operating channel accuracy, occupied channel bandwidth, maximum effective isotropic radiated power (EIRP), spurious emissions, modulation, duty cycle, data coding, bit rate, bit rate accuracy, bit transmission order, and, where appropriate, operating channels, frequency hop rate, hop sequence, spreading sequence, and chip rate. It further defines the communications protocol used in the air interface. ISO/IEC 18000-6:2010 specifies the physical and logical requirements for a passive-backscatter, Interrogator-Talks-First (ITF) or tag-talks-only-after-listening (TOTAL) RFID system. The system comprises Interrogators,	DIS ends on 2012-02-24	

			and tags, also known as labels. An Interrogator receives information from a tag by transmitting a continuous-wave (CW) RF signal to the tag; the tag responds by modulating the reflection coefficient of its antenna, thereby backscattering an information signal to the Interrogator. The system is ITF, meaning that a tag modulates its antenna reflection coefficient with an information signal only after being directed to do so by an Interrogator, or TOTAL, meaning that a tag modulates its antenna reflection coefficient with an information signal upon entering an Interrogator's field after first listening for Interrogator modulation in order to determine if the system is ITF or not. In detail, ISO/IEC 18000-6:2010 contains one mode with four types. The detailed technical differences between the four types are shown in the associated parameter tables. Types A, B and C are ITF. Type A uses Pulse-Interval Encoding (PIE) in the forward link and an adaptive ALOHA collision-arbitration algorithm. Type B uses Manchester in the forward link and an adaptive binary-tree collision-arbitration algorithm. Type C uses PIE in the forward link and a random slotted collision-arbitration algorithm. Type D is TOTAL based on Pulse Position Encoding or Miller M=2 encoded subcarrier. ISO/IEC 18000-6:2010 specifies - physical interactions (the signalling layer of the communication link) between Interrogators and tags, - Interrogator and tag operating procedures and commands, - the collision arbitration scheme used to identify a specific tag in a multiple-tag environment.		
RFID	ISO/IEC JTC 1/SC	ISO/IEC 18000-7, Information	ISO/IEC 18000-7:2009 defines the air interface for	CD	

	31	technology – Radio frequency identification for item management – Part 7: Parameters for active air interface communications at 433 MHz	radio frequency identification (RFID) devices operating as an active RF tag in the 433 MHz band used in item management applications. It provides a common technical specification for RFID devices that can be used by ISO technical committees developing RFID application standards. ISO/IEC 18000-7:2009 is intended to allow for compatibility and to encourage inter-operability of products for the growing RFID market in the international marketplace. ISO/IEC 18000-7:2009 defines the forward and return link parameters for technical attributes including, but not limited to, operating frequency, operating channel accuracy, occupied channel bandwidth, maximum power, spurious emissions, modulation, duty cycle, data coding, bit rate, bit rate accuracy, bit transmission order, and, where appropriate, operating channels, frequency hop rate, hop sequence, spreading sequence, and chip rate. ISO/IEC 18000-7:2009 further defines the communications protocol used in the air interface.		
RFID	ISO/IEC JTC 1/SC 31	ISO/IEC 15963, Information technology – Radio frequency identification for item management – Unique identification for RF tags	ISO/IEC 15963:2009 describes numbering systems that are available for the identification of RF tags. The unique ID can be used - for the traceability of the integrated circuit itself for quality control in its manufacturing process, - for the traceability of the RF tag during its manufacturing process and along its lifetime, - for the completion of the reading in a multi-antenna configuration, - by the anti-collision mechanism to inventory multiple tags in the reader's field of view, and - for the traceability of the Item to which the RF tag is attached.	International Standard	2009-08-31

MIIM	ISO/IEC JTC 1/SC 31	ISO/IEC 29143, Information technology – Automatic identification and data capture techniques – Air interface specification for Mobile RFID interrogators	ISO/IEC 29143:2011 specifies - Mobile RFID interrogator media access control, - interrogator to interrogator and multiple interrogator to tag collision arbitration scheme including interrogator requirements, - interrogator to interrogator and multiple interrogator to tag collision avoidance scheme, and - tag memory use for Mobile RFID applications. ISO/IEC 29143:2011 does not specify - physical interactions (the signaling layer of the communication link) between interrogators and tags, - interrogator and tag operating procedures and commands, and - the collision arbitration algorithm used to singulate (separate to the current response slot) a specific tag in a multiple-tag environment.	International Standard	2011-01-31
AIDC	ISO/IEC JTC 1/SC 31	ISO/IEC 29161, Automatic identification and data capture techniques – Unique identification	This International Standard establishes a scheme of unique digital identification for products, product packages, transport units, assets, and other items. This International Standard specifies the common rules applicable for unique digital identification that are required to ensure full compatibility across different identities. The unique digital identification is a universal binary identifier for any physical object. It is used in information systems that need to track or otherwise refer to physical objects. It is intended for use within any AIDC media capable of encoding binary structures.	NP end on 2012-02-29	
RFID	ISO TC 122	ISO 17363, Supply chain applications of RFID – Freight containers	ISO 17363:2007 defines the usage of read/write radio-frequency identification technology (RFID) cargo shipment-specific tags on	2nd Edition FDIS	

			freight containers for supply chain management purposes (shipment tags). It defines the air-interface communications, a common set of required data structures, and a commonly organized set of optional data requirements (through common syntax and semantics). It contains recommendations about a containerized cargo supply chain RFID system, based on shipment tags; specific recommendations about mandatory non-reprogrammable information on the shipment tag; and specific recommendations about optional, re-programmable information on the shipment tag. Identified within ISO 17363:2007 are the air-interface and communication parameters for active radio-frequency identification communications using ISO/IEC 18000-7. ISO 17363:2007 is applicable to freight containers as defined in ISO 668 and to freight containers that are not defined by other ISO standards. It complements ISO 10374 for permanent container license-plate tags. It fully describes cargo shipment-specific tags. It does not address smart container technologies affixed to, or inside, freight containers (e.g. sensors) for supply chain management purposes.		
RFID	ISO TC 122	ISO 17364, Supply chain applications of RFID – Returnable transport items (RTIs)	ISO 17364:2009 defines the basic features of RFID for the use in the supply chain when applied to returnable transport items. In particular it: - provides specifications for the identification of the RTI, - makes recommendations about additional information on the RF tag, - specifies the semantics and data syntax to be used, - specifies the data protocol to be used to	2nd Edition FDIS	

			interface with business applications and the RFID system, - specifies the minimum performance requirements, - specifies the air interface standards between the RF interrogator and RF tag, and - specifies the reuse and recyclability of the RF tag.		
RFID	ISO TC 122	ISO 17365, Supply chain applications of RFID – Transport units	ISO 17365:2009 defines the basic features of RFID for the use in the supply chain when applied to transport units. In particular it: - provides specifications for the identification of the transport unit, - makes recommendations about additional information on the RF tag, - specifies the semantics and data syntax to be used, - specifies the data protocol to be used to interface with business applications and the RFID system, - specifies the minimum performance requirements, - specifies the air interface standards between the RF interrogator and RF tag, and - specifies the reuse and recyclability of the RF tag.	2nd Edition FDIS	
RFID	ISO TC 122	ISO 17366, Supply chain applications of RFID – Product packaging	ISO 17366 defines the usage of RFID technology for product packaging in supply chain management applications. It defines the air-interface communications, a common set of required data structures, and a commonly organized set of optional data requirements (through common syntax and semantics). ISO 17366 identifies the air-interface and communication parameters for passive radio-frequency identification communications using	2nd Edition FDIS	

			ISO/IEC 18000-6C or alternately ISO/IEC 18000-3m3.		
RFID	ISO TC 122	ISO 17367, Supply chain applications of RFID – Returnable transport items (RTIs)	ISO 17367:2009 defines the basic features of RFID for the use in the supply chain when applied to product tagging. In particular it - provides specific recommendations about the encoded identification of the product, - makes recommendations about additional information about the product on the RF tag, - makes recommendations about the semantics and data syntax to be used, - makes recommendations about the data protocol to be used to interface with business applications and the RFID system, and - makes recommendations about the air interface standards between the RF interrogator and RF tag. It only addresses product tagging and does not address product packaging.	2nd Edition FDIS	
Identity management	OMA	OMA Web Services Network Identity	The 'OMA Web Services Enabler (OWSER): Network Identity Specifications' provides the specifications of the components needed to provide aspects of the Network Identity related capabilities of the OWSER.	Approved Enabler	2006-03-28
Identity management	OMA	OMA Identity Management Framework Requirements	The intention of this Requirements Document is to tie together all existing efforts relating to Identity within the OMA in order to create a single Identity Management (IdM) enabler to be used by all OMA enablers. This document sets requirements for all technical working groups of OMA, and all Identity Management related functions should be satisfied according to the resulting enabler.	Candidate Enabler	2005-02-02
Identity management	OMA	OMA Global Permissions Management	The GPM enabler consists of the Permission Checking and Management	Candidate Enabler	2009-07-10

			component, which provides the following main functions: - The Permissions Checking function which processes Permissions Rules, and is exposed by a derivative of the PEM-1 interface. - The Permissions Rules management function for creating, reading, deleting, modifying of Permissions Rules, which is exposed by a derivative of the PEM-2 interface. - Consent interaction function, which uses the Interfaces to other resources to asks Ask Targets for consent on Permissions Checking decisions (e.g. send Ask Request to Ask Target). This may be performed during processing of Permissions Rules.		
NID	ITU-T SG17 Q11	F.5xx, Directory Service - Support of Tag-based Identification Services	The scope of this Recommendation is to provide sufficient information for the use of directories for supporting tag-based identification applications without having to study the details of the many specifications for tag-based identification. It describes how this support may be provided using systems supporting the ITU-T X.500 Series of Recommendations | ISO/IEC 9594-All Parts. The capabilities required are primarily limited to those capabilities that are also supported by the LDAP specifications. NOTE 1 – Use of LDAP based systems provides low-cost solutions. For more complex environments this Recommendation also provides guidance on how directory responsibilities may be split between a general service provider and the information owners. This Recommendation is only concerned with tag-based identification as related to Automatic Identification and Data Capture (AIDC) media as specified in numerous ISO/IEC and ISO	Draft Recommendation	

			International Standards and in GS1 specifications. This Recommendation is further limited to the following types of AIDC media: - The 18000-6C tag type as defined in [ISO/IEC 18000-6]. This tag type is identical to the GS1 EPCglobal Class 1 Gen 2 tag type. - The 18000-3 Mode 3 tag type as defined in [ISO/IEC 18000-3].		
NID	ITU-T SG11 Q12	Q.3950, Testing and model network architecture for tag-based identification systems and functions	A set of standards and relevant implementations are necessary to enable tag-based identification applications and services over the NGN and other communication networks. The implementations are recommended to be verified according to given standards to evaluate their conformance and interoperability. This Recommendation specifies a testing and model network architecture that describes target systems, target functions and system configurations in terms of model network, general procedures and testing requirements	Recommendation	2011-11
FN	ITU-T SG13 Q21	Y.3001 (Future Networks: Objectives and Design Goals)	This Recommendation describes objectives and design goals for Future Networks. The scope of this Recommendation covers: - Fundamental issues to which not enough attention was paid in designing current networks, and which are recommended to be the objective of Future Networks - High-level capabilities and characteristics that are recommended to be supported by Future Networks - Target timeframe for Future Networks Ideas and research topics of Future Networks that are important and may be relevant to future ITU-T standardization are included in the Appendix of this Recommendation.	Recommendation	2011-05
FN	ITU-T SG13 Q21	Y.FNid (Framework of identifiers in future networks)	The scope of this Recommendation includes the following items:	Under study	Februar y 2012

			- Specification of important objects requiring new identifiers in future networks (FNs); - Analysis of the identifiers being used in existing networks and FNs projects; Framework and generic requirements for identifiers in FNs.		
Geospatial Information	OGC	OGC Abstract Specification, Topic 2: Spatial Referencing by Coordinates Version 4.0, OGC Document 08-015r2 Also published as ISO 19111:2007	This Abstract Specification defines the conceptual schema for the description of spatial referencing by coordinates, optionally extended to spatio-temporal referencing. It describes the minimum data required to define one-, two- and three-dimensional spatial coordinate reference systems with an extension to merged spatial-temporal reference systems. It allows additional descriptive information to be provided. It also describes the information required to change coordinates from one coordinate reference system to another. http://www.opengeospatial.org/standards/as	Abstract Specification.	2010-04-27
Geospatial Information	ISO	ISO 19112:2003 Geographic information – Spatial referencing by geographic identifiers	ISO 19912:2003 defines the conceptual schema for spatial references based on geographic identifiers. It establishes a general model for spatial referencing using geographic identifiers, defines the components of a spatial reference system and defines the essential components of a gazetteer. Spatial referencing by coordinates is not addressed in this document; however, a mechanism for recording complementary coordinate references is included. http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=26017	International Standard	2003
Geospatial Information	OGC	KML OGC Document 07-147r2	KML is an XML language focused on geographic visualization, including annotation of maps and images. Geographic visualization includes not only the presentation of graphical data on the globe, but also the control of the user's navigation in the sense of where to go and where to look.	Implementation Standard	2008-04-14

			http://www.opengeospatial.org/standards/kml		
Geospatial Information	OGC	Web Map Service (WMS) OGC Document 06-042 Also published as ISO 19128	The Web Map Service Interface Standard provides a simple HTTP interface for requesting geo-registered map images from one or more distributed geospatial databases. A WMS request defines the geographic layer(s) and area of interest to be processed. The response to the request is one or more geo-registered map images (returned as JPEG, PNG, etc) that can be displayed in a browser application. http://www.opengeospatial.org/standards/wms	Implementation Standard	2006-03-15
Geospatial Information	OGC	Geography Markup Language (GML) Encoding Standard Version 3.2.1 Document 07-036 Also published as ISO 19136	GML is an XML grammar for expressing geographical features. GML serves as a modeling language for geographic systems as well as an open interchange format for geographic transactions on the Internet. As with most XML based grammars, there are two parts to the grammar – the schema that describes the document and the instance document that contains the actual data. A GML document is described using a GML Schema. This allows users and developers to describe generic geographic data sets that contain points, lines and polygons. However, the developers of GML envision communities working to define community-specific application schemas that are specialized extensions of GML. Using application schemas, users can refer to roads, highways, and bridges instead of points, lines and polygons. http://www.opengeospatial.org/standards/gml	Implementation Standard	2007-12-28
Geospatial Information	OGC	City Geography Markup Language (CityGML) Encoding Standard OGC Document 08-007r1	This document is an OpenGIS® Encoding Standard for the representation, storage and exchange of virtual 3D city and landscape models. CityGML is implemented as an application schema of the Geography Markup Language version 3.1.1 (GML3). CityGML models both complex and georeferenced 3D vector data along with the semantics associated with	Implementation Standard	2008-08-20

			the data. In contrast to other 3D vector formats, CityGML is based on a rich, general purpose information model in addition to geometry and appearance information. For specific domain areas, CityGML also provides an extension mechanism to enrich the data with identifiable features under preservation of semantic interoperability. http://www.opengeospatial.org/standards/citygml		
Geospatial Information	OGC	Web Feature Service OGC Document 09-025r1 also ISO 19142	This International Standard specifies the behaviour of a service that provides transactions on and access to geographic features in a manner independent of the underlying data store. It specifies discovery operations, query operations, locking operations, transaction operations and operations to manage stored parameterized query expressions. http://www.opengeospatial.org/standards/wfs	Implementation Standard	2010-11-02
Geospatial Information	OGC	OGC Filter Encoding Encoding Standard Version 2.0 Document 09-026r1 Also published as ISO 19143	This International Standard describes an XML and KVP encoding of a system neutral syntax for expressing projections, selection and sorting clauses collectively called a query expression. These components are modular and intended to be used together or individually by other standards which reference this International Standard. http://www.opengeospatial.org/standards/filter	Implementation Standard	2010-11-22
SWE	OGC	Sensor Web Enablement Architecture OGC Document 06-021r4	This document describes the architecture implemented by OGC's Sensor Web Enablement (SWE). In much the same way that HTML and HTTP standards enabled the exchange of any type of information on the Web, the SWE initiative is focused on developing standards to enable the discovery of sensors and corresponding observations, exchange, and processing of sensor observations, as well as the tasking of sensors and sensor systems. http://portal.opengeospatial.org/files/?artifact_id=29405	Best Practice	2008-08-20

SWE	OGC	OGC Abstract Specification, Topic 20: Observations and Measurements Version 2.0 Document 10-004r3 Also published as ISO 19156:2010	This International Standard defines a conceptual schema for observations, and for features involved in sampling when making observations. These provide models for the exchange of information describing observation acts and their results, both within and between different scientific and technical communities. http://www.opengeospatial.org/standards/as	Approved Abstract Specification	2010-11-10
SWE	OGC	Observations and Measurements - XML Implementation OGC Document 10-025r1	This standard specifies an XML implementation for the OGC and ISO Observations and Measurements (O&M) conceptual model (OGC Observations and Measurements v2.0 also published as ISO/DIS 19156), including a schema for Sampling Features. This encoding is an essential dependency for the OGC Sensor Observation Service (SOS) Interface Standard. More specifically, this standard defines XML schemas for observations, and for features involved in sampling when making observations. These provide document models for the exchange of information describing observation acts and their results, both within and between different scientific and technical communities. http://www.opengeospatial.org/standards/om	Implementation Standard	2011-03-22
SWE	OGC	Sensor Model Language (SensorML) OGC Document 07-000	The Sensor Model Language Encoding Standard (SensorML) specifies models and XML encoding that provide a framework within which the geometric, dynamic, and observational characteristics of sensors and sensor systems can be defined. There are many different sensor types, from simple visual thermometers to complex electron microscopes and earth observing satellites. These can all be supported through the definition of atomic process models and process chains. http://www.opengeospatial.org/standards/sensorml	Implementation Standard	2007-07-17
SWE	OGC	Sensor Observation Service OGD Document 06-009r6	The Sensor Observation Service Interface Standard (SOS) provides an API for managing deployed sensors and retrieving sensor data	Implementation Standard	2007-10-26

			and specifically "observation" data. Whether from in-situ sensors (e.g., water monitoring) or dynamic sensors (e.g., satellite imaging), measurements made from sensor systems contribute most of the geospatial data by volume used in geospatial systems today. http://www.opengeospatial.org/standards/sos		
SWE	OGC	Sensor Planning Service OGC Document 09-000	The Sensor Planning Service Interface Standard (SPS) defines interfaces for queries that provide information about the capabilities of a sensor and how to task the sensor. The standard is designed to support queries that have the following purposes: to determine the feasibility of a sensor planning request; to submit and reserve/commit such a request; to inquire about the status of such a request; to update or cancel such a request; and to request information about other OGC Web services that provide access to the data collected by the requested task. http://www.opengeospatial.org/standards/sps	Implementation Standard	2011-03-28
LBS	OGC	OpenGIS Location Service (OpenLS) Implementation Specification: Core Services OGC Document 07-074	The five Core OpenLS services are defined in a single document: 1. Directory Service. Provides access to an online directory enabling an application to find the location of a specific or nearest place, product, or service. 2. Gateway Service. Retrieves the position of a known Mobile Terminal from the network. This interface is modelled after the LIF/OMA Mobile Location Protocol (MLP), Standard Location Immediate Service, specified in Open Mobile Alliance MLP. 3. Location Utility Service (Geocoder/Reverse Geocoder) Geocoding converts a text description of a location, such as a place name, street address, or postal code to a position structured as Point geometry. Reverse Geocoding converts a position into a feature (Address with Point), where the address may be a street	Implementation Standard	9 September 2008

			address, intersection address, place name, or postal code. 4. Presentation Service. Creates maps and other graphic depictions of selected geospatial data, with a set of ADTs as logical layers. 5. Route Service. Determines travel routes and navigation information between two or more points http://www.opengeospatial.org/standards/ols		
LBS	OGC	OpenLS: Part 6- Navigation Service Implementation Standard OGC Document 08-028r7	The OpenLS: Part 6- Navigation Service Implementation Standard is an enhanced version of the Route Service, that determines travel routes and navigation information between two or more points. http://www.opengeospatial.org/standards/ols	Implementation Standard	2008
LBS	OGC	OpenLS Tracking Service Interface Standard OGC Document 06-024r4	The OpenLS Tracking Service Interface Standard supports a very simple functionality allowing a collection of movable objects to be tracked as they move and change orientation. http://www.opengeospatial.org/standards/ols	Implementation Standard	2008
LBS	OGC	Open GeoSMS	The OpenGIS Open GeoSMS standard defines an encoding for location enabling the Short Message Service. SMS is a communication service for phone, web or mobile communication systems, that provides exchange of short text messages between fixed line or mobile phone devices. The OGC Open GeoSMS encoding standard facilitates communication of location content using the extended SMS devices or applications for achieving interoperable communications while still maintaining human readability of the content. http://www.opengeospatial.org/projects/groups/opengeosmsswg	Standards Working Group	2011
AIDC	EN 841:1995	Bar coding - Symbology specifications - Format Description	This standard - specifies the format for bar code symbology specifications. - specifies the characteristics of the symbology which need to be defined.	Published	

			The standard is applicable as the basis for European Standards for bar code symbologies.		
AIDC	EN 1573:1996	Bar coding - Multi-industry transport label	This European Standard - specifies the general requirements for the design of bar coded transport labels for use by a wide range of industries; - provides for traceability of transported units by automatic access via a 'license plate' printed in bar code and supplemented where necessary by other identified data presented both in bar code and human readable form. - provides a choice of bar code symbologies; - specifies quality requirements, classes of bar code density; - gives recommendations as to label material, size and the inclusion of free text and any appropriate graphics.	Published	Revision started 11-2011
AIDC	EN 1556:1998	Bar coding - Terminology	This European Standard defines a number of technical and other terms applicable to bar code technology, which are used in the standards produced by CEN TC225 and may be encountered elsewhere in bar coding standards produced by other organisations. Definitions given are in the context of bar coding and the terms so defined may customarily have a wider meaning than that shown in this Standard. Translations of the terms defined into the t w o other official languages of CEN are also shown to facilitate cross-reference.	Published	
AIDC	EN 606:2004	Bar coding - Transport and handling labels for steel products	This document specifies the requirements for labels containing human readable and bar coded information for fixing to steel products for the purpose of despatch, transport, and reception in accordance with the requirements of ISO 15394. Data elements are specified together with their status, location on the label, the appropriate data identifier	Published	

			and choice of bar code symbology.		
AIDC	EN 1649:2004	AIDC technologies - Operational aspects affecting the reading of bar code symbols	This document specifies the operational aspects affecting the reading of bar code symbols which must be considered in the preparation of application standards. It defines the subjects which must be addressed by application standards if they are to provide practical guidance to the user industries for whose use they are developed.	Published	
AIDC	EN 12323:2005	AIDC technologies - Symbology specifications - Code 16K	This document: - specifies the requirements for the multi row bar code symbology known as "Code 16K"; - specifies "Code 16K" symbology characteristics, data character encodation, dimensions, tolerances, decoding algorithms and user-defined application parameters; - describes a subset of "Code 16K" assigned to EAN International.	Published	
WASN	ITU-R SG 5 WP 5A Q.250/5	ITU-R M. 2001, Objectives, characteristics and functional requirements of wide-area sensor and/or actuator network (WASN) systems	This Recommendation provides the objectives, system characteristics, functional requirements, service applications and fundamental network functionalities for mobile wireless access systems providing communications to a large number of ubiquitous sensors and/or actuators scattered over wide areas in the land mobile service. The key objective of WASN systems is to support machine-to-machine service applications irrespective of machine locations.	Draft new Recommendation	2012-03
WASN	ITU-R SG 5 WP 5A Q.250/5	System design guidelines for wide area sensor and/or actuator network (WASN) systems	This report provides detailed information for service applications, network architecture, system design guidelines, wireless applications and examples of wide area sensors and/or actuators network (WASN) systems.	Draft new Report	November 2011
Supply chain	GS1	GS1 System Landscape	This document provides a comprehensive inventory of the GS1 standards and catalogues and classifies them into topic areas.	Published	February 2011

M2M	ITU-T SG9 Q5	J.295, "Functional Requirements for Advanced Cable Set-Top Box"	This Recommendation defines functional requirements for the advanced cable set-top box to enable cable television operators to provide advanced services to their subscribers. The advanced cable set-top box is intended to apply to cable television operators' service provision, where many types of access network technologies have been recently introduced, e.g. HFC, PON, RFoG. Cable television operators have a capability of providing both broadcasting and interactivity over its own network originally intended to distribute broadcasting television programs, and the advanced cable set-top box is a core device for the delivery of attractive advanced services.	Approved on January 2012	Consented on 11-2011
USN	ITU-T SG9 Q8	ITU-T J.700, "IPTV service requirements and framework for secondary distribution"	This Recommendation describes the service requirements and functional framework architecture for support of IPTV services to provide enhanced broadcasting, where broadcasting programs are delivered over existing cable-based secondary distribution networks composed of HFC or FTTx with some enhancements by applications and/or services provided over IP-enabled networks. It addresses the service requirements, use cases and functional components required to support these requirements. Where possible, this Recommendation utilizes the material already developed, or under development, in ITU-T Recommendations related to video service delivery over secondary networks.	Approved on December 2008	
USN	ITU-T SG9 Q8	[ITU-T J.360] "IPCablecom2 architecture framework"	The initial release of IPCablecom [ITU-T J.160-J.178] provides for telephony. IPCablecom multimedia [ITU-T J.179] creates a bridge that allows for the expansion of IPCablecom into a full range of multimedia services. This Recommendation provides the architectural framework, technical background and project organization for the second release of the	Approved on November 2006	

			IPCablecom family of Recommendations providing for the extension into the multimedia domain.		
M2M	ITU-T SG9 Q8	[ITU-T J.366] IPCablecom2 IP Multimedia Subsystem (IMS): Delta Recommendations overview	This Recommendation is an overview document introducing the family of IMS delta Recommendations that adapt the wireless industries IMS initiative to the needs of the cable industry. A delta Recommendation references another document and then shows only the changes necessary to adapt the other document to the current needs. It is an important objective of this work that interoperability between IPCablecom 2.0 and 3GPP IMS is provided. IPCablecom 2.0 is based upon 3GPP IMS, but includes additional functionality necessary to meet the requirements of cable operators. Recognizing developing converged solutions for wireless, wireline, and cable, it is expected that further development of IPCablecom 2.0 will continue to monitor and contribute to IMS developments in 3GPP, with the aim of alignment of 3GPP IMS and IPCablecom 2.0.	Approved on November 2006	
USN	ITU-T SG9 Q9	Draft new ITU-T Rec. J.lasdp-req "Functional and Application Programming Interface Requirements for Local Application and Service Delivery Platform for Cable Home Networks"	This draft new Recommendation defines functional requirements for the local application and service delivery platform (LASDP) in the cable home network environment. The local application service delivery platform is a conceptual platform which resides within the home network to provide programming interfaces and functionalities to enable the cable service provider and third party entities to deliver advanced and innovative applications and services to cable subscribers in the home network. The LASDP can communicate and interwork with network service delivery platforms to create more value for customers and the service provider.		Expected for approval on May 2012 Ref. TD 284 (GEN-9)
IoT	ITU-T SG13 Q3	Y.2060, Overview of Internet of Things	This Recommendation provides an overview of the Internet of Things (IoT) with the main objectives to introduce to this important area for future	Recommendation	2012-06

			standardization. More specifically, this Recommendation covers the following: - IoT related terms and definitions; - concept and scope of IoT; - characteristics of IoT; - high level requirements of IoT; - IoT reference models. IoT ecosystem and business models related information is provided in Appendix I.		
MOC	ITU-T SG13 Q3	**Y.2061**, Requirements for support of machine oriented communication applications in the NGN environment	This Recommendation covers extensions and additions to NGN capabilities [ITU-T Y.2201] and MOC device domain capabilities in order to support machine oriented communication (MOC) applications in the NGN environment. Although this Recommendation deals with support of MOC applications in the NGN environment, these capabilities can conceptually be applicable to other networks. The scope of this Recommendation includes: - Service overview, description of MOC ecosystem and key supporting features of MOC applications; - Service requirements to support MOC applications; - Requirements of extended or new NGN capabilities based on the MOC service requirements; - Requirements of MOC device domain capabilities (for supporting MOC applications over NGN) - Reference framework for MOC capabilities.	Recommendation	
	ITU-T SG13 Q3	**Y.SCN**, Applications of Sensor Control Networks over NGN			
	ITU-T SG13 Q3	**Y.EHM-Reqts**, Requirements and Capabilities for E-health Monitoring Applications			
	ITU-T	**Y.2062**, Framework	This draft Recommendation	Recommendation	2012-

	SG13 Q12	of object-to-object communication for ubiquitous networking in NGN	describes concept and high-level architectural model of object-to-object communication for ubiquitous networking in NGN and presents several requirements and mechanism for identification of all objects and providing connectivity to them. For this, this draft Recommendation covers the followings: - General overview of ubiquitous networking in NGN in the end-user perspective; - Basic concept and high-level architectural model for object to object communication with NGN; - Requirements and technical considerations of object-to-object communication for ubiquitous networking; - A mechanism for object to object communication.		03
	ITU-T SG13 Q12	**Y.2063**, Framework of Web of Things	The scope of this Recommendation is to addresses Web of Things to realize the ubiquitous networking [ITU-T Y.2002]. The draft Recommendation covers: - Requirement analysis of Web of Things - Deployment model of Web of Things - Identify the capabilities for Web of Things - Functional architecture for Web of Things	Recommendation	2012-07
	ITU-T SG13 Q12	**Y.energy-hn**, Energy saving using smart objects in next generation home network	This draft Recommendation describes requirements and capabilities for energy saving using smart objects in next generation home network (NG-HN) and present several mechanisms for energy saving of constraint smart objects. For this, this draft Recommendation covers the following: - General overview of energy saving using smart objects in NG-HN;		

			- Requirements for energy saving using smart objects in NG-HN; - Functional model for energy saving using smart objects in NG-HN; - Mechanisms for energy saving of constraint smart objects in NG-HN. Basically, this draft Recommendation consider fixed smart environment like home/building and mobile smart environment like networked vehicle which support ubiquitous networking among objects.		
IoT	ITU-T SG13 Q3	**Y.gw-IoT-Reqts**, Common requirements and capabilities of gateways for IoT applications		Draft Recommendation	2013-02
IoT	ITU-T SG13 Q3	**Y.IoT-common-reqts**, Common requirements of Internet of Things		Draft Recommendation	2013-12
	ITU-T SG13 Q3	**Supplement to Y.2704 (formerly Y.NGN Certificate Management)**, Certificate Management			
	ITU-T SG13 Q3	**Supplement NGN Security Planning and Operations Guidelines**, Draft Supplement NGN Security Planning and Operations Guidelines			
	ITU-T SG13 Q25	**Y.2069**, Terms and definition for Internet of Things	This Recommendation specifies terms and definitions related to Internet of Things from an ITU-T perspective.	Recommendation	2012-07
USN	SG16 Q25	F.747.2, Deployment guidelines for ubiquitous sensor network (USN) applications and services for mitigating the climate change	This Recommendation describes deployment guideline of Ubiquitous Sensor Network (USN) applications and services for mitigating the climate change. The scope of this Recommendation includes: - Analysis of environmental impact by USN applications and services; Deployment guideline of USN applications and services for mitigating the climate change.	Recommendation	2012-06

USN	SG16 Q25	F.USN-NRP, Requirements of USN application and services for network robot platform	This Recommendation covers the following: - Overview of network robot platform in terms of USN applications and services; - Use cases of USN applications and services for network robot platform; USN service requirements for network robot platform.	Draft Recommendation	2012
USN	SG16 Q25	F.747.1, Capabilities of ubiquitous sensor network (USN) for supporting requirements of smart metering systems	The main purpose of this Recommendation is to identify capabilities of ubiquitous sensor network which supports requirements of smart metering services. The scope of this Recommendation covers the following: - Overview of smart metering; - Smart metering scenarios; - Requirements of smart metering services; USN capabilities for supporting requirements of smart metering services.	Recommendation	2012-06
USN	SG16 Q25	F.OpenUSN, Requirements and reference architecture for open USN service framework	The objective of this Recommendation is to define an open USN service framework, and provide requirements, and reference architecture of open USN service framework. The use of standard interfaces of open USN service framework will ensure USN service reusability, portability across several USN services, as well as accessibility and interoperability by USN application providers and/or developers. This Recommendation describes requirements and reference architecture for open USN service framework. The scope of this Recommendation includes: - Concept of open USN service framework - Requirements of open USN service framework - Reference architecture of open USN service framework	Draft Recommendation	2013

			Functional entities of open USN service framework		
USN	SG16 Q25	F.USN-ALI, Requirements and reference structure of automatic location identification capability for USN applications and services	Automatic Location Identification capability enables a device to discover its own location. Within USN scheme, ALI locates between the application and service layers. The ALI can be deployed with the network equipment, or independently integrated by end-node devices. It can be used in various networks such as hybrid mobile networks, internet, low power wireless network (smart gird), and other USN communication systems. The scope of this recommendation includes: - The specific scenario of ALI for USN; - The requirements of ALI for USN; The reference structure of ALI system within USN scheme.	Draft Recommendation	2013
IoT	SG16 Q25	H.IoT-reqs, Common Service Requirements for Internet of Things (IoT) applications and services	This draft Recommendation defines the common services requirements for Internet of Things applications and services based on [ITU-T Y.IoT-overview]. This Recommendation covers the following from the service point of view: - General overview of Internet of Things applications and services, and; - Characteristics of Internet of Things applications and services, and; - Common services requirements for Internet of Things applications and services NOTE: This draft Recommendation mainly focuses on the view point of applications and services. Network layer aspect of Internet of Things is out of scope of this draft Recommendation.	Draft Recommendation	2013
IoT	SG16 Q25	H.IoT-ID, Requirements and Common Characteristics of IoT Identifier for IoT Service	The objective of this Recommendation is to analyse identifiers in existing technologies and networks for IoT service, and describe the requirements of IoT identifier, common	Draft Recommendation	2013

			characteristics of IoT identifier, and the general architecture of IoT identifier. This Recommendation describes the requirements and common characteristics of IoT identifier for IoT service. The scope of this Recommendation includes: - Analysis of identifiers in existing technologies and networks - Describe requirements of IoT identifier - Describe common characteristics of IoT identifier - Describe the general architecture of IoT identifier		
USN	SG16 Q25	H.USN-WQA, Requirements of water quality assessment services in USN	This Recommendation identifies USN requirements and scenarios of water quality assessment services. The scope covers the following: - Overview of water quality assessment; - Water quality assessment scenarios; - Requirements of water quality assessment services; - USN capabilities for supporting the requirements of water quality assessment services;	Draft Recommendation	2013
	SG16 Q25	H.WoT-SA, Web of Things service architecture	The objective of this Recommendation is to define the reference architecture of Web of things for its deployment. The scope of this Recommendation covers the followings: - Overview of WoT Service Architecture; - WoT accessibility; - WoT findability; - WoT sharing; - WoT composition; - WoT interface.	Draft Recommendation	2013
e-Health Application	SG16 Q28	HSTP. EHMSI, Multimedia Service and Interfaces for e-health	This Technical Paper describes requirements and use cases of multimedia services for e-health and their interfaces.	Draft Technical Paper	2012

Annex 3: Overview of IEEE Standards

Communication standards	
IEEE 377™-1980	IEEE Recommended Practice for Measurement of Spurious Emission from Land-Mobile Communication Transmitters
IEEE 802.1AS™ -2011	IEEE Standard for Local and Metropolitan Area Networks - Timing and
IEEE P802.1ASbt™	Draft Standard for Local and Metropolitan Area Networks - Timing and Synchronization for Time-Sensitive Applications in Bridged Local Area Networks Amendment: Enhancements and performance improvements
IEEE 802.1Q™ -2011	IEEE Standard for Local and metropolitan area networks--Media Access
IEEE 802.3™ -2012	IEEE Standard for Ethernet
IEEE 802.3.1™ -2011	IEEE Standard for Management Information Base (MIB) Definitions for Ethernet
IEEE 802.11™ -2012	IEEE Standard for Information Technology-- Telecommunications and information exchange between systems--Local and metropolitan area networks--Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications Amendment 10: Mesh Networking
IEEE 802.11ad™ -2012	IEEE Standard for Local and Metropolitan Area Networks - Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications - Amendment 3: Enhancements for Very High Throughput in the 60 GHz Band
IEEE P802.11af™	Draft Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications; Amendment: TV White Spaces Operation
IEEE P802.11ah™	Draft Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Amendment- Sub 1 GHz License-Exempt Operation
IEEE P802.11ai™	Draft Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Amendment- Fast Initial Link Setup
IEEE 802.15.1™ -2005	IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements. - Part 15.1: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Wireless Personal Area Networks (WPANs)
IEEE 802.15.2™ -2003	IEEE Recommended Practice for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements Part 15.2: Coexistence of Wireless Personal Area Networks With Other Wireless Devices Operating in Unlicensed Frequency Bands
IEEE 802.15.3™ -2003	IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements Part 15.3: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for High Rate Wireless Personal Area Networks (WPANs) Amendment 1: Mac Sublayer
IEEE 802.15.3c™ -2009	IEEE Standard for Information technology-- Local and metropolitan area networks-- Specific requirements-- Part 15.3: Amendment 2: Millimeter-wave- based Alternative Physical Layer Extension

IEEE 802.15.4™ -2011	IEEE Standard for Local and metropolitan area networks--Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs)
IEEE 802.15.4e™ -2012	IEEE Standard for Local and metropolitan area networks—Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs) Amendment 1: MAC sublayer
IEEE 802.15.4f™ -2012	IEEE Standard for Local and metropolitan area networks-- Part 15.4: Low-Rate Wireless Personal Area Networks (LRWPANs) Amendment 2: Active Radio Frequency Identification (RFID) System Physical Layer (PHY)
IEEE 802.15.4g™ -2012	IEEE Standard for Local and metropolitan area networks—Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs) Amendment 3: Physical Layer (PHY) Specifications for Low-Data-Rate, Wireless, Smart Metering Utility Networks
IEEE 802.15.4j™ -2013	IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 15.4: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low Rate Wireless Personal Area Networks (WPANs) Amendment: Alternative Physical Layer Extension to support Medical Body Area Network (MBAN) services operating in the 2360-2400 MHz band
IEEE 802.15.4k™ -2013	IEEE Standard for Local and Metropolitan Area Networks – Part 15.4: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low Rate Wireless Personal Area Networks (WPANs) Amendment - Physical Layer (PHY) Specifications for Low Energy, Critical Infrastructure Monitoring Networks (LECIM)
IEEE P802.15.4m™	Draft Standard for Local and Metropolitan Area Networks Part 15.4: Low Rate Wireless Personal Area Networks (LR-WPANs) Amendment: TV White Space Between 54 MHz and 862 MHz Physical Layer
IEEE P802.15.4n™	Draft Standard for Local and metropolitan area networks-- Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs) Amendment: Physical Layer Utilizing Dedicated Medical Bands in China
IEEE P802.15.4p™	Draft Standard for Local and metropolitan area networks-- Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs) Amendment: Positive Train Control (PTC) System Physical Layer
IEEE P802.15.4q™	Draft Standard for Local and Metropolitan Area Networks - Part 15.4: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low Rate Wireless Personal Area Networks (WPANs) Amendment - Physical Layer (PHY) Specifications for Low Energy, Critical Infrastructure Monitoring Networks (LECIM)
IEEE 802.15.5™ -2009	IEEE Recommended Practice for Information technology-Telecommunications and information exchange between systems-Local and metropolitan area networks-Specific requirements Part 15.5: Mesh Topology Capability in Wireless Personal Area Networks (WPANs)
IEEE 802.15.6™ -2012	IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 15.6: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Wireless Personal Area Networks (WPANs)used in or around a body
IEEE 802.15.7™ -2011	IEEE Standard for Local and Metropolitan Area Networks—Part 15.7: Short-Range Wireless Optical Communication Using Visible Light
IEEE P802.15.8™	Draft Standard for Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Peer Aware Communications (PAC)
IEEE P802.15.9™	Draft Recommended Practice for Transport of Key Management Protocol (KMP) Datagrams
IEEE P802.15.10™	Draft Recommended Practice for Routing Packets in 802.15.4 Dynamically Changing Wireless Networks
IEEE 802.16™ -2012	IEEE Standard for Local and metropolitan area networks Part 16: Air Interface for Broadband Wireless Access Systems
IEEE 802.16n™ -2013	IEEE Standard for local and metropolitan area networks Part 16: Air Interface for Broadband Wireless Access Systems

IEEE 802.16p™ -2012	Standard for Air Interface for Broadband Wireless Access Systems. Amendment: Enhancements to Support Machine-to-Machine Applications
IEEE 802.16.1™ -2012	Standard for WirelessMAN-Advanced Air Interface for Broadband Wireless Access Systems
IEEE 802.16.1a™ -2013	IEEE Standard for WirelessMAN-Advanced Air Interface for Broadband Wireless Access Systems - Amendment: Higher Reliability Networks
IEEE 802.16.1b™ -2012	Standard for WirelessMAN-Advanced Air Interface for Broadband Wireless
IEEE 802.16.2™ -2004	Recommended Practice for Local and Metropolitan Area Networks - Recommended Practice for Coexistence of Fixed Broadband Wireless Access Systems
IEEE P802.16.3™	Draft Standard for Mobile Broadband Network Performance Measurements
IEEE P802.21d™	Draft Standard for Local and metropolitan area networks -- Part 21: Media Independent Handover Services Amendment: Multicast Group Management
IEEE 802.22™ -2011	IEEE Standard for Information Technology-- Telecommunications and information exchange between systems Wireless Regional Area Networks (WRAN)--Specific requirements Part 22: Cognitive Wireless RAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Policies and Procedures for Operation in the TV Bands*
IEEE P802.22b™	Draft Standard for Information Technology-- Telecommunications and information exchange between systems Wireless Regional Area Networks (WRAN)--Specific requirements Part 22: Cognitive Wireless RAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Policies and Procedures for Operation in the TV Bands Amendment: Enhancement for Broadband Services and Monitoring Applications
IEEE 802.22.1™ -2010	IEEE Standard for Information Technology-- Telecommunications and information exchange between systems--Local and metropolitan area networks--Specific requirements Part 22.1: Standard to Enhance Harmful Interference Protection for Low-Power Licensed Devices Operating in TV Broadcast Bands*
IEEE 802.22.2™ -2012	IEEE Standard for Information Technology-- Telecommunications and information exchange between systems--Local and metropolitan area networks--Specific requirements Part 22.2: Installation and Deployment of IEEE 802.22 Systems
IEEE 1174™ -2000	IEEE Standard Serial Interface for Programmable Instrumentation
IEEE 1278.1™ -2012	IEEE Standard for Distributed Interactive Simulation – Application Protocols
IEEE 1278.2™ -1995	IEEE Standard for Distributed Interactive Simulation (DIS) - Communication Services and Profiles*
IEEE 1284™ -2000	IEEE Standard Signaling Method for a Bidirectional Parallel Peripheral Interface for Personal Computers
IEEE 1377™ -2012	IEEE Standard for Utility Industry Metering Communication Protocol Application Layer (End Device Data Tables)
IEEE 1394™ -2008	IEEE Standard for a High-Performance Serial Bus*
IEEE 1451.0™ -2007	IEEE Standard for a Smart Transducer Interface for Sensors and Actuators - Common Functions, Communication Protocols, and Transducer Electronic Data Sheet (TEDS) Formats
IEEE P1451.2™	Draft Standard for a Smart Transducer Interface for Sensors and Actuators - Serial Point-to-Point Interface
IEEE 1451.4™ -2004	IEEE Standard for a Smart Transducer Interface for Sensors and Actuators - Mixed-mode Communication Protocols and Transducer Electronic Data Sheet (TEDS) Format
IEEE P1451.4a™	Draft Standard for a Smart Transducer Interface for Sensors and Actuators--Mixed-Mode Communication Protocols and Transducer Electronic Data Sheet (TEDS) Formats – Amendment
IEEE 1473™ -2010	IEEE Standard for Communications Protocol Aboard Passenger Trains
IEEE 1474™ -2004	IEEE Standard for Communications-Based Train Control (CBTC) Performance and Functional Requirements
IEEE 1474.2™ -2003	IEEE Standard for User Interface Requirements in Communication Based Train Control (CBTC) Systems
IEEE 1474.3™ -2008	IEEE Recommended Practice for Communications-Based Train Control (CBTC) System Design and Functional Allocations

IEEE 1474.4™ -2011	IEEE Recommended Practice for Functional Testing of a Communications-Based Train Control (CBTC) System
IEEE 1484.4™ -2007	IEEE Recommended Practice for Digital Rights Expression Languages (DRELs) Suitable for eLearning Technologies
IEEE 1484.11.1™ -2004	IEEE Standard for Learning Technology--Data Model for Content Object Communication
IEEE 1484.11.2v-2003	IEEE Standard for Learning Technology - ECMAScript Application Programming Interface for Content to Runtime Services Communication
IEEE 1484.11.3™ -2005	IEEE Standard for Learning Technology Extensible Markup Language (XML) Schema Binding for Data Model for Content Object Communication
IEEE 1484.12.1™ -2002	IEEE Standard for Learning Object Metadata
IEEE 1484.12.3™ -2005	IEEE Standard for Extensible Markup Language (XML) Schema Definition Language Binding for Learning Object Metadata
IEEE 1484.13.1™ -2012	IEEE Standard for Learning Technology -- Conceptual Model for Resource Aggregation for Learning, Education, and Training
IEEE P1484.13.2™	Draft Recommended Practice for Learning Technology - Metadata Encoding and Transmission Standard (METS) Mapping to the Conceptual Model for Resource Aggregation
IEEE P1484.13.3™	Draft Recommended Practice for Learning Technology - ISO 21000-2:2005 Information Technology -- Multimedia Framework (MPEG-21) -- Part 2: Digital Item Declaration Mapping to the Conceptual Model for Resource Aggregation
IEEE P1484.13.4™	Draft Recommended Practice for Learning Technology - IMS Content Packaging Information Model (CP) Version 1.2 - Mapping to the Conceptual Model for Resource Aggregation
IEEE 1484.13.5™ -2013	IEEE Recommended Practice for Learning Technology - IETF RFC 4287 - Atom Syndication Format - Mapping to the Conceptual Model for Resource Aggregation
IEEE P1484.13.6™	Draft Recommended Practice for Learning Technology - Open Archives Initiative Object Reuse and Exchange Abstract Model (OAI-ORE) - Mapping to the Conceptual Model for Resource Aggregation
IEEE 1484.20.1v-2007	IEEE Standard for Learning Technology-Data Model for Reusable Competency Definitions
IEEE 1512™ -2006	IEEE Standard for Common Incident Management Message Sets for Use by Emergency Management Centers
IEEE 1512.1™ -2006	IEEE Standard for Common Traffic Incident Management Message Sets for Use by Emergency Management Centers
IEEE 1512.3™ -2006	IEEE Standard for Hazardous Material Incident Management Message Sets for Use by Emergency Management Centers
IEEE 1516™ -2010	IEEE Standard for Modeling and Simulation (M&S) High Level Architecture (HLA)--Framework and Rules
IEEE 1516.1™ -2010	IEEE Standard for Modeling and Simulation (M&S) High Level Architecture (HLA)--Federate Interface Specification
IEEE 1516.2™ -2010	IEEE Standard for Modeling and Simulation (M&S) High Level Architecture (HLA)--Object Model Template (OMT) Specification
IEEE 1547.3™ -2007	IEEE Guide for Monitoring, Information Exchange, and Control of Distributed Resources Interconnected with Electric Power Systems
IEEE 1516.4™ -2007	IEEE Standard for Recommended Practice for Verification, Validation, and Accreditation of a Federation - an Overlay to the High Level Architecture Federation Development and Execution Process
IEEE 1588™ -2008	IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems*
IEEE P1609.0™	Draft Guide for Wireless Access in Vehicular Environments (WAVE) – Architecture*
IEEE 1609.3™ -2010	IEEE Standard for Wireless Access in Vehicular Environments (WAVE) - Networking Services
IEEE 1609.4™ -2010	IEEE Standard for Wireless Access in Vehicular Environments (WAVE)--Multi-channel Operation
IEEE 1609.1™ 1-2010	IEEE Standard for Wireless Access in Vehicular Environments (WAVE)--Over-the-Air Electronic Payment Data Exchange Protocol for Intelligent Transportation Systems (ITS)
IEEE 1609.12™ -2012	IEEE 1609.12™ -2012 IEEE Standard for Wireless Access in Vehicular Environments (WAVE) - Identifier Allocations*

IEEE 1615™ -2007	IEEE Recommended Practice for Network Communication in Electric Power Substations*
IEEE 1675 TM -2008	IEEE Standard for Broadband Over Powerline Hardware
IEEE 1701 TM -2011	IEEE Standard for Optical Port Communication Protocol to Complement the Utility Industry End Device Data Tables
IEEE 1702™ -2011	IEEE Standard for Telephone Modem Communication Protocol to Complement the Utility Industry End Device Data Tables
IEEE 1703™ -2012	IEEE Standard for Local Area Network/Wide Area Network (LAN/WAN) Node Communication Protocol to complement the Utility Industry End Device Data Tables
IEEE P1704™	Draft Standard for Utility Industry End Device Communications Module
IEEE P1705™	Draft Standard for Compliance Testing to Utility Industry Metering Communications Protocol Standards
IEEE 1775™ -2010	IEEE Standard for Power Line Communication Equipment--Electromagnetic Compatibility (EMC) Requirements--Testing and Measurement Methods
IEEE 1815™ -2012	IEEE Standard for Electric Power Systems Communications - Distributed Network Protocol (DNP3)
IEEE 1888™ -2011	IEEE Standard for Ubiquitous Green Community Control Network Protocol*
IEEE 1888.1™ -2013	IEEE Standard for a Ubiquitous Community Network: Control and Management
IEEE P1888.2™	Draft Standard for Ubiquitous Green Community Control Network: Heterogeneous Networks Convergence and Scalability
IEEE 1888.3™ -2013	IEEE Standard for Ubiquitous Green Community Control Network: Security
IEEE 1900.1™ -2008	IEEE Standard Definitions and Concepts for Dynamic Spectrum Access: Terminology Relating to Emerging Wireless Networks, System Functionality, and Spectrum Management*
IEEE 1900.2™ -2008	IEEE Recommended Practice for the Analysis of In- Band and Adjacent Band Interference and Coexistence Between Radio Systems
IEEE 1900.4™ -2009	IEEE Standard for Architectural Building Blocks Enabling Network- Device Distributed Decision Making for Optimized Radio Resource Usage in Heterogeneous Wireless Access Networks
IEEE 1900.4a™ -2011	IEEE Standard for Architectural Building Blocks Enabling Network- Device Distributed Decision Making for Optimized Radio Resource Usage in Heterogeneous Wireless Access Networks Amendment 1: Architecture and Interfaces for Dynamic Spectrum Access Networks in White Space Frequency Bands
IEEE P1900.7™	Draft Standard for Radio Interface for White Space Dynamic Spectrum Access Radio Systems Supporting Fixed and Mobile Operation
IEEE 1901™ -2010	IEEE Standard for Broadband over Power Line Networks: Medium Access Control and Physical Layer Specifications
IEEE 1901.2™ -2013	EEE Standard for Low Frequency (less than 500 kHz) Narrow Band Power Line Communications for Smart Grid Applications
IEEE 1902.1™ -2009	IEEE Standard for Long Wavelength Wireless Network Protocol
IEEE 1904.1™ -2013	IEEE Standard for Service Interoperability in Ethernet Passive Optical Networks
IEEE 1904.1™ -Conformance 01	Draft Standard for Conformance Test Procedures for Service Interoperability in Ethernet Passive Optical Networks, IEEE Std 1904.1 Package A
IEEE P1904.1™ -Conformance 02	Draft Standard for Conformance Test Procedures for Service Interoperability in Ethernet Passive Optical Networks, IEEE Std 1904.1 Package B
IEEE P1904.1™ -Conformance 03	Draft Standard for Conformance Test Procedures for Service Interoperability in Ethernet Passive Optical Networks, IEEE Std 1904.1 Package C
IEEE 1905.1™ -2013	IEEE Draft Standard for a Convergent Digital Home Network for Heterogeneous Technologies
IEEE P1907.1™	Draft Standard for Network-Adaptive Quality of Experience (QoE) Management Scheme for Real-Time Mobile Video Communications
IEEE P1909.1™	Draft Recommended Practice for Smart Grid Communication Equipment - Test methods and installation requirements
IEEE P2100.1™	Draft Standard Specifications for Wireless Power and Charging Systems

IEEE 2030™ -2011	IEEE Guide for Smart Grid Interoperability of Energy Technology and Information Technology Operation with the Electric Power System (EPS), End-Use Applications, and Loads
IEEE 2200™ -2012	IEEE Standard Protocol for Stream Management in Media Client Devices*
IEEE P2301™	Draft Guide for Cloud Portability and Interoperability Profiles (CPIP)
IEEE P2302™	Draft Standard for Intercloud Interoperability and Federation (SIIF)
IEEE 11073-00101™ -2008	IEEE 11073-00101™ -2008 IEEE Standard for Health Informatics – Point of Care Medical Device Communication - Part 00101: Guide--Guidelines for the Use of RF Wireless Technology
IEEE 11073-00103™: 2012	IEEE Standard for Health informatics - Personal health device communication Part 00103: Overview
IEEE 11073-10101™: 2004	IEEE Standard for Health informatics - Point-of-care medical device communication – Nomenclature*
IEEE P11073-10101a™: ISO/IEEE 11073-10101:2004,	Health informatics - Point-of-care medical device communication - Nomenclature Amendment for additional definitions
IEEE 11073-10102-2012™	IEEE Standard for Health informatics - Point-of care medical device communication - Nomenclature - Annotated ECG
IEEE 11073-10103™ -2013	IEEE Standard for Health informatics - Point-of-care medical device communication - Nomenclature - Implantable device, cardiac
IEEE 11073-10201™:2004	IEEE Standard for Health informatics - Point-of-care medical device communication - Domain information model*
IEEE P11073-10301-1™	Draft Standard for Health informatics - Point-of-care medical device communication - Part 10301-1: Device Specialization - Infusion pump, General
IEEE P11073-10302-1™	Draft Standard for Health informatics - Point-of-care medical device communication - Part 10302-1: Device Specialization - Physiologic monitor, General
IEEE P11073-10303-1™	Draft Standard for Health informatics - Point-of-care medical device communication - Part 10303-1: Device Specialization - Ventilator, General
IEEE 11073-10404™ -2010	IEEE Standard for Health Informatics - Personal Health Device Communication - Device Specialization - Pulse Oximeter*
IEEE P11073-10404a™	Draft Standard for Health Informatics - Personal Health Device Communication - Device Specialization - Pulse Oximeter Amendment
IEEE 11073-10406™:2011	IEEE Standard for Health informatics--Personal health device communication Part 10406: Device specialization--Basic electrocardiograph (ECG) (1-to 3-lead ECG)
IEEE P11073-10406a™	Draft Standard for Health informatics--Personal health device communication Part 10406: Device specialization--Basic electrocardiograph (ECG) (1- to 3-lead ECG) Amendment
IEEE 11073-10407™:2008	IEEE 11073-10407™:2008 IEEE Standard for Health Informatics - Personal Health Device Communication - Device Specialization - Blood Pressure Monitor
IEEE 11073-10408™:2008	IEEE Standard for Health informatics-- Personal health device communication Part 10408: Device specialization -- Thermometer
IEEE P11073-10413™	Draft Standard for Health informatics - Personal health device communication - Device specialization - Respiration rate monitor
IEEE 11073-10415™:2008	IEEE Standard for Health Informatics - Personal Health Device Communication - Device Specialization - Weighing Scale
IEEE 11073-10417™:2011	IEEE Standard for Health informatics--Personal health device communication Part 10417: Device specialization--Glucose meter
IEEE 11073-10417a™	Draft Standard for Health informatics--Personal health device communication Part 10417: Device specialization--Glucose meter Amendment 1
IEEE 11073-10418™:2011 monitor	IIEEE Standard for Health informatics--Personal health device communication Part 10418: Device specialization--International Normalized Ratio (INR) monitor
IEEE P11073-10419™	Draft Standard for Health informatics - Personal health device communication - Device specialization - Insulin pump
IEEE 11073-10420™:2010	IEEE Standard for Health informatics -- Personal health device communication Part 10420: Device specialization -- Body composition analyzer
IEEE 11073-10421™:2010	Standard for Health informatics--Personal health device

	communication Part 10421: Device specialization--Peak expiratory flow monitor (peak flow)
IEEE P11073-10422™	Draft Standard for Health informatics - Personal health device communication - Device specialization - Urine analyzer
IEEE P11073-10423™	Draft Standard for Health informatics -Personal health device communication - Device specialization - Sleep Monitor
IEEE P11073-10424™	Draft Standard for Health informatics - Personal health device communication - Device specialization - Sleep apnea breathing therapy equipment
IEEE P11073-10425™	IEEE Draft Standard for Health informatics - Personal health device communication - Device specialization - Continuous Glucose Monitor (CGM)
IEEE 11073-10441™:2013	IEEE Standard for Health Informatics--Personal health device communication Part 10441: Device specialization--Cardiovascular fitness and activity monitor
IEEE 11073-10442™:2008	IEEE Standard for Health informatics - Personal health device communication Part 10442: Device specialization - Strength fitness equipment
IEEE 11073-10471™:2008	IEEE Standard for Health informatics--Personal health device communication Part 10471: Device specialization--Independent living activity hub
IEEE P11073-10471a™:	Draft Standard for Health informatics-Personal health device communication Part 10471: Device specialization-Independent living activity hub Amendment
IEEE 11073-10472™:2010	IEEE Standard for Health informatics--Personal health device communication--Part 10472: Device specialization--Medication monitor
IEEE 11073-20101™:2004	IEEE Standard for Health informatics - Point-of-care medical device communication - Application profile - Base standard*
IEEE P11073-20201™	™ Draft Standard for Health informatics -- Point-of-care medical device communication -- Part 20201: Application profile -- Polling mode
IEEE P11073-20202™	Draft Standard for Health informatics -- Point-of-care medical device communication -- Part 20202: Application profile -- Baseline asynchronous mode
IEEE P11073-20301™	Draft Standard for Health informatics -- Point-of-care medical device communication -- Part 20301: Application profile -- Optional package, remote control
IEEE P11073-20401™	Draft Standard for Health informatics -- Point-of-care medical device communication -- Part 20401: Application profile -- Common networking services
IEEE 11073-20601™:2008	IEEE Standard for Health informatics - Personal health device communication - Part 20601: Application profile - Optimized exchange protocol
IEEE 11073-20601a™:2010	IEEE Standard for Health informatics--Personal health device communication Part 20601: Application profile--Optimized Exchange Protocol Amendment 1
IEEE 11073-30200™:2000	ISO/IEEE Standard for Health informatics - Point-of-care medical device communication - Transport profile - Cable connected
IEEE 11073-30200a™:2011	IEEE Standard for Health informatics--Point-of-care medical device communication Part 30200: Transport profile--Cable connected Amendment 1
IEEE 11073-30300™:2004 ISO/IEEE 11073-30300:2004,	IEEE Health informatics - Point-of-care medical device communication - Transport profile - Infrared
IEEE 11073-30400™:2010	IEEE Health informatics--Point-of-care medical device communication Part 30400: Interface profile--Cabled Ethernet
IEEE 14575™ -2000	IEEE Standard for Heterogeneous Interconnect (HIC) (Low-Cost, Low- Latency Scalable Serial Interconnect for Parallel System Construction)
IEEE 21450™ -2010	IEEE Standard for Information technology -- Smart transducer interface for sensors and actuators -- Common functions, communication protocols, and Transducer Electronic Data Sheet (TEDS) formats
IEEE P21451™ -001	Draft Recommended Practice for Signal Treatment Applied to Smart Transducers
IEEE 21451-1™ -2010	IEEE Standard for Information technology -- Smart transducer interface for sensors and actuators -- Part 1: Network Capable Application Processor (NCAP) information model*
IEEE P21451-1™	Draft Standard for Smart Transducer Interface for Sensors and Actuators - Common Network Services*

IEEE P21451-1-4™	Draft Standard for a Smart Transducer Interface for Sensors, Actuators, and Devices - eXtensible Messaging and Presence Protocol (XMPP) for Networked Device Communication
IEEE 21451-2™ -2010	IEEE Standard for Information technology -- Smart transducer interface for sensors and actuators -- Part 2: Transducer to microprocessor communication protocols and Transducer Electronic Data Sheet (TEDS) formats*
IEEE 21451-4™ -2010	IEEE Standard for Information technology -- Smart transducer interface for sensors and actuators -- Part 4: Mixed-mode communication protocols and Transducer Electronic Data Sheet (TEDS) formats
IEEE 21451-7™ -2011	IEEE Standard for Smart Transducer Interface for Sensors and Actuators--Transducers to Radio Frequency Identification (RFID) Systems Communication Protocols and Transducer Electronic Data Sheet Formats
IEEE IEC 60488-2™ Ed.1 2004 (IEEE 488.2(TM)-1992)	Standard Digital Interface for Programmable Instrumentation - Part 2: Codes, formats, protocols and common commands
IEEE IEC 60488-1™ Ed.1 2004 (IEEE 488.1(TM)-2003)	Higher Performance Protocol for the Standard Digital Interface for Programmable Instrumentation - Part 1: General
IEEE C37.11™ -1997	IEEE Standard Requirements for Electrical Control for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis*
IEEE C37.118.2™ -2011	IEEE Standard for Synchrophasor Data Transfer for Power Systems
IEEE PC37.243™	Draft Guide for the Application of Digital Line Current Differential Relays Using Digital Communications
IEEE C37.244™ -2013	IEEE Guide for Phasor Data Concentrator Requirements for Power System Protection, Control, and Monitoring
IEEE PC62.36™	Draft Standard for Test Methods for Surge Protectors Used in Low- Voltage Data, Communications, and Signaling Circuits

*An asterisk means that a revision project for this standard is underway.

IEEE-SA Industry Connections programs:

- IEEE Intercloud Testbed
- Cloud Computing Innovation Council for India

Identification standards	
IEEE Registration Authority for Organizationally Unique Identifiers (OUIs)	
IEEE 802.1AB™ -2009	IEEE Standard for Local and metropolitan area networks -- Station and Media Access Control Connectivity Discovery
IEEE 802.15.4f™ -2012	IEEE Standard for Local and metropolitan area networks—Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs) Amendment 2: Active Radio Frequency Identification (RFID) System Physical Layer (PHY)
IEEE 1284.1™ -1997	IEEE Standard for Information Technology -Transport Independent Printer/System Interface (TIP/SI)
IEEE 1902.1™ -2009	IEEE Standard for Long Wavelength Wireless Network Protocol
IEEE 21451-7™ -2011	IEEE Standard for Smart Transducer Interface for Sensors and Actuators--Transducers to Radio Frequency Identification (RFID) Systems Communication Protocols and Transducer Electronic Data Sheet Formats
IEEE C37.111™ -2013	IEEE Standard for Common Format for Transient Data Exchange (COMTRADE) for Power Systems

Security standards	
IEEE 802.1AE™ -2006	IEEE Standard for Local and Metropolitan Area Networks: Media Access Control (MAC) Security
IEEE 802.1AEbn™ -2011	IEEE Standard for Local and Metropolitan Area Networks: Media Access Control (MAC) Security Amendment: Galois Counter Mode-Advanced Encryption Standard-256 (GCM-AES-256) Cipher Suite
IEEE 802.1AEbw™ -2013	IEEE Standard for Local and Metropolitan Area Networks: Media Access Control (MAC) Security Amendment: Extended Packet

	Numbering
IEEE 802.11™-2012	IEEE Standard for Information Technology-- Telecommunications and information exchange between systems--Local and metropolitan area networks--Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications Amendment 10: Mesh Networking
IEEE 1363™-2000	IEEE Standard Specifications for Public-Key Cryptography
IEEE 1363a™-2004	IEEE Standard Specifications for Public-Key Cryptography: Additional Techniques
IEEE 1363.1™-2008	IEEE Standard Specification for Public-Key Cryptographic Techniques Based on Hard Problems over Lattices
IEEE 1363.2™-2008	IEEE Standard Specification for Password-Based Public- Key Cryptographic Techniques
IEEE 1363.3™-2013	IEEE Standard for Identity-Based Cryptographic Techniques Using Pairings
IEEE 1402™-2000	IEEE Guide for Electric Power Substation Physical and Electronic Security*
IEEE 1609.2™-2013	IEEE Standard for Wireless Access in Vehicular Environments - Security Services for Applications and Management Messages
IEEE 1619™-2007 IEEE	Standard for Cryptographic Protection of Data on Block-Oriented Storage Devices*
IEEE 1619.1™-2007	IEEE Standard for Authenticated Encryption with Length Expansion for Storage Devices
IEEE 1619.2™-2010	IEEE Standard for Wide-Block Encryption for Shared Storage Media
IEEE 1667™-2009	IEEE Standard Protocol for Authentication in Host Attachments of Transient Storage Devices*
IEEE 1686™-2007	IEEE Standard for Substation Intelligent Electronic Devices (IED) Cyber Security Capabilities*
IEEE 1711™-2010	IEEE Trial-Use Standard for Cryptographic Protocol for Cyber Security of Substation Serial Links*
IEEE P1711.3™	Draft Standard for Secure SCADA Communications Protocol (SSCP)
IEEE 1888.3™-2013	IEEE Standard for Ubiquitous Green Community Control Network: Security
IEEE P2030.102.1™	Draft Standard for Interoperability of Internet Protocol Security (IPsec) Utilized within Utility Control Systems
IEEE 2600™-2008	IEEE Standard for Information Technology: Hardcopy Device and System Security
IEEE 2600.1™-2009	IEEE Standard for a Protection Profile in Operational Environment A
IEEE 2600.2™-2009	IEEE Standard Protection Profile for Hardcopy Devices in IEEE 2600™-2008 Operational Environment B
IEEE 2600.3™-2009	IEEE Standard Protection Profile for Hardcopy Devices in IEEE 2600™-2008 Operational Environment C
IEEE 2600.4™-2010	IEEE Standard Protection Profile for Hardcopy Devices in IEEE 2600™-2008 Operational Environment D
IEEE PC37.240™	Draft Standard for Cyber Security Requirements for Substation Automation, Protection and Control Systems

IEEE-SA Industry Connections programs:

- Malware Metadata Exchange Format (MMDEF)
- Software Taggant System
- Clean-file Metadata Exchange (CMX)
- eCrime Management and Response (Stop-eCrime)
- Privilege Management Protocols (PMP WG)
- Convergence of Smart Homes and Building Architectures (CSHBA)

Privacy standards	
IEEE 1363™ -2000	IEEE Standard Specifications for Public-Key Cryptography
IEEE 1363a™ -2004	IEEE Standard Specifications for Public-Key Cryptography: Additional Techniques
IEEE 1363.1™ -2008	IEEE Standard Specification for Public-Key Cryptographic Techniques Based on Hard Problems over Lattices
IEEE 1363.2™ -2008	IEEE Standard Specification for Password-Based Public- Key Cryptographic Techniques
IEEE 1363.3™ -2013	IEEE Standard for Identity-Based Cryptographic Techniques Using Pairings
IEEE 1609.2™ -2013	IEEE Standard for Wireless Access in Vehicular Environments — Security Services for Applications and Management Messages
IEEE P1817™	Draft Standard for Consumer-Ownable Digital Personal Property
IEEE 2600™ -2008	IEEE Standard for Information Technology: Hardcopy Device and System Security
IEEE 2600.1™ -2009	IEEE Standard for a Protection Profile in Operational Environment A
IEEE 2600.2™ -2009	IEEE Standard Protection Profile for Hardcopy Devices in IEEE 2600™-2008 Operational Environment B
IEEE 2600.3™ -2009	IEEE Standard Protection Profile for Hardcopy Devices in IEEE 2600™-2008 Operational Environment C
IEEE 2600.4™ -2010	IEEE Standard Protection Profile for Hardcopy Devices in IEEE 2600™-2008 Operational Environment D

IEEE-SA Industry Connections programs:

- Convergence of Smart Home and Building Architectures (CSHBA)

Interoperability standards (the ability of two or more systems or components to exchange data and use information)	
IEEE 754 ™ -2008	IEEE Standard for Floating-Point Arithmetic
IEEE 802.3 ™ -2012	IEEE Standard for Ethernet
IEEE 802.11 ™ -2012	IEEE Standard for Information Technology--Telecommunications and information exchange between systems--Local and metropolitan area networks--Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications Amendment 10: Mesh Networking
IEEE 802.15.1 ™ -2005	IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements. - Part 15.1: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Wireless Personal Area Networks (WPANs)
IEEE 802.15.2 ™ -2003	IEEE Recommended Practice for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements Part 15.2: Coexistence of Wireless Personal Area Networks With Other Wireless Devices Operating in Unlicensed Frequency Bands
IEEE 802.15.3 ™ -2003	IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements Part 15.3: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for High Rate Wireless Personal Area Networks (WPANs) Amendment 1: Mac Sublayer
IEEE 802.15.3c ™ -2009	IEEE Standard for Information technology-- Local and metropolitan area networks-- Specific requirements-- Part 15.3: Amendment 2: Millimeter-wave- based Alternative Physical Layer Extension
IEEE 802.15.4 ™ -2011	IEEE Standard for Local and metropolitan area networks--Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs)
IEEE 802.15.4e ™ -2012	IEEE Standard for Local and metropolitan area networks--Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs) Amendment 1: MAC sublayer
IEEE 802.15.4f ™ -2012	IEEE Standard for Local and metropolitan area networks-- Part 15.4: Low-Rate Wireless Personal Area Networks (LRWPANs)

	Amendment 2: Active Radio Frequency Identification (RFID) System Physical Layer (PHY)
IEEE 802.15.4g ™ -2012	IEEE Standard for Local and metropolitan area networks--Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs) Amendment 3: Physical Layer (PHY) Specifications for Low-Data-Rate, Wireless, Smart Metering Utility Networks
IEEE 802.15.4j ™ -2013	IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 15.4: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low Rate Wireless Personal Area Networks (WPANs) Amendment: Alternative Physical Layer Extension to support Medical Body Area Network (MBAN) services operating in the 2360-2400 MHz band
IEEE 802.15.4k ™ -2013	IEEE Standard for Local and Metropolitan Area Networks - Part 15.4: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low Rate Wireless Personal Area Networks (WPANs) Amendment - Physical Layer (PHY) Specifications for Low Energy, Critical Infrastructure Monitoring Networks (LECIM)
IEEE P802.15.4m ™	Draft Standard for Local and Metropolitan Area Networks Part 15.4: Low Rate Wireless Personal Area Networks (LR-WPANs) Amendment: TV White Space Between 54 MHz and 862 MHz Physical Layer
IEEE P802.15.4n ™	Draft Standard for Local and metropolitan area networks-- Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs) Amendment: Physical Layer Utilizing Dedicated Medical Bands in China
IEEE P802.15.4p ™	Draft Standard for Local and metropolitan area networks-- Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs) Amendment: Positive Train Control (PTC) System Physical Layer
IEEE P802.15.4q ™	Draft Standard for Local and Metropolitan Area Networks - Part 15.4: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low Rate Wireless Personal Area Networks (WPANs) Amendment - Physical Layer (PHY) Specifications for Low Energy, Critical Infrastructure Monitoring Networks (LECIM)
IEEE 802.15.5 ™ -2009	IEEE Recommended Practice for Information technology-Telecommunications and information exchange between systems-Local and metropolitan area networks-Specific requirements Part 15.5: Mesh Topology Capability in Wireless Personal Area Networks (WPANs)
IEEE 802.15.6 ™ -2012	IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 15.6: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Wireless Personal Area Networks (WPANs)used in or around a body
IEEE 802.15.7 ™ -2011	IEEE Standard for Local and Metropolitan Area Networks--Part 15.7: Short-Range Wireless Optical Communication Using Visible Light
IEEE P802.15.8 ™	Draft Standard for Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Peer Aware Communications (PAC)
IEEE P802.15.9 ™	Draft Recommended Practice for Transport of Key Management Protocol (KMP) Datagrams
IEEE P802.15.10 ™	Draft Recommended Practice for Routing Packets in 802.15.4
IEEE 802.16n ™ -2013	IEEE Standard for local and metropolitan area networks Part 16: Air Interface for Broadband Wireless Access Systems
IEEE 802.16p TM -2012	IEEE Standard for Air Interface for Broadband Wireless Access Systems Amendment: Enhancements to Support Machine-to-Machine Applications
IEEE 802.16.1b ™ -2012	IEEE Standard for WirelessMAN-Advanced Air Interface for Broadband Wireless Access Systems - Amendment: Enhancements to Support Machine-to- Machine Applications
IEEE 802.22 ™ -2011	IEEE Standard for Information Technology-- Telecommunications and information exchange between systems Wireless Regional Area Networks (WRAN)--Specific requirements Part 22: Cognitive Wireless RAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Policies and Procedures for Operation in the TV Bands

IEEE 1285 ™ -2005	IEEE Standard for Scalable Storage Interface (S/SUP 2/I)
IEEE 1377 ™ -2012	IEEE Standard for Utility Industry Metering Communication Protocol Application Layer (End Device Data Tables)
IEEE 1394.1 ™ -2004	IEEE Standard for High Performance Serial Bus Bridges
IEEE 1394.3 ™ -2003	IEEE Standard for High Performance Serial Bus Peer to Peer Data Transport Protocol
IEEE 1451.0 ™ -2007	IEEE Standard for a Smart Transducer Interface for Sensors and Actuators - Common Functions, Communication Protocols, and Transducer Electronic Data Sheet (TEDS) Formats
IEEE P1451.2 ™	Draft Standard for a Smart Transducer Interface for Sensors and Actuators - Serial Point-to-Point Interface
IEEE 1451.4 ™ -2004	IEEE Standard for a Smart Transducer Interface for Sensors and Actuators - Mixed-mode Communication Protocols and Transducer Electronic Data Sheet (TEDS) Formats
IEEE P1451.4a ™	Draft Standard for a Smart Transducer Interface for Sensors and Actuators--Mixed-Mode Communication Protocols and Transducer Electronic Data Sheet (TEDS) Formats – Amendment
IEEE 1484.11.1 ™ -2004	IEEE Standard for Learning Technology--Data Model for Content Object Communication
IEEE 1484.4 ™ -2007	IEEE Recommended Practice for Digital Rights Expression Languages (DRELs) Suitable for eLearning Technologies
IEEE 1484.11.1 ™ -2004	IEEE Standard for Learning Technology--Data Model for Content Object Communication
IEEE 1484.11.2 ™ -2003	IEEE Standard for Learning Technology - ECMAScript Application Programming Interface for Content to Runtime Services Communication
IEEE 1484.11.3 ™ -2005	IEEE Standard for Learning Technology Extensible Markup Language (XML) Schema Binding for Data Model for Content Object Communication
IEEE 1484.12.1 ™ -2002	IEEE Standard for Learning Object Metadata
IEEE 1484.12.3 ™ -2005	IEEE Standard for Extensible Markup Language (XML) Schema Definition Language Binding for Learning Object Metadata
IEEE 1484.13.1 ™ -2012	IEEE Standard for Learning Technology -- Conceptual Model for Resource Aggregation for Learning, Education, and Training
IEEE 1484.13.4 ™	Draft Recommended Practice for Learning Technology - IMS Content Packaging Information Model (CP) Version 1.2 - Mapping to the Conceptual Model for Resource Aggregation
IEEE 1484.13.5 ™ -2013	IEEE Recommended Practice for Learning Technology - IETF RFC 4287 - Atom Syndication Format - Mapping to the Conceptual Model for Resource Aggregation
IEEE 1484.13.6 ™	Draft Recommended Practice for Learning Technology - Open Archives Initiative Object Reuse and Exchange Abstract Model (OAI-ORE) - Mapping to the Conceptual Model for Resource Aggregation
IEEE 1484.20.1 ™ -2007	IEEE Standard for Learning Technology-Data Model for Reusable Competency Definitions
IEEE 1516 ™ -2010	IEEE Standard for Modeling and Simulation (M&S) High Level Architecture (HLA)--Framework and Rules
IEEE 1516.1 ™ -2010	IEEE Standard for Modeling and Simulation (M&S) High Level Architecture (HLA)--Federate Interface Specification
IEEE 1516.2 ™ -2010	IEEE Standard for Modeling and Simulation (M&S) High Level Architecture (HLA)--Object Model Template (OMT) Specification
IEEE 1516.4 ™ -2007	IEEE Recommended Practice for Verification, Validation, and Accreditation of a Federation - an Overlay to the High Level Architecture Federation Development and Execution Process
IEEE 1547 ™ -2003	IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems
IEEE 1547.1 ™ -2005	IEEE Standard for Conformance Tests Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems
IEEE P1547.1a ™	Draft Standard Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems Amendment 1
IEEE 1547.2 ™ -2008	IEEE Application Guide for IEEE 1547 TM, IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems
IEEE 1547.3 ™ -2007	IEEE Guide for Monitoring, Information Exchange, and Control of Distributed Resources Interconnected With Electric Power Systems
IEEE 1547.4 ™ -2011	IEEE Guide for Design, Operation, and Integration of Distributed Resource Island Systems with Electric Power Systems

IEEE 1547.6 ™ -2011	Draft Recommended Practice for Interconnecting Distributed Resources with Electric Power Systems Distribution Secondary Networks
IEEE P1547.7 ™	Draft Guide to Conducting Distribution Impact Studies for Distributed Resource Interconnection
IEEE P1547.8 ™	Draft Recommended Practice for Establishing Methods and Procedures that Provide Supplemental Support for Implementation Strategies for Expanded Use of IEEE Standard 1547 TM
IEEE P1609.6 ™	Draft Standard for Wireless Access in Vehicular Environments (WAVE) - Remote Management Service
IEEE 1615 ™ -2007	IEEE Recommended Practice for Network Communication in Electric Power Substations*
IEEE 1636.2 ™ -2010	IEEE Standard for Software Interface for Maintenance Information Collection and Analysis (SIMICA): Exchanging Maintenance Action Information via the Extensible Markup Language (XML)
IEEE 1701 ™ -2011	IEEE Standard for Optical Port Communication Protocol to Complement the Utility Industry End Device Data Tables
IEEE 1702 ™ -2011	IEEE Standard for Telephone Modem Communication Protocol to Complement the Utility Industry End Device Data Tables
IEEE 1703v-2012	IEEE Standard for Local Area Network/Wide Area Network (LAN/WAN) Node Communication Protocol to complement the Utility Industry End Device Data Tables
IEEE P1704 ™	Draft Standard for Utility Industry End Device Communications Module
IEEE P1705 ™	Draft Standard for Compliance Testing to Utility Industry Metering Communications Protocol Standards
IEEE 1722 ™ -2011	IEEE Standard for Layer 2 Transport Protocol for Time Sensitive Applications in Bridged Local Area Networks
IEEE P1722a ™	Draft Standard for Layer 2 Transport Protocol for Time Sensitive Applications in a Bridged Local Area Network Amendment 1 - Extensible Streaming Formats
IEEE 1722.1 ™ -2013	IEEE Standard for Device Discovery, Connection Management and Control Protocol for IEEE 1722 Based Devices
IEEE 1733 ™ -2011	IEEE Standard for Layer 3 Transport Protocol for Time Sensitive Applications in Local Area Networks
IEEE P1828 ™	Draft Standard for Systems with Virtual Components
IEEE P1855 ™	Draft Standard for FML - Fuzzy Markup Language - for achieving interoperability in fuzzy systems design
IEEE P1856 ™	Draft Standard Framework for Prognostics and Health Management of Electronic Systems
IEEE P1873 ™	Draft Standard for Robot Map Data Representation for Navigation
IEEE 1888 ™ -2011	IEEE Standard for Ubiquitous Green Community Control Network Protocol*
IEEE 1888.1 ™ -2013	IEEE Standard for a Ubiquitous Community Network: Control and Management
IEEE P1888.2 ™	Draft Standard for Ubiquitous Green Community Control Network: Heterogeneous Networks Convergence and Scalability
IEEE 1888.3 ™ -2013	IEEE Standard for Ubiquitous Green Community Control Network: Security
IEEE P1888.4 ™	Draft Standard for Green Smart Home and Residential Quarter Control Network Protocol
IEEE 1901 ™ -2010	IEEE Standard for Broadband over Power Line Networks: Medium Access Control and Physical Layer Specifications
IEEE 1901.2 ™ -2013	IEEE Standard for Low Frequency (less than 500 kHz) Narrow Band Power Line Communications for Smart Grid Applications
IEEE 1903 ™ -2011	IEEE Standard for the Functional Architecture of Next Generation Service Overlay Networks (NGSON)
IEEE P1903.1 ™	Draft Standard for Content Delivery Protocols of Next Generation Service Overlay Network (NGSON)
IEEE P1903.2 ™	Draft Standard for Service Composition Protocols of Next Generation Service Overlay Network (NGSON)
IEEE P1903.3 ™	Draft Standard for Self-Organizing Management Protocols of Next Generation Service Overlay Network (NGSON)
IEEE 2030 ™ -2011	IEEE Guide for Smart Grid Interoperability of Energy Technology and Information Technology Operation with the Electric Power System (EPS), End-Use Applications, and Loads
IEEE P2030.1 ™	Draft Guide for Electric-Sourced Transportation Infrastructure
IEEE P2030.2 ™	Draft Guide for the Interoperability of Energy Storage Systems Integrated with the Electric Power Infrastructure

IEEE P2030.3 ™	Draft Standard for Test Procedures for Electric Energy Storage Equipment and Systems for Electric Power Systems Applications
IEEE P2030.4 ™	Draft Guide for Control and Automation Installations Applied to the Electric Power Infrastructure
IEEE 2030.5 ™ -2013	IEEE Standard for Smart Energy Profile 2.0 Application Protocol
IEEE P2030.6 ™	Draft Guide for the Benefit Evaluation of Electric Power Grid Customer Demand Response
IEEE P2030.100 ™	Draft Recommended Practice for Implementing an IEC 61850 Based Substation Communications, Protection, Monitoring and Control System
IEEE P2030.101 ™	Draft Guide for Designing a Time Synchronization System for Power Substations
IEEE P2030.102.1 ™	IEEE Standard for Interoperability of Internet Protocol Security (IPsec) Utilized within Utility Control Systems
IEEE P2302 ™	Draft Standard for Intercloud Interoperability and Federation (SIIF)
IEEE P2401 ™	Draft Standard Format for LSI-Package-Board Interoperable Design
IEEE 11073-00101 ™ -2008	IEEE Standard for Health Informatics – Point of Care Medical Device Communication - Part 00101: Guide--Guidelines for the Use of RF Wireless Technology
IEEE 11073-00103 ™: 2012	IEEE Standard for Health informatics - Personal health device communication Part 00103: Overview
IEEE 11073-10101 ™: 2004	IEEE Standard for Health informatics - Point-of-care medical device communication – Nomenclature*
IEEE P11073-10101a ™: ISO/IEEE 11073-10101:2004	Health informatics - Point-of- care medical device communication - Nomenclature Amendment for additional definitions
IEEE 11073-10102 ™ -2012	IEEE Standard for Health informatics - Point-of care medical device communication - Nomenclature - Annotated ECG
IEEE 11073-10103 ™ -2013	IEEE Standard for Health informatics - Point-of-care medical device communication - Nomenclature - Implantable device, cardiac
IEEE 11073-10201 ™:2004	IEEE Standard for Health informatics - Point-of-care medical device communication - Domain information model*
IEEE P11073-10301-1 ™	Draft Standard for Health informatics - Point-of-care medical device communication - Part 10301-1: Device Specialization - Infusion pump, General
IEEE P11073-10302-1 ™	Draft Standard for Health informatics - Point-of-care medical device communication - Part 10302-1: Device Specialization - Physiologic monitor, General
IEEE P11073-10303-1 ™	Draft Standard for Health informatics - Point-of-care medical device communication - Part 10303-1: Device Specialization - Ventilator, General
IEEE 11073-10404 ™ -2010	IEEE Standard for Health Informatics - Personal Health Device Communication - Device Specialization - Pulse Oximeter*
IEEE P11073-10404a ™	Draft Standard for Health Informatics - Personal Health Device Communication - Device Specialization - Pulse Oximeter Amendment
IEEE 11073-10406 ™:2011	IEEE Standard for Health informatics--Personal health device communication Part 10406: Device specialization--Basic electrocardiograph (ECG) (1-to 3-lead ECG)
IEEE P11073-10406a ™	Draft Standard for Health informatics--Personal health device communication Part 10406: Device specialization--Basic electrocardiograph (ECG) (1- to 3-lead ECG) Amendment
IEEE 11073-10407 ™:2008	IEEE Standard for Health Informatics - Personal Health Device Communication - Device Specialization - Blood Pressure Monitor
IEEE P2030.101 ™	Draft Guide for Designing a Time Synchronization System for Power Substations
IEEE P2030.102.1 ™	IEEE Standard for Interoperability of Internet Protocol Security (IPsec) Utilized within Utility Control Systems
IEEE P2302 ™	Draft Standard for Intercloud Interoperability and Federation (SIIF)
IEEE P2401 ™	Draft Standard Format for LSI-Package-Board Interoperable Design
IEEE 11073-00101 ™ -2008	IEEE Standard for Health Informatics – Point of Care Medical Device Communication - Part 00101: Guide--Guidelines for the Use of RF Wireless Technology
IEEE 11073-00103 ™: 2012	IEEE Standard for Health informatics - Personal health device communication Part 00103: Overview
IEEE 11073-10101 ™: 2004	IEEE Standard for Health informatics - Point-of-care medical device communication – Nomenclature*

IEEE P11073-10101a ™: ISO/IEEE 11073-10101:2004	Health informatics - Point-of- care medical device communication - Nomenclature Amendment for additional definitions
IEEE 11073-10102 ™ -2012	IEEE Standard for Health informatics - Point-of care medical device communication - Nomenclature - Annotated ECG
IEEE 11073-10103 ™ -2013	IEEE Standard for Health informatics - Point-of-care medical device communication - Nomenclature - Implantable device, cardiac
IEEE 11073-10201 ™:2004	IEEE Standard for Health informatics - Point-of-care medical device communication - Domain information model*
IEEE P11073-10301-1 ™	Draft Standard for Health informatics - Point-of-care medical device communication - Part 10301-1: Device Specialization - Infusion pump, General
IEEE P11073-10302-1 ™	Draft Standard for Health informatics - Point-of-care medical device communication - Part 10302-1: Device Specialization - Physiologic monitor, General
IEEE P11073-10303-1 ™	Draft Standard for Health informatics - Point-of-care medical device communication - Part 10303-1: Device Specialization - Ventilator, General
IEEE 11073-10404 ™ -2010	IEEE Standard for Health Informatics - Personal Health Device Communication - Device Specialization - Pulse Oximeter*
IEEE P11073-10404a ™	Draft Standard for Health Informatics - Personal Health Device Communication - Device Specialization - Pulse Oximeter Amendment
IEEE 11073-10406 ™:2011	IEEE Standard for Health informatics--Personal health device communication Part 10406: Device specialization--Basic electrocardiograph (ECG) (1-to 3-lead ECG)
IEEE P11073-10406a ™	Draft Standard for Health informatics--Personal health device communication Part 10406: Device specialization--Basic electrocardiograph (ECG) (1- to 3-lead ECG) Amendment
IEEE 11073-10407 ™:2008	IEEE Standard for Health Informatics - Personal Health Device Communication - Device Specialization - Blood Pressure Monitor
IEEE 11073-10408 ™:2008	IEEE Standard for Health informatics-- Personal health device communication Part 10408: Device specialization -- Thermometer
IEEE P11073-10413 ™	Draft Standard for Health informatics - Personal health device communication - Device specialization - Respiration rate monitor
IEEE 11073-10415 ™:2008	IEEE Standard for Health Informatics - Personal Health Device Communication - Device Specialization - Weighing Scale
IEEE 11073-10417 ™:2011	Draft Standard for Health informatics--Personal health device communication Part 10417: Device specialization--Glucose meter
IEEE 11073-10417a ™	Draft Standard for Health informatics--Personal health device communication Part 10417: Device specialization--Glucose meter Amendment 1
IEEE 11073-10418 ™:2011	IEEE Standard for Health informatics--Personal health device communication Part 10418: Device specialization--International Normalized Ratio (INR) monitor
IEEE P11073-10419 ™	Draft Standard for Health informatics - Personal health device communication - Device specialization - Insulin pump
IEEE 11073-10420 ™:2010	IEEE Standard for Health informatics -- Personal health device communication Part 10420: Device specialization -- Body composition analyzer
IEEE 11073-10421 ™:2010	IEEE Standard for Health informatics--Personal health device communication Part 10421: Device specialization--Peak expiratory flow monitor (peak flow)
IEEE P11073-10422 ™	Draft Standard for Health informatics - Personal health device communication - Device specialization - Urine analyzer
IEEE P11073-10423 ™	Draft Standard for Health informatics -Personal health device communication - Device specialization - Sleep Monitor
IEEE P11073-10424 ™	Draft Standard for Health informatics - Personal health device communication - Device specialization - Sleep apnea breathing therapy equipment
IEEE P11073-10425 ™	Draft Standard for Health informatics - Personal health device communication - Device specialization - Continuous Glucose Monitor (CGM)
IEEE 11073-10441 ™:2013	IEEE Standard for Health Informatics--Personal health device communication Part 10441: Device specialization--Cardiovascular fitness and activity monitor
IEEE 11073-10442 ™:2008	IEEE Standard for Health informatics - Personal health device communication Part 10442: Device specialization - Strength fitness equipment
IEEE 11073-10471 ™:2008	IEEE Standard for Health informatics--Personal health device communication Part 10471: Device specialization--Independent

	living activity hub
IEEE P11073-10471a ™	Draft Standard for Health informatics-Personal health device communication Part 10471: Device specialization-Independent living activity hub Amendment
IEEE 11073-10472 ™:2010	IEEE Standard for Health informatics--Personal health device communication--Part 10472: Device specialization--Medication monitor
IEEE 11073-20101 ™:2004	IEEE Standard for Health informatics - Point-of-care medical device communication - Application profile - Base standard*
IEEE P11073-20201 ™	Draft Standard for Health informatics -- Point-of-care medical device communication -- Part 20201: Application profile -- Polling mode
IEEE P11073-20202 ™	Draft Standard for Health informatics -- Point-of-care medical device communication -- Part 20202: Application profile -- Baseline asynchronous mode
IEEE P11073-20301 ™	Draft Standard for Health informatics -- Point-of-care medical device communication -- Part 20301: Application profile -- Optional package, remote control
IEEE P11073-20401 ™	Draft Standard for Health informatics -- Point-of-care medical device communication -- Part 20401: Application profile -- Common networking services
IEEE 11073-20601 ™:2008	IEEE Standard for Health informatics - Personal health device communication - Part 20601: Application profile - Optimized exchange protocol
IEEE 11073-20601a ™:2010	IEEE Standard for Health informatics--Personal health device communication Part 20601: Application profile--Optimized Exchange Protocol Amendment 1
IEEE 11073-30200 ™:2000	ISO/IEEE Standard for Health informatics - Point-of-care medical device communication - Transport profile - Cable connected
IEEE 11073-30200a ™:2011	IEEE Standard for Health informatics--Point-of-care medical device communication Part 30200: Transport profile--Cable connected Amendment 1
IEEE 11073-30300 ™:2004	ISO/IEEE 11073-30300:2004 Health informatics - Point-of-care medical device communication - Transport profile - Infrared
IEEE 11073-30400 ™:2010	IEEE Standard for Health informatics--Point-of-care medical device communication Part 30400: Interface profile--Cabled Ethernet
IEEE P21451-001 ™	Draft Recommended Practice for Signal Treatment Applied to Smart Transducers
IEEE 21451-1 ™ -2010	IEEE Standard for Information technology -- Smart transducer interface for sensors and actuators -- Part 1: Network Capable Application Processor (NCAP) information model*
IEEE P21451-1 ™	Draft Standard for Smart Transducer Interface for Sensors and Actuators - Common Network Services*
IEEE P21451-1-4 ™	Draft Standard for a Smart Transducer Interface for Sensors, Actuators, and Devices - eXtensible Messaging and Presence Protocol (XMPP) for Networked Device Communication
IEEE 21451-2 ™ -2010	IEEE Standard for Information technology -- Smart transducer interface for sensors and actuators -- Part 2: Transducer to microprocessor communication protocols and Transducer Electronic Data Sheet (TEDS) formats*
IEEE 21451-4 ™ -2010	IEEE Standard for Information technology -- Smart transducer interface for sensors and actuators -- Part 4: Mixed-mode communication protocols and Transducer Electronic Data Sheet (TEDS) formats
IEEE 21451-7 ™ -2011 I	EEE Standard for Smart Transducer Interface for Sensors and Actuators--Transducers to Radio Frequency Identification (RFID) Systems Communication Protocols and Transducer Electronic Data Sheet Formats
IEEE P62704-4 ™	Draft Standard for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body from Wireless Communications Devices, 30 MHz - 6 GHz: General Requirements for Using the Finite Element Method (FEM) for SAR Calculations and Specific Requirements for Modeling Vehicle-Mounted Antennas and Personal Wireless Devices
IEEE C37.238 ™ -2011	IEEE Standard Profile for Use of IEEE 1588 TM Precision Time Protocol in Power System Applications*
IEEE PC37.247 ™	Draft Standard for Phasor Data Concentrators for Power Systems

*An asterisk means that a revision project for this standard is underway.

IEEE-SA Industry Connections programs:

- Convergence of Smart Homes and Building Architectures (CSHBA)
- IEEE Intercloud Testbed
- Cloud Computing Innovation Council for India

Semantic Interoperability standards (a common understanding between people of the meaning of the content (information) being exchanged)	
IEEE 1278.1 ™ -2012	IEEE Standard for Distributed Interactive Simulation - Application Protocols
IEEE 1278.2 ™ -1995	IEEE Standard for Distributed Interactive Simulation (DIS) - Communication Services and Profiles*
IEEE 1278.3 ™ -1996	IEEE Recommended Practice for Distributed Interactive Simulation - Exercise Management and Feedback
IEEE 1278.4 ™ -1997	IEEE Recommended Practice for Distributed Interactive Simulation - Verification, Validation and Accreditation
IEEE 1484.4 ™ -2007	IEEE Recommended Practice for Digital Rights Expression Languages (DRELs) Suitable for eLearning Technologies
IEEE 1484.11.1 ™ -2004	IEEE Standard for Learning Technology--Data Model for Content Object Communication
IEEE 1484.11.2 ™ -2003	IEEE Standard for Learning Technology - ECMAScript Application Programming Interface for Content to Runtime Services Communication
IEEE 1484.11.3 ™ -2005	IEEE Standard for Learning Technology Extensible Markup Language (XML) Schema Binding for Data Model for Content Object Communication
IEEE 1484.12.1 ™ -2002	IEEE Standard for Learning Object Metadata
IEEE 1484.12.3 ™ -2005	IEEE Standard for Extensible Markup Language (XML) Schema Definition Language Binding for Learning Object Metadata
IEEE 1484.13.1 ™ -2012	IEEE Standard for Learning Technology -- Conceptual Model for Resource Aggregation for Learning, Education, and Training
IEEE P1484.13.2 ™	Draft Recommended Practice for Learning Technology - Metadata Encoding and Transmission Standard (METS) Mapping to the Conceptual Model for Resource Aggregation
IEEE 1484.13.3 ™	Draft Recommended Practice for Learning Technology - ISO 21000- 2:2005 Information Technology -- Multimedia Framework (MPEG-21) -- Part 2: Digital Item Declaration Mapping to the Conceptual Model for Resource Aggregation
IEEE 1484.13.4 ™	Draft Recommended Practice for Learning Technology - IMS Content Packaging Information Model (CP) Version 1.2 - Mapping to the Conceptual Model for Resource Aggregation
IEEE 1484.13.5 ™ -2013	IEEE Recommended Practice for Learning Technology - IETF RFC 4287 - Atom Syndication Format - Mapping to the Conceptual Model for Resource Aggregation
IEEE 1484.13.6 ™	Draft Recommended Practice for Learning Technology - Open Archives Initiative Object Reuse and Exchange Abstract Model (OAI-ORE) - Mapping to the Conceptual Model for Resource Aggregation
IEEE 1484.20.1 ™ -2007	IEEE Standard for Learning Technology-Data Model for Reusable Competency Definitions
IEEE P1876 ™	Draft Standard for Networked Smart Learning for Online Laboratories
IEEE P3333.1 ™	Draft Standard for the Quality Assessment of Three Dimensional (3D) Displays, 3D Contents and 3D Devices based on Human Factors
IEEE P3333.2 ™	Draft Standard for Three-Dimensional Model Creation Using Unprocessed 3D Medical Data

Internet of Things Specific Applications

Smart Cities standards	
IEEE 487™ -2007	Recommended Practice for the Protection of Wire-Line Communication Facilities Serving Electric Supply Stations*
IEEE P487.1™	Draft Standard for the Electrical Protection of Communication Facilities Serving Electric Supply Locations Through the Use of On-Grid Isolation Equipment
IEEE 487.2™ -2013	IEEE Standard for the Electrical Protection of Communication Facilities Serving Electric Supply Locations Through the Use of Optical Fiber Systems
IEEE P487.3™	Draft Standard for the Electrical Protection of Communication Facilities Serving Electric Supply Locations Through the Use of Hybrid Facilities
IEEE 487.4™ -2013	IEEE Standard for the Electrical Protection of Communication Facilities Serving Electric Supply Locations Through the Use of Neutralizing Transformers
IEEE 487.5™ -2013	IEEE Standard for the Electrical Protection of Communication Facilities Serving Electric Supply Locations Through the Use of Isolation Transformers
IEEE 789™ -2013	IEEE Standard Performance Requirements for Communications and Control Cables for Application in High Voltage Environments
IEEE 802™ -2001	IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture*
IEEE 802.1X™ -2010	IEEE Standard for Local and metropolitan area networks - Port-Based
IEEE 802.1AB™ -2009	IEEE Standard for Local and metropolitan area networks -- Station and Media Access Control Connectivity Discovery
IEEE 802.1AE™ -2006	IEEE Standard for Local and Metropolitan Area Networks: Media Access Control (MAC) Security
IEEE 802.1AEbn™ -2011	IEEE Standard for Local and Metropolitan Area Networks: Media Access Control (MAC) Security Amendment: Galois Counter Mode-Advanced Encryption Standard-256 (GCM-AES-256) Cipher Suite
IEEE 802.1AEbw™ -2013	IEEE Standard for Local and Metropolitan Area Networks: Media Access Control (MAC) Security Amendment: Extended Packet Numbering
IEEE 802.1AR™ -2009	IEEE Standard for Local and Metropolitan Area Networks – Secure Device Identity
IEEE 802.1AS™ -	IEEE Standard for Local and Metropolitan Area Networks - Timing and Synchronization for Time-Sensitive Applications in Bridged Local Area Networks
IEEE P802.1ASbt™	Draft Standard for Local and Metropolitan Area Networks - Timing and Synchronization for Time-Sensitive Applications in Bridged Local Area Networks Amendment: Enhancements and performance improvements
IEEE 802.1AX™ -2008	IEEE Standard for Local and Metropolitan Area Networks – Link Aggregation*
IEEE 802.1AXbk™ -2012	IEEE Standard for Local and metropolitan area networks—Link Aggregation Amendment: Protocol Addressing
IEEE 802.3™ -2012	IEEE Standard for Ethernet
IEEE 802.11™ -2012	IEEE Standard for Information Technology-- Telecommunications and information exchange between systems--Local and metropolitan area networks--Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications Amendment 10: Mesh Networking
IEEE 802.11ad™ -2012	IEEE Standard for Local and Metropolitan Area Networks - Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications - Amendment 3: Enhancements for Very High Throughput in the 60 GHz Band
IEEE P802.11af™	Draft Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications; Amendment: TV White Spaces Operation
IEEE P802.11ah™	Draft Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 11:

	Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Amendment- Sub 1 GHz License-Exempt Operation
IEEE P802.11ai™	Draft Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Amendment- Fast Initial Link Setup
IEEE 802.15.1™ -2005 I	EEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements. - Part 15.1: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Wireless Personal Area Networks (WPANs)
IEEE 802.15.2™ -2003	IEEE Recommended Practice for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements Part 15.2: Coexistence of Wireless Personal Area Networks With Other Wireless Devices Operating in Unlicensed Frequency Bands
IEEE 802.15.3™ -2003	IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements Part 15.3: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for High Rate Wireless Personal Area Networks (WPANs) Amendment 1: Mac Sublayer
IEEE 802.15.3c™ -2009	IEEE Standard for Information technology-- Local and metropolitan area networks-- Specific requirements-- Part 15.3: Amendment 2: Millimeter-wave- based Alternative Physical Layer Extension
IEEE 802.15.4™ -2011	IEEE Standard for Local and metropolitan area networks--Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs)
IEEE 802.15.4e™ -2012	IEEE Standard for Local and metropolitan area networks—Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs) Amendment 1: MAC sublayer
IEEE 802.15.4f™ -2012	IEEE Standard for Local and metropolitan area networks—Part 15.4: Low-Rate Wireless Personal Area Networks (LRWPANs) Amendment 2: Active Radio Frequency Identification (RFID) System Physical Layer (PHY)
IEEE 802.15.4g™ -2012	IEEE Standard for Local and metropolitan area networks--Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs) Amendment 3: Physical Layer (PHY) Specifications for Low-Data-Rate, Wireless, Smart Metering Utility Networks
IEEE 802.15.4j™ -2013	IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 15.4: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low Rate Wireless Personal Area Networks (WPANs) Amendment: Alternative Physical Layer Extension to support Medical Body Area Network (MBAN) services operating in the 2360-2400 MHz band
IEEE 802.15.4k™ -2013	IEEE Standard for Local and Metropolitan Area Networks – Part 15.4: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low Rate Wireless Personal Area Networks (WPANs) Amendment - Physical Layer (PHY) Specifications for Low Energy, Critical Infrastructure Monitoring Networks (LECIM)
IEEE P802.15.4m™	Draft Standard for Local and Metropolitan Area Networks Part 15.4: Low Rate Wireless Personal Area Networks (LR-WPANs) Amendment: TV White Space Between 54 MHz and 862 MHz Physical Layer
IEEE P802.15.4n™	Draft Standard for Local and metropolitan area networks-- Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs) Amendment: Physical Layer Utilizing Dedicated Medical Bands in China
IEEE P802.15.4p™	Draft Standard for Local and metropolitan area networks-- Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs) Amendment: Positive Train Control (PTC) System Physical Layer
IEEE P802.15.4q™	Draft Standard for Local and Metropolitan Area Networks - Part 15.4: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low Rate Wireless Personal Area Networks (WPANs) Amendment - Physical Layer (PHY) Specifications for Low Energy, Critical Infrastructure Monitoring

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IEEE 802.15.5™ -2009	IEEE Recommended Practice for Information technology-Telecommunications and information exchange between systems-Local and metropolitan area networks-Specific requirements Part 15.5: Mesh Topology Capability in Wireless Personal Area Networks (WPANs)
IEEE 802.15.6™ -2012	IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 15.6: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Wireless Personal Area Networks (WPANs)used in or around a body
IEEE 802.15.7™ -2011	IEEE Standard for Local and Metropolitan Area Networks—Part 15.7: Short-Range Wireless Optical Communication Using Visible Light
IEEE P802.15.8™	Draft Standard for Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Peer Aware Communications (PAC)
IEEE P802.15.9™	Draft Recommended Practice for Transport of Key Management Protocol (KMP) Datagrams
IEEE P802.15.10™	Draft Recommended Practice for Routing Packets in 802.15.4 Dynamically Changing Wireless Networks
IEEE 802.16™ -2012	IEEE Standard for Local and metropolitan area networks Part 16: Air Interface for Broadband Wireless Access Systems
IEEE 802.16n™ -2013	IEEE Standard for local and metropolitan area networks Part 16: Air Interface for Broadband Wireless Access Systems
IEEE 802.16p™ -2012	IEEE Standard for Air Interface for Broadband Wireless Access Systems Amendment: Enhancements to Support Machine-to-Machine Applications
IEEE 802.16.1™ -2012	IEEE Standard for WirelessMAN-Advanced Air Interface for Broadband Wireless Access Systems
IEEE 802.16.1a™ -2013	IEEE Standard for WirelessMAN-Advanced Air Interface for Broadband Wireless Access Systems - Amendment: Higher Reliability Networks
IEEE 802.16.1b™ -2012	IEEE Standard for WirelessMAN-Advanced Air Interface for Broadband Wireless
IEEE 802.16.2™ -2004	IEEE Recommended Practice for Local and Metropolitan Area Networks - Recommended Practice for Coexistence of Fixed Broadband Wireless Access Systems
IEEE P802.16.3™	Draft Standard for Mobile Broadband Network Performance Measurements
IEEE P802.19.1™	Draft Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 19: TV White Space Coexistence Methods
IEEE 802.20™ -2008	IEEE Standard for Local and Metropolitan Area Networks - Part 20: Air Interface for Mobile Broadband Wireless Access Systems Supporting Vehicular Mobility -- Physical and Media Access Control Layer Specification
IEEE 802.20a™ -2010	IEEE Standard for Local and Metropolitan Area Networks Part 20: Air Interface for Mobile Broadband Wireless Access Systems Supporting Vehicular Mobility - Physical and Media Access Control Layer Specification - Amendment: Management Information Base Enhancements and Corrigenda Items
IEEE 802.20b™ -2010	IEEE Standard for Local and Metropolitan Area Networks – Virtual Bridged Local Area Networks - Amendment: Bridging of 802.20
IEEE 802.20.3™ -2010	IEEE Standard for Minimum Performance Characteristics of IEEE P802.20 Terminals and Base Stations/Access Nodes
IEEE 802.21™ -2008	IEEE Standard for Local and metropolitan area networks -- Part 21: Media Independent Services Framework*
IEEE 802.21a™ -2012	IEEE Standard for Local and Metropolitan Area Networks: Media Independent Handover Services - Amendment for Security Extensions to Media Independent Handover Services and Protocol
IEEE 802.21b™ -2012	IEEE Standard for Media Independent Handover Services - Amendment: Handovers with Downlink Only Technologies
IEEE P802.21c™	Draft Standard for Local and metropolitan area networks -- Part 21: Media Independent Handover Services Amendment: Optimized Single Radio Handovers
IEEE P802.21.d™	Draft Standard for Local and metropolitan area networks -- Part 21: Media Independent Handover Services Amendment: Multicast

	Group Management
IEEE P802.21.1™	Draft Standard for Local and metropolitan area networks-- Part 21.1: Media Independent Services
IEEE 802.22™ -2011	IEEE Standard for Information Technology-- Telecommunications and information exchange between systems Wireless Regional Area Networks (WRAN)--Specific requirements Part 22: Cognitive Wireless RAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Policies and Procedures for Operation in the TV Bands*
IEEE P802.22a™	Draft Standard for Information Technology--Telecommunications and information exchange between systems Wireless Regional Area Networks (WRAN)--Specific requirements Part 22: Cognitive Wireless RAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Policies and Procedures for Operation in the TV Bands Amendment: Management and Control Plane Interfaces and Procedures and enhancement to the Management Information Base (MIB)
IEEE P802.22b™	Draft Standard for Information Technology-- Telecommunications and information exchange between systems Wireless Regional Area Networks (WRAN)--Specific requirements Part 22: Cognitive Wireless RAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Policies and Procedures for Operation in the TV Bands Amendment: Enhancement for Broadband Services and Monitoring Applications
IEEE 802.22.1™ -2010	IEEE Standard for Information Technology-- Telecommunications and information exchange between systems--Local and metropolitan area networks--Specific requirements Part 22.1: Standard to Enhance Harmful Interference Protection for Low-Power Licensed Devices Operating in TV Broadcast Bands*
IEEE 802.22.2™ -2012	IEEE Standard for Information Technology-- Telecommunications and information exchange between systems--Local and metropolitan area networks--Specific requirements Part 22.2: Installation and Deployment of IEEE 802.22 Systems
IEEE 1020™ -2011	IEEE Guide for Control of Small (100 kVA to 5 MVA) Hydroelectric Power Plants
IEEE 1127™ -1998	IEEE Guide for the Design Construction and Operation of Electric Power Substations for Community Acceptance and Environmental Compatibility*
IEEE 1138™ -2009	IEEE Standard for Testing and Performance for Optical Ground Wire (OPGW) for use on Electric Utility Power Lines
IEEE 1159.3™ -2003	IEEE Recommended Practice for the Transfer of Power Quality Data
IEEE 1366™ -2012	IEEE Guide for Electric Power Distribution Reliability Indices
IEEE 1377™ -2012	IEEE Standard for Utility Industry Metering Communication Protocol Application Layer Standard (End Device Data Tables)
IEEE 1402™ -2000	IEEE Guide for Electric Power Substation Physical and Electronic Security*
IEEE 1409™ -2012	IEEE Guide for the Application of Power Electronics for Power Quality Improvement on Distribution Systems Rated 1 kV Through 38 kV
IEEE 1547™ -2003	IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems
IEEE 1547.1™ -2005	IEEE Standard for Conformance Tests Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems
IEEE P1547.1a™	Draft Standard Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems Amendment 1
IEEE 1547.2™ -2008	IEEE Application Guide for IEEE 1547™, IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems
IEEE 1547.3™ -2007	IEEE Guide for Monitoring, Information Exchange, and Control of Distributed Resources Interconnected With Electric Power Systems
IEEE 1547.4™ -2011	IEEE Guide for Design, Operation, and Integration of Distributed Resource Island Systems with Electric Power Systems
IEEE 1547.6™ -2011	Draft Recommended Practice for Interconnecting Distributed Resources With Electric Power Systems Distribution Secondary Networks
IEEE P1547.7™	Draft Guide to Conducting Distribution Impact Studies for

	Distributed Resource Interconnection
IEEE P1547.8™	Draft Recommended Practice for Establishing Methods and Procedures that Provide Supplemental Support for Implementation Strategies for Expanded Use of IEEE Standard 1547™
IEEE 1590™ -2009	IEEE Recommended Practice for the Electrical Protection of Communication Facilities Serving Electric Supply Locations Using Optical Fiber Systems
IEEE 1591.1™ -2012	IEEE Standard for Testing and Performance of Hardware for Optical Groundwire (OPGW)
IEEE P1591.2™	Draft Standard for Testing and Performance of Hardware for All-Dielectric Self-Supporting (ADSS) Fiber Optic Cable
IEEE 1591.3™ -2011	IEEE Standard for Qualifying Hardware for Helically-Applied Fiber Optic Cable Systems (WRAP Cable)
IEEE P1595™	Draft Standard for Quantifying Greenhouse Gas Emission Credits from Small Hydro and Wind Power Projects and for Grid Baseline Conditions
IEEE P1613.1™	Draft Standard Environmental and Testing Requirements for Communications Networking Devices Installed in Electric Power Substations
IEEE 1615™ -2007	IEEE Recommended Practice for Network Communication in Electric Power Substations*
IEEE 1646™ -2004	IEEE Standard Communication Delivery Time Performance Requirements for Electric Power Substation Automation*
IEEE 1675™ -2008	IEEE Standard for Broadband over Power Line Hardware
IEEE 1686™ -2007	IEEE Standard for Substation Intelligent Electronic Devices (IEDs) Cyber Security Capabilities*
IEEE 1701™ -2011	IEEE Standard for Optical Port Communication Protocol to complement the Utility Industry End Device Data Tables
IEEE 1702™ -2011	IEEE Standard for Telephone Modem Communication Protocol to complement the Utility Industry End Device Data Tables
IEEE 1703™ -2012	IEEE Standard for Local Area Network/Wide Area Network (LAN/WAN) Node Communication Protocol to complement the Utility Industry End Device Data Tables
IEEE P1704™	Draft Standard for Utility Industry End Device Communications Module
IEEE P1705™	Draft Standard for Compliance Testing Standard for Utility Industry metering communications protocol standards
IEEE 1711™ -2010	IEEE Trial-Use Standard for a Cryptographic Protocol for Cyber Security of Substation Serial Links*
IEEE 1775™ -2010	IEEE Standard for Powerline Communication Equipment - Electromagnetic Compatibility (EMC) Requirements - Testing and Measurement Methods
IEEE P1797™	Draft Guide for Design and Application of Solar Technology in Commercial Power Generating Stations
IEEE 1808™ -2011	IEEE Guide for Collecting and Managing Transmission Line Inspection and Maintenance Data
IEEE 1815™ -2012	IEEE Standard for Electric Power Systems Communications – Distributed Network Protocol (DNP3)
IEEE P1828™	Draft Standard for Systems with Virtual Components
IEEE P1854™	Draft Guide for Smart Distribution Applications Guide
IEEE P1876™	Draft Standard for Networked Smart Learning for Online Laboratories
IEEE 1901™ -2010	IEEE Standard for Broadband over Power Line Networks: Medium Access Control and Physical Layer Specifications
IEEE 1901.2™ -2013	IEEE Standard for Low Frequency (less than 500 kHz) Narrow Band Power Line Communications for Smart Grid Applications
IEEE P1909.1™	Draft Recommended Practice for Smart Grid Communication Equipment - Test methods and installation requirements
IEEE 2030™ -2011	IEEE Guide for Smart Grid Interoperability of Energy Technology and Information Technology Operation with the Electric Power System (EPS), End-Use Applications, and Loads
IEEE P2030.1™	Draft Guide for Electric-Sourced Transportation Infrastructure
IEEE P2030.2™	Draft Guide for the Interoperability of Energy Storage Systems Integrated with the Electric Power Infrastructure
IEEE P2030.3™	Draft Standard for Test Procedures for Electric Energy Storage Equipment and Systems for Electric Power Systems Applications
IEEE P2100.1™	Draft Standard Specifications for Wireless Power and Charging

	Systems
IEEE P2302™	Draft Standard for Intercloud Interoperability and Federation (SIIF)
IEEE C37.1™ -2007	IEEE Standard for SCADA and Automation Systems*
IEEE C37.2™ -2008	IEEE Standard Electrical Power System Device Function Numbers Acronyms and Contact Designations
IEEE C37.91™ -2008	IEEE Guide for Protecting Power Transformers
IEEE C37.95™ -2002	IEEE Guide for Protective Relaying of Utility-Consumer Interconnections*
IEEE C37.101™ -2006	IEEE Guide for Generator Ground Protection
IEEE C37.102™ -2006	IEEE Guide for AC Generator Protection
IEEE C37.104™ -2012	IEEE Guide for Automatic Reclosing of Circuit Breakers for AC Distribution and Transmission Lines
IEEE C37.106™ -2003	IEEE Guide for Abnormal Frequency Protection for Power Generating Plants
IEEE C37.111™ -2013	IEEE Standard for Common Format for Transient Data Exchange (COMTRADE) for Power Systems
IEEE C37.116™ -2007	IEEE Guide for Protective Relay Application to Transmission-Line Series Capacitor Banks*
IEEE C37.117™ -2007	IEEE Guide for the Application of Protective Relays Used for Abnormal Frequency Load Shedding and Restoration
IEEE C37.118™ -2006	IEEE Standard for Synchrophasors for Power Systems
IEEE PC37.118a™	Draft Standard for Synchrophasor Measurements for Power Systems Amendment to modify selected performance requirements
IEEE C37.118.1™ -2011	IEEE Standard for Synchrophasor Measurements for Power Systems
IEEE C37.118.2™ -2011	IEEE Standard for Synchrophasor Data Transfer for Power Systems
IEEE C37.230™ -2007	IEEE Guide for Protective Relay Applications to Distribution Lines
IEEE C37.231™ -2006	IEEE Recommended Practice for Microprocessor-Based Protection Equipment Firmware Control
IEEE C37.232™ -2011	IEEE Standard for Common Format for Naming Time Sequence Data Files (COMNAME)
IEEE C37.236™ -2013	IEEE Guide for Power System Protective Relay Applications over Digital Communication Channels
IEEE PC37.237™	Draft Standard Requirements for Time Tags Created by Intelligent Electronic Devices - COMTAG™
IEEE C37.238™ -2011	IEEE Standard Profile for Use of IEEE 1588™ Precision Time Protocol in Power System Applications*
IEEE C37.239™ -2010	IEEE Standard Common Format for Event Data Exchange (COMFEDE) for Power Systems
IEEE PC37.240™	Draft Standard for Cyber Security Requirements for Substation Automation, Protection and Control Systems
IEEE C37.242™ -2013	Draft Guide for Synchronization, Calibration, Testing and Installation of Phasor Measurement Units (PMU) for Power System Protection and Control
IEEE PC37.243™	Draft Guide for the Application of Digital Line Current Differential Relays Using Digital Communications
IEEE C37.244™ -2013	IEEE Guide for Phasor Data Concentrator Requirements for Power System Protection, Control, and Monitoring

*An asterisk means that a revision project for this standard is underway.

IEEE-SA Industry Connections programs:

- Convergence of Smart Home and Business Architectures (CSHBA)
- Electric Vehicle Wireless Power Transfer
- IEEE Intercloud Testbed
- Cloud Computing Innovation Council for India

Smart Energy standards	
IEEE 80™ -2000	IEEE Guide for Safety in AC Substation Grounding*
IEEE 81™ -2012	IEEE Guide for Measuring Earth Resistivity Ground Impedance and Earth Surface Potentials of a Grounding System
IEEE 367™ -2012	IEEE Recommended Practice for Determining the Electric Power Station Ground Potential Rise and Induced Voltage from a Power Fault
IEEE 487™ -2007	IEEE Recommended Practice for the Protection of Wire-Line Communication Facilities Serving Electric Supply Stations*
IEEE P487.1™	Draft Standard for the Electrical Protection of Communication Facilities Serving Electric Supply Locations Through the Use of On-Grid Isolation Equipment
IEEE 487.2™ -2013	IEEE Standard for the Electrical Protection of Communication Facilities Serving Electric Supply Locations Through the Use of Optical Fiber Systems
IEEE P487.3™	Draft Standard for the Electrical Protection of Communication Facilities Serving Electric Supply Locations Through the Use of Hybrid Facilities
IEEE 487.4™ -2013	IEEE Standard for the Electrical Protection of Communication Facilities Serving Electric Supply Locations Through the Use of Neutralizing Transformers
IEEE 487.5™ -2013	IEEE Standard for the Electrical Protection of Communication Facilities Serving Electric Supply Locations Through the Use of Isolation Transformers
IEEE 644™ -1994	IEEE Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines
IEEE 656™ -1992	IEEE Standard for the Measurement of Audible Noise from Overhead Transmission Lines
IEEE 789™ -2013	Standard Performance Requirements for Communications and Control Cables for Application in High Voltage Environments
IEEE 802™ -2001	IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture*
IEEE 802.1X™ -2010	IEEE Standard for Local and metropolitan area networks - Port-Based Network Access Control
IEEE 802.1AB™ -2009	IEEE Standard for Local and metropolitan area networks -- Station and Media Access Control Connectivity Discovery
IEEE 802.1AC™ -2012	IEEE Standard for Local and metropolitan area networks-Media Access Control (MAC) Service Definition*
IEEE 802.1AE™ -2006	IEEE Standard for Local and Metropolitan Area Networks: Media Access Control (MAC) Security
IEEE 802.1AEbn™ -2011	IEEE Standard for Local and Metropolitan Area Networks: Media Access Control (MAC) Security Amendment: Galois Counter Mode-Advanced Encryption Standard-256 (GCM-AES-256) Cipher Suite
IEEE 802.1AEbw™ -2013	IEEE Standard for Local and Metropolitan Area Networks: Media Access Control (MAC) Security Amendment: Extended Packet Numbering
IEEE 802.1AR™ -2009	IEEE Standard for Local and Metropolitan Area Networks – Secure Device Identity
IEEE 802.1AX™ -2008	IEEE Standard for Local and Metropolitan Area Networks – Link Aggregation
IEEE 802.1AXbk™ -2012	IEEE Standard for Local and metropolitan area networks—Link Aggregation Amendment: Protocol Addressing
IEEE 802.3™ -2012	IEEE Standard for Ethernet
IEEE P802.3bq™	IEEE Standard for Ethernet Amendment: Physical Layer and
IEEE 802.11™ -2012	IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications
IEEE 802.15.1™ -2005	IEEE Standard for Information Technology - telecommunications and information exchange Systems between systems - Local and metropolitan area networks- Specific requirements - Part 15.1a: Wireless Medium Access Control (MAC) and Physical Layer (PHY) specifications for Wireless Personal Area Networks (WPAN)
IEEE 802.15.4™ -2011	IEEE Standard for Local and metropolitan area networks—Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs)
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	Amendment to the MAC sub- layer
IEEE 802.15.4g™ -2012	IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 15.4: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low Rate Wireless Personal Area Networks (WPANs) - Amendment: Physical Layer(PHY) Specifications for Low Data Rate Wireless Smart Metering Utility Networks
IEEE 802.16™ -2012	IEEE Standard for Local and metropolitan area networks Part 16: Air Interface for Broadband Wireless Access Systems
IEEE 802.16n™ -2013	IEEE Standard for Wireless MAN-Advanced Air Interface for Broadband Wireless Access Systems - Amendment: Higher Reliability Networks
IEEE 802.16p™ -2012	IEEE Standard for Air Interface for Broadband Wireless Access Systems Amendment: Enhancements to Support Machine-to-Machine Applications
IEEE P802.16q™	Draft Standard for Air Interface for Broadband Wireless Access Systems Amendment for Multi-tier Networks
IEEE P802.16r™	IEEE Standard for Air Interface for Broadband Wireless Access Systems - Amendment for Small Cell Backhaul (SCB)
IEEE 802.16.1™ -2012	IEEE Standard for WirelessMAN-Advanced Air Interface for Broadband Wireless Access Systems
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IEEE 802.21™ -2008	IEEE Standard for Local and metropolitan area networks -- Part 21: Media Independent Services Framework
IEEE 802.21a™ -2012	IEEE Standard for Local and Metropolitan Area Networks: Media Independent Handover Services - Amendment for Security Extensions to Media Independent Handover Services and Protocol
IEEE 802.21b™ -2012	IEEE Standard for Media Independent Handover Services - Amendment: Handovers with Downlink Only Technologies
IEEE P802.21.d™	Draft Standard for Local and metropolitan area networks -- Part 21: Media Independent Handover Services Amendment: Multicast Group Management
IEEE P802.21.1™	IEEE Standard for Local and Metropolitan Area Networks - Part 21.1: Media Independent Services
IEEE 802.22™ -2011	IEEE Standard for Information Technology -Telecommunications and information exchange between systems - Wireless Regional Area Networks (WRAN) - Specific requirements - Part 22: Cognitive Wireless RAN Medium Access Control (MAC) and Physical Layer (PHY) specifications: Policies and procedures for operation in the TV Bands
EEE P802.22a™	Draft Standard for Information Technology--Telecommunications and information exchange between systems Wireless Regional Area Networks (WRAN)--Specific requirements Part 22: Cognitive Wireless RAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Policies and Procedures for Operation in the TV Bands Amendment: Management and Control Plane Interfaces and Procedures and enhancement to the Management Information Base (MIB)
IEEE P802.22b™	Draft Standard for Information Technology--Telecommunications and information exchange between systems Wireless Regional

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IEEE 802.22.1™ -2010	IEEE Standard to enhance harmful interference protection for low power licensed devices operating in TV Broadcast Bands
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IEEE 1031™ -2011	IEEE Guide for the Functional Specification of Transmission Static Var Compensators
IEEE 1127™ -1998	IEEE Guide for the Design Construction and Operation of Electric Power Substations for Community Acceptance and Environmental Compatibility*
IEEE 1138™ -2009	IEEE Standard for Testing and Performance for Optical Ground Wire (OPGW) for use on Electric Utility Power Lines
IEEE 1159.3™ -2003	IEEE Recommended Practice for the Transfer of Power Quality Data
IEEE 1222™ -2011	IEEE Standard for All-Dielectric Self-Supporting Fiber Optic Cable
IEEE 1247™ -2005	IEEE Standard for Interrupter Switches for Alternating Current Rated Above 1000 Volts
IEEE 1250™ -2011	IEEE Guide for Identifying and Improving Voltage Quality in Power Systems
IEEE 1366™ -2012	IEEE Guide for Electric Power Distribution Reliability Indices
IEEE 1377™ -2012	IEEE Standard for Utility Industry Metering Communication Protocol Application Layer Standard (End Device Data Tables)
IEEE 1402™ -2000	IEEE Guide for Electric Power Substation Physical and Electronic Security*
IEEE 1409™ -2012	IEEE Guide for the Application of Power Electronics for Power Quality Improvement on Distribution Systems Rated 1 kV Through 38 kV
IEEE 1453™ -2011	IEEE Recommended Practice for Measurement and Limits of Voltage Fluctuations and Associated Light Flicker on AC Power Systems*
IEEE 1459™ – 2010	IEEE Standard Definitions for the Measurement of Electric Power Quantities under Sinusoidal Non-Sinusoidal Balanced or Unbalanced Conditions
IEEE 1547™ -2003	IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems
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IEEE P1547.1a™	Draft Standard Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems Amendment 1
IEEE 1547.2™ -2008	Application Guide for IEEE 1547™, IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems
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IEEE 1547.6™ -2011	IEEE Recommended Practice for Interconnecting Distributed Resources with Electric Power Systems Distribution Secondary Networks
IEEE P1547.7™	Draft Guide to Conducting Distribution Impact Studies for Distributed Resource Interconnection
IEEE P1547.8™	Draft Recommended Practice for Establishing Methods and Procedures that Provide Supplemental Support for Implementation Strategies for Expanded Use of IEEE Standard 1547™
IEEE 1588™ -2008	IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems*
IEEE 1590™ -2009	IEEE Recommended Practice for the Electrical Protection of Communication Facilities Serving Electric Supply Locations Using Optical Fiber Systems
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IEEE 1646™ -2004	IEEE Standard Communication Delivery Time Performance Requirements for Electric Power Substation Automation*
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IEEE 1703™ -2012	IEEE Standard for Local Area Network/Wide Area Network (LAN/WAN) Node Communication Protocol to complement the Utility Industry End Device Data Tables
IEEE P1704™	Draft Standard for Utility Industry End Device Communications Module
IEEE P1705™	Draft Standard for Compliance Testing Standard for Utility Industry metering communications protocol standards
IEEE 1711 ™ -2010	IEEE Trial-Use Standard for a Cryptographic Protocol for Cyber Security of Substation Serial Links*
IEEE P1711.3 ™	Draft Standard for Secure SCADA Communications Protocol (SSCP)
IEEE 1775 ™ -2010	IEEE Standard for Powerline Communication Equipment - Electromagnetic Compatibility (EMC) Requirements - Testing and Measurement Methods
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IEEE 1801 ™ -2013	IEEE Standard for Design and Verification of Low-Power Integrated Circuits*
IEEE 1808 ™ -2011	IEEE Guide for Collecting and Managing Transmission Line Inspection and Maintenance Data
IEEE 1815 ™ -2012	IEEE Standard for Electric Power Systems Communications -- Distributed Network Protocol (DNP3)
IEEE P1815.1 ™	Draft Standard for Exchanging Information Between Networks Implementing IEC 61850 and IEEE 1815™ (Distributed Network Protocol - DNP3)
IEEE P1854 ™	Draft Guide for Smart Distribution Applications Guide
IEEE P1885 ™	Draft Guide for Assessing, Measuring and Verifying Volt-Var Control Optimization on Distribution Systems
IEEE P1888.4 ™	Draft Standard for Green Smart Home and Residential Quarter Control Network Protocol
IEEE P1894 ™	Draft Guide for Online Monitoring and Recording Systems for Transient Overvoltages in Electric Power Systems
IEEE 1901 ™ -2010	IEEE Standard for Broadband over Power Line Networks: Medium Access Control and Physical Layer Specifications
IEEE 1901.2 ™ -2013	IEEE Standard for Low Frequency (less than 500 kHz) Narrow Band Power Line Communications for Smart Grid Applications
IEEE 1905.1 ™ -2013	IEEE Standard for a Convergent Digital Home Network for Heterogeneous Technologies
IEEE P1905.1a ™	Draft Standard for a Convergent Digital Home Network for Heterogeneous Technologies: Amendment: Support of new MAC/PHYs and enhancements
IEEE P1909.1 ™	Draft Recommended Practice for Smart Grid Communication Equipment - Test methods and installation requirements
IEEE 2030 ™ -2011	IEEE Guide for Smart Grid Interoperability of Energy Technology and Information Technology Operation with the Electric Power System (EPS), and End-Use Applications and Loads
IEEE P2030.1 ™	Draft Guide for Electric-Sourced Transportation Infrastructure
IEEE P2030.2™	Draft Guide for the Interoperability of Energy Storage Systems Integrated with the Electric Power Infrastructure
IEEE P2030.3™	Draft Standard for Test Procedures for Electric Energy Storage Equipment and Systems for Electric Power Systems Applications
IEEE P2030.4™	Draft Guide for Control and Automation Installations Applied to the Electric Power Infrastructure
IEEE 2030.5™ -2013	IEEE Standard for Smart Energy Profile 2.0 Application Protocol
IEEE P2030.6™	Draft Amendment to add additional underlying technologies (G.hn

	and HomePNA)
IEEE P2030.100™	Draft Recommended Practice for Implementing an IEC 61850 Based Substation Communications, Protection, Monitoring and Control System
IEEE P2030.101™	Draft Guide for Designing a Time Synchronization System for Power Substations
IEEE P2030.102.1™	Draft Standard for Interoperability of Internet Protocol Security (IPsec) Utilized within Utility Control Systems
IEEE P2100.1™	Draft Standard Specifications for Wireless Power and Charging Systems
IEEE P60255-118-1™	Draft Measuring relays and protection equipment - Part 118-1: Synchrophasor for power system - Measurements
IEC 61588 Ed.2 (2009-02) (IEEE 1588™-2008)	Precision Clock Synchronization Protocol for Networked Measurement and Control Systems
IEEE C37.1™ -2007	IEEE Standard for SCADA and Automation Systems*
IEEE C37.2™ -2008	IEEE Standard Electrical Power System Device Function Numbers Acronyms and Contact Designations
IEEE C37.13™ -2008	IEEE Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.90.1™ -2012	IEEE Standard Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
IEEE C37.90.2™ -2004	IEEE Standard for Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers
IEEE C37.91™ -2008	IEEE Guide for Protecting Power Transformers
IEEE C37.92™ -2005	IEEE Standard for Analog Inputs to Protective Relays From Electronic Voltage and Current Transducers
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IEEE C37.94™ -2004	IEEE Standard for N Times 64 Kilobit Per Second Optical Fiber Interfaces Between Teleprotection and Multiplexer Equipment
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IEEE C37.104™ -2012	IEEE Guide for Automatic Reclosing of Circuit Breakers for AC Distribution and Transmission Lines
IEEE C37.106™ -2003	IEEE Guide for Abnormal Frequency Protection for Power Generating Plants
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IEEE C37.112™ -1996	IEEE Standard Inverse-Time Characteristic Equations for Overcurrent Relays
IEEE C37.114™ -2004	IEEE Guide for Determining Fault Location on AC Transmission and Distribution Lines*
IEEE C37.116™ -2007	IEEE Guide for Protective Relay Application to Transmission-Line Series Capacitor Banks*
IEEE C37.117™ -2007	IEEE Guide for the Application of Protective Relays Used for Abnormal Frequency Load Shedding and Restoration
IEEE C37.118.1™ -2011	IEEE Standard for Synchrophasor Measurements for Power Systems
IEEE PC37.118.1a™	Draft Standard for Synchrophasor Measurements for Power Systems Amendment to modify selected performance requirements
IEEE C37.118.2™ -2011	IEEE Standard for Synchrophasor Data Transfer for Power Systems
IEEE C37.230™ -2007	IEEE Guide for Protective Relay Applications to Distribution Lines
IEEE C37.231™ -2006	IEEE Recommended Practice for Microprocessor-Based Protection Equipment Firmware Control
IEEE C37.232™ -2011	IEEE Standard for Common Format for Naming Time Sequence Data Files (COMNAME)
IEEE C37.236™ -2013	IEEE Guide for Power System Protective Relay Applications over Digital Communication Channels
IEEE PC37.237™	Draft Standard Requirements for Time Tags Created by Intelligent Electronic Devices - COMTAG™
IEEE C37.238™ -2011	IEEE Standard Profile for Use of IEEE 1588™ Precision Time Protocol in Power System Applications*

IEEE C37.239™ -2010	IEEE Standard Common Format for Event Data Exchange (COMFEDE) for Power Systems
IEEE PC37.240™	Draft Standard for Cyber Security Requirements for Substation Automation, Protection and Control Systems
IEEE C37.242™ -2013	IEEE Guide for Synchronization, Calibration, Testing and Installation of Phasor Measurement Units (PMU) for Power System Protection and Control
IEEE PC37.243™	Draft Guide for the Application of Digital Line Current Differential Relays Using Digital Communications
IEEE C37.244™ -2013	IEEE Guide for Phasor Data Concentrator Requirements for Power System Protection, Control, and Monitoring
IEEE PC37.246™	Draft Guide for Protection Systems of Transmission to Generation Interconnections
IEEE C57.120™ -1991	IEEE Loss Evaluation Guide for Power Transformers and Reactors*
IEEE C57.123™ -2010	IEEE Guide for Transformer Loss Measurement
IEEE C62.11™ -2012	IEEE Standard for Metal-Oxide Surge Arresters for AC Power Circuits (> 1 kV)*
IEEE C62.39™ -2012	IEEE Standard for Test Methods for Self-Restoring Current Limiter Components used in Telecommunication Surge Protectors

*An asterisk means that a revision project for this standard is underway.

IEEE-SA Industry Connections programs:

- DC in the Home
- Systems and Components for Energy Routers
- Electric Vehicle Wireless Power Transfer
- Indian Low-Voltage DC Forum

Smart Transport standards	
IEEE 802.11™ -2012	IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications. NOTE: The original IEEE 802.11p-2010, which added *Wireless Access in Vehicular Environments*, has been superseded by the revision IEEE 802.11-2012, in which the content is now incorporated.
IEEE P802.15.4p™	Draft Standard for Local and metropolitan area networks - Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs) Amendment: Physical Layer for Rail Communications and Control
IEEE 802.16™ -2009	IEEE Standard for Local and metropolitan area networks Part 16: Air Interface for Broadband Wireless Access Systems
IEEE 802.20™ -2008	IEEE Standard for Local and Metropolitan Area Networks - Standard Air Interface for Mobile Broadband Wireless Access Systems Supporting Vehicular Mobility - Physical and Media Access Control Layer Specification
IEEE 1512™ -2006	IEEE Standard for Common Incident Management Message Sets for Use by Emergency Management Centers
IEEE 1512.1™ -2006	IEEE Standard for Common Traffic Incident Management Message Sets for Use by Emergency Management Centers
IEEE 1512.3™ -2006	IEEE Standard for Hazardous Material Incident Management Message Sets for Use by Emergency Management Centers
IEEE 1547™ -2003	IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems
IEEE 1547.1™ -2005	IEEE Standard for Conformance Tests Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems
IEEE P1547.1a™	Draft Standard Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems Amendment 1
IEEE 1547.2™ -2008	IEEE Application Guide for IEEE 1547™, IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems
IEEE 1547.3™ -2007	IEEE Guide for Monitoring, Information Exchange, and Control of

	Distributed Resources Interconnected With Electric Power Systems
IEEE 1547.4™ -2011IEEE	IEEE Guide for Design, Operation, and Integration of Distributed Resource Island Systems with Electric Power Systems
IEEE 1547.6™ -2011	IEEE Recommended Practice for Interconnecting Distributed Resources with Electric Power Systems Distribution Secondary Networks
IEEE P1547.7™	Draft Guide to Conducting Distribution Impact Studies for Distributed Resource Interconnection
IEEE P1547.8™	Draft Recommended Practice for Establishing Methods and Procedures that Provide Supplemental Support for Implementation Strategies for Expanded Use of IEEE Standard 1547™
IEEE P1609.0™	Draft Guide for Wireless Access in Vehicular Environments (WAVE) – Architecture*
IEEE 1609.2™ -2013	IEEE Standard for Wireless Access in Vehicular Environments - Security Services for Applications and Management Messages
IEEE 1609.3™ -2010	IEEE Standard for Wireless Access in Vehicular Environments (WAVE) - Networking Services [and IEEE 1609.3/Cor1-2012]
IEEE 1609.4™ -2010	IEEE Standard for Wireless Access in Vehicular Environments (WAVE) - Multi-channel Operation
IEEE P1609.6™	Draft Standard for Wireless Access in Vehicular Environments (WAVE) - Remote Management Service
IEEE 1609.11™ -2010	IEEE Standard for Wireless Access in Vehicular Environments (WAVE) - Over-the-Air Electronic Payment Data Exchange Protocol for Intelligent Transportation Systems (ITS)
IEEE 1609.12™ -2012	IEEE Standard for Wireless Access in Vehicular Environments (WAVE) - Identifier Allocations*
IEEE 1901™ -2010	IEEE Standard for Broadband over Power Line Networks: Medium Access Control and Physical Layer Specifications
IEEE 2030™ -2011	IEEE Guide for Smart Grid Interoperability of Energy Technology and Information Technology Operation with the Electric Power System (EPS), End-Use Applications, and Loads
IEEE P2030.1™	Draft Guide for Electric-Sourced Transportation Infrastructure
IEEE P2100.1™	Draft Standard Specifications for Wireless Power and Charging Systems

*An asterisk means that a revision project for this standard is underway.

IEEE-SA Industry Connections programs:

- Electric Vehicle Wireless Power Transfer

Smart Health standards	
IEEE P1708™	Draft Standard for Wearable Cuffless Blood Pressure Measuring Devices
IEEE P1721™	Draft Standard for Objective Measurement of Systemic Arterial Blood Pressure in Humans
IEEE P1822™	Draft Standard for Digital Microscope Analyzer, Whole Slide Image Scanner and Digital Microscope
IEEE P1856™	Draft Standard Framework for Prognostics and Health Management of Electronic Systems
IEEE 2010™ -2012	IEEE Recommended Practice for Neurofeedback Systems
IEEE P2302™	Draft Standard for Intercloud Interoperability and Federation (SIIF)
IEEE P3333.1™	Draft Standard for the Quality Assessment of Three Dimensional (3D) Displays, 3D Contents and 3D Devices based on Human Factors
IEEE P3333.2™	Draft Standard for Three-Dimensional Model Creation Using Unprocessed 3D Medical Data
IEEE 11073-00101™ -2008	IEEE Standard for Health Informatics – Point of Care Medical Device Communication - Part 00101: Guide--Guidelines for the Use of RF Wireless Technology
IEEE 11073-00103™: 2012	IEEE Standard for Health informatics - Personal health device communication Part 00103: Overview
IEEE 11073-10101™: 2004	IEEE Standard for Health informatics - Point-of-care medical device communication – Nomenclature*

IEEE P11073-10101a™:ISO/IEEE 11073-10101:2004	Health informatics - Point-of- care medical device communication - Nomenclature Amendment for additional definitions
IEEE 11073-10102™ -2012	IEEE Standard for Health informatics - Point-of care medical device communication - Nomenclature - Annotated ECG
IEEE 11073-10103™ -2013	IEEE Standard for Health informatics - Point-of-care medical device communication - Nomenclature - Implantable device, cardiac
IEEE 11073-10201™:2004	IEEE Standard for Health informatics - Point-of-care medical device communication - Domain information model*
IEEE P11073-10301-1™	Draft Standard for Health informatics - Point-of-care medical device communication - Part 10301-1: Device Specialization - Infusion pump, General
IEEE P11073-10302-1™	Draft Standard for Health informatics - Point-of-care medical device communication - Part 10302-1: Device Specialization - Physiologic monitor, General
IEEE P11073-10303-1™	Draft Standard for Health informatics - Point-of-care medical device communication - Part 10303-1: Device Specialization - Ventilator, General
IEEE 11073-10404™ -2010	IEEE Standard for Health Informatics - Personal Health Device
IEEE P11073-10404a™	Draft Standard for Health Informatics - Personal Health Device Communication - Device Specialization - Pulse Oximeter Amendment
IEEE 11073-10406™:2011	IEEE Standard for Health informatics--Personal health device communication Part 10406: Device specialization--Basic electrocardiograph (ECG) (1-to 3-lead ECG)
IEEE P11073-10406a™	Draft Standard for Health informatics--Personal health device communication Part 10406: Device specialization--Basic electrocardiograph (ECG) (1- to 3-lead ECG) Amendment
IEEE 11073-10407™:2008	IEEE Standard for Health Informatics - Personal Health Device Communication - Device Specialization - Blood Pressure Monitor
IEEE 11073-10408™:2008	IEEE Standard for Health informatics-- Personal health device communication Part 10408: Device specialization -- Thermometer
IEEE P11073-10413™	Draft Standard for Health informatics - Personal health device communication - Device specialization - Respiration rate monitor
IEEE 11073-10415™:2008	IEEE Standard for Health Informatics - Personal Health Device Communication - Device Specialization - Weighing Scale
IEEE 11073-10417™:2011	IEEE Standard for Health informatics--Personal health device communication Part 10417: Device specialization--Glucose meter
IEEE 11073-10417a™	Draft Standard for Health informatics--Personal health device communication Part 10417: Device specialization--Glucose meter Amendment 1
IEEE 11073-10418™:2011	IEEE Standard for Health informatics--Personal health device communication Part 10418: Device specialization--International Normalized Ratio (INR) monitor
IEEE P11073-10419™	Draft Standard for Health informatics - Personal health device communication - Device specialization - Insulin pump
IEEE 11073-10420™:2010	IEEE Standard for Health informatics -- Personal health device communication Part 10420: Device specialization -- Body composition analyzer
IEEE 11073-10421™:2010	IEEE Standard for Health informatics--Personal health device communication Part 10421: Device specialization--Peak expiratory flow monitor (peak flow)
IEEE P11073-10422™	Draft Standard for Health informatics - Personal health device communication - Device specialization - Urine analyzer
IEEE P11073-10423™	Draft Standard for Health informatics -Personal health device communication - Device specialization - Sleep Monitor
IEEE P11073-10424™	Draft Standard for Health informatics - Personal health device communication - Device specialization - Sleep apnea breathing therapy equipment
IEEE P11073-10425™	Draft Standard for Health informatics - Personal health device communication - Device specialization - Continuous Glucose Monitor (CGM)
IEEE 11073-10441™:2013	IEEE Standard for Health Informatic--Personal health device communication Part 10441: Device specialization--Cardiovascular fitness and activity monitor
IEEE 11073-10442™:2008	IEEE Standard for Health informatics - Personal health device communication Part 10442: Device specialization - Strength fitness equipment
IEEE 11073-10471™:2008	IEEE Standard for Health informatics--Personal health device communication Part 10471: Device specialization--Independent

	living activity hub
IEEE P11073-10471a™	Draft Standard for Health informatics-Personal health device communication Part 10471: Device specialization-Independent living activity hub Amendment
IEEE 11073-10472™:2010	IEEE Standard for Health informatics--Personal health device communication--Part 10472: Device specialization--Medication monitor
IEEE 11073-20101™:2004	IEEE Standard for Health informatics - Point-of-care medical device communication - Application profile - Base standard*
IEEE P11073-20201™	Draft Standard for Health informatics -- Point-of-care medical device communication -- Part 20201: Application profile -- Polling mode
IEEE P11073-20202™	Draft Standard for Health informatics -- Point-of-care medical device communication -- Part 20202: Application profile -- Baseline asynchronous mode
IEEE P11073-20301™	Draft Standard for Health informatics -- Point-of-care medical device communication -- Part 20301: Application profile -- Optional package, remote control
IEEE P11073-20401™	Draft Standard for Health informatics -- Point-of-care medical device communication -- Part 20401: Application profile -- Common networking services
IEEE 11073-20601™:2008	IEEE Standard for Health informatics - Personal health device communication - Part 20601: Application profile - Optimized exchange protocol
IEEE 11073-20601a™:2010	IEEE Standard for Health informatics--Personal health device communication Part 20601: Application profile--Optimized Exchange Protocol Amendment 1
IEEE 11073-30200™:2000	ISO/IEEE Standard for Health informatics - Point-of-care medical device communication - Transport profile - Cable connected
IEEE 11073-30200a™:2011	IEEE Standard for Health informatics--Point-of-care medical device communication Part 30200: Transport profile--Cable connected Amendment 1
IEEE 11073-30300™:2004 ISO/IEEE 11073-30300:2004	Health informatics - Point-of-care medical device communication - Transport profile - Infrared
IEEE 11073-30400:™ 2010	IEEE Standard for Health informatics--Point-of-care medical device communication Part 30400: Interface profile--Cabled Ethernet
IEEE P62704-4™	Draft Standard for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body from Wireless Communications Devices, 30 MHz -6 GHz: General Requirements for Using the Finite Element Method (FEM) for SAR Calculations and Specific Requirements for Modeling Vehicle-Mounted Antennas and Personal Wireless Devices

*An asterisk means that a revision project for this standard is underway.

IEEE-SA Industry Connections programs:

- IEEE Intercloud Testbed
- Cloud Computing Innovation Council for India

Smart Manufacturing standards	
IEEE 802.11™-2012	IEEE Standard for Information technology--Telecommunications and information exchange between systems Local and metropolitan area networks--Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications
IEEE 802.11aa™-2012	IEEE Standard for Information technology--Telecommunications and information exchange between systems Local and metropolitan area networks--Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment 2: MAC Enhancements for Robust Audio Video Streaming
IEEE 802.11ad™-2012	IEEE Standard for Information technology--Telecommunications and information exchange between systems--Local and metropolitan area networks--Specific requirements-Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment 3: Enhancements for Very High Throughput in the 60 GHz Band

IEEE 802.11ae™-2012	IEEE Standard for Information technology--Telecommunications and information exchange between systems--Local and metropolitan area networks--Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment 1: Prioritization of Management Frames
IEEE 802.15.4™-2011	IEEE Standard for Local and metropolitan area networks--Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs)
IEEE 802.15.4e™-2012	IEEE Standard for Local and metropolitan area networks--Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs) Amendment 1: MAC sublayer
IEEE 802.15.4f™-2012	IEEE Standard for Local and metropolitan area networks-- Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs) Amendment 2: Active Radio Frequency Identification (RFID) System Physical Layer (PHY)
IEEE 802.15.4g™-2012	IEEE Standard for Local and metropolitan area networks--Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs) Amendment 3: Physical Layer (PHY) Specifications for Low-Data-Rate, Wireless, Smart Metering Utility Networks
IEEE 802.15.4m™	Draft IEEE Standard for Local and Metropolitan Area Networks Part 15.4: Low Rate Wireless Personal Area Networks (LR-WPANs) Amendment: TV White Space Between 54 MHz and 862 MHz Physical Layer
IEEE 802.15.4n™	Draft IEEE Standard for Local and metropolitan area networks— Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs) Amendment: Physical Layer Utilizing Dedicated Medical Bands in China
IEEE 802.15.4p™	Draft IEEE Standard for Local and metropolitan area networks— Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs) Amendment: Physical Layer for Rail Communications and Control
IEEE 802.15.4q™	Draft IEEE Standard for Local and metropolitan area networks— Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs) Amendment for an Ultra-Low Power Physical Layer
IEEE 1451.0™ -2007	IEEE Standard for a Smart Transducer Interface for Sensors and Actuators - Common Functions, Communication Protocols, and Transducer Electronic Data Sheet (TEDS) Formats
IEEE P1451.2™	Draft Standard for a Smart Transducer Interface for Sensors and Actuators - Serial Point-to-Point Interface
IEEE 1451.4™ -2004	IEEE Standard for a Smart Transducer Interface for Sensors and Actuators - Mixed-mode Communication Protocols and Transducer Electronic Data Sheet (TEDS) Formats
IEEE P1451.4a™	Draft Standard for a Smart Transducer Interface for Sensors and Actuators--Mixed-Mode Communication Protocols and Transducer Electronic Data Sheet (TEDS) Formats – Amendment
IEEE P1828™	Draft Standard for Systems with Virtual Components
IEEE P1872™	Draft Standard for Ontologies for Robotics and Automation
IEEE P1873™	Draft Standard for Robot Map Data Representation for Navigation
IEEE 1902.1™ -2009	IEEE Standard for Long Wavelength Wireless Network Protocol
IEEE P21451 -001™	Draft Recommended Practice for Signal Treatment Applied to Smart Transducers
IEEE 21451-1™ -2010	IEEE Standard for Information technology -- Smart transducer interface for sensors and actuators -- Part 1: Network Capable Application Processor (NCAP) information model*
IEEE P21451-1™	Draft Standard for Smart Transducer Interface for Sensors and Actuators - Common Network Services*
IEEE P21451-1-4™	Draft Standard for a Smart Transducer Interface for Sensors, Actuators, and Devices - eXtensible Messaging and Presence Protocol (XMPP) for Networked Device Communication
IEEE 21451-2™ -2010	IEEE Standard for Information technology -- Smart transducer interface for sensors and actuators -- Part 2: Transducer to microprocessor communication protocols and Transducer Electronic Data Sheet (TEDS) formats*
IEEE 21451-4™ -2010	IEEE Standard for Information technology -- Smart transducer interface for sensors and actuators -- Part 4: Mixed-mode communication protocols and Transducer Electronic Data Sheet

	(TEDS) formats
IEEE 21451-7™-2011	IEEE Standard for Smart Transducer Interface for Sensors and Actuators--Transducers to Radio Frequency Identification (RFID) Systems Communication Protocols and Transducer Electronic Data Sheet Formats

*An asterisk means that a revision project for this standard is underway.

Annex 4: Abbreviations

List of Abbreviations and Acronyms

Acronym	Meaning
3GPP	3rd Generation Partnership Project
AAL	Ambient Assisted Living
ACID	Atomicity, Consistency, Isolation, Durability
ACL	Access Control List
AMR	Automatic Meter Reading Technology
API	Application Programming Interface
AWARENESS	EU FP7 coordination action Self-Awareness in Autonomic Systems
BACnet	Communications protocol for building automation and control networks
BAN	Body Area Network
BDI	Belief-Desire-Intention architecture or approach
Bluetooth	Proprietary short range open wireless technology standard
BPM	Business process modelling
BPMN	Business Process Model and Notation
BUTLER	EU FP7 research project uBiquitous, secUre inTernet of things with Location and contExt-awaReness
CAGR	Compound annual growth rate
CE	Council of Europe
CEN	Comité Européen de Normalisation
CENELEC	Comité Européen de Normalisation Électrotechnique
CEO	Chief executive officer
CEP	Complex Event Processing
CSS	Chirp Spread Spectrum
D1.3	Deliverable 1.3
DATEX-II	Standard for data exchange involving traffic centres
DCA	Data Collection and Analysis
DNS	Domain Name System
DoS/DDOS	Denial of service attack Distributed denial of service attack
EC	European Commission
eCall	eCall – eSafety Support A European Commission funded project, coordinated by ERTICO-ITS Europe
EDA	Event Driven Architecture
EH	Energy harvesting
EMF	Electromagnetic Field
ERTICO-ITS	Multi-sector, public / private partnership for intelligent transport systems and services for Europe
ESOs	European Standards Organisations
ESP	Event Stream Processing
ETSI	European Telecommunications Standards Institute
EU	European Union
Exabytes	10^{18} bytes

FI	Future Internet
FI PPP	Future Internet Public Private Partnership programme
FIA	Future Internet Assembly
FIS 2008	Future Internet Symposium 2008
F-ONS	Federated Object Naming Service
FP7	Framework Programme 7
FTP	File Transfer Protocol
GFC	Global Certification Forum
GreenTouch	Consortium of ICT research experts
GS1	Global Standards Organization
Hadoop	Project developing open-source software for reliable, scalable, distributed computing
IAB	Internet Architecture Board
IBM	International Business Machines Corporation
ICAC	International Conference on Autonomic Computing
ICANN	Internet Corporation for Assigned Name and Numbers
ICT	Information and Communication Technologies
iCore	EU research project Empowering IoT through cognitive technologies
IERC	European Research Cluster for the Internet of Things
IETF	Internet Engineering Task Force
INSPIRE	Infrastructure for Spatial Information in the European Community
IoE	Internet of Energy
IoM	Internet of Media
IoP	Internet of Persons
IoS	Internet of Services
IoT	Internet of Things
IoT6	EU FP7 research project Universal integration of the Internet of Things through an IPv6-based service oriented architecture enabling heterogeneous components interoperability
IoT-A	Internet of Things Architecture
IoT-est	EU ICT FP7 research project Internet of Things environment for service creation and testing
IoT-GSI	Internet of Things Global Standards Initiative
IoT-i	Internet of Things Initiative
IoV	Internet of Vehicles
IP	Internet Protocol
IPSO Alliance	Organization promoting the Internet Protocol (IP) for Smart Object communications
IPv6	Internet Protocol version 6
ISO 19136	Geographic information, Geography Mark-up Language, ISO Standard
IST	Intelligent Transportation System
ITS	Intelligent Transport Systems
JCA-IoT	Joint Coordination Activity on Internet of Things
KNX	Standardized, OSI-based network communications protocol for intelligent buildings
LNCS	Lecture Notes in Computer Science
LOD	Linked Open Data Cloud

LTE	Long Term Evolution
M2M	Machine to Machine
MAC	Media Access Control data communication protocol sub-layer
MAPE-K	Model for autonomic systems: Monitor, Analyse, Plan, Execute in interaction with a Knowledge base
makeSense	EU FP7 research project on Easy Programming of Integrated Wireless Sensors
MB	Megabyte
MIT	Massachusetts Institute of Technology
MPP	Massively parallel processing
NIEHS	National Institute of Environmental Health Sciences
NFC	Near Field Communication
NoSQL	not only SQL – a broad class of database management systems
OASIS	Organisation for the Advancement of Structured Information Standards
OEM	Original equipment manufacturer
OGC	Open Geospatial Consortium
OMG	Object Management Group
OpenIoT	EU FP7 research project Part of the Future Internet public private partnership Open source blueprint for large scale self-organizing cloud environments for IoT applications
Outsmart	EU project Provisioning of urban/regional smart services and business models enabled by the Future Internet
PAN	Personal Area Network
PET	Privacy Enhancing Technologies
Petabytes	10^{15} byte
PHY	Physical layer of the OSI model
PIPES	Public infrastructure for processing and exploring streams
PKI	Public key infrastructure
PPP	Public-private partnership
Probe-IT	EU ICT-FP7 research project Pursuing roadmaps and benchmarks for the Internet of Things
PSI	Public Sector Information
PV	Photo Voltaic
QoI	Quality of Information
RFID	Radio-frequency identification
SASO	IEEE international conferences on Self-Adaptive and Self-Organizing Systems
SDO	Standard Developing Organization
SEAMS	International Symposium on Software Engineering for Adaptive and Self-Managing Systems
SENSEI	EU FP7 research project Integrating the physical with the digital world of the network of the future
SIG	Special Interest Group
SLA	Service-level agreement / Software license agreement
SmartAgriFood	EU ICT FP7 research project

	Smart Food and Agribusiness: Future Internet for safe and healthy food from farm to fork
SmartSantander	EU ICT FP7 research project Future Internet research and experimentation
SOA	Service Oriented Approach
SON	Self Organising Networks
SSW	Semantic Sensor Web
SRA	Strategic Research Agenda
SRIA	Strategic Research and Innovation Agenda
SRA2010	Strategic Research Agenda 2010
SWE	Sensor Web Enablement
TC	Technical Committee
TTCN-3	Testing and Test Control Notation version 3
USDL	Unified Service Description Language
UWB	Ultra-wideband
W3C	World Wide Web Consortium
WS&AN	Wireless sensor and actuator networks
WSN	Wireless sensor network
WS-BPEL	Web Services Business Process Execution Language
Zettabytes	10^{21} byte
ZigBee	Low-cost, low-power wireless mesh network standard based on IEEE 802.15.4

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