ILNAS

TECHNICAL STANDARDIZATION

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ADDRESSING CLOUD COMPUTING CHALLENGES AND SUPPORTING RELATED ICT DEVELOPMENT

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ILNAS
Institut Luxembourgeois de la Normalisation, de l'Accréditation, de la Sécurité et qualité des produits et services

ANEC
Agence pour la Normalisation et l'Economie de la Connaissance

Foreword

Technical standardization plays an important role in the support of economic development. Nowadays, almost every sector relies on standards to provide services in an efficient manner. Standards are therefore considered as a major source of benefits, and this is particularly true for Information and Communication Technology (ICT), which supports all other economic developments.

The Grand Duchy of Luxembourg has clearly understood the importance of the digital economy and has engaged since several years in an ambitious innovation strategy for the ICT sector. The "Institut Luxembourgeois de la Normalisation, de l'Accréditation, de la Sécurité et qualité des produits et services" (ILNAS) supports this development through the "Luxembourg Standardization Strategy 2020-2030", signed by the Minister of the Economy, which identifies the ICT sector as one of the most relevant for national economic growth, along with the Construction and Aerospace sectors. Directly linked, ILNAS has also developed the "Luxembourg's policy on ICT technical standardization 2020-2025", which it carries out with the support of the Economic Interest Group "Agence pour la Normalisation et l'économie de la Connaissance" (ANEC GIE – Standardization Department). The aim of this policy is threefold: to promote and strengthen the use of technical standards by the national market; to reinforce the positioning of Luxembourg in the global ICT standardization landscape, particularly through a stronger involvement of national stakeholders in the relevant standardization technical committees; to pursue the development of research and education programs. In the frame of this policy, ILNAS has notably launched different research activities in the Smart Secure ICT domain.

As a result of these research activities, various documents have been published. More publications were realized with the support of the ANEC GIE such as: the Standards Analysis "ICT Sector - Luxembourg" document, which is intended to serve as a practical tool to discover the latest standardization developments in the overall landscape of ICT related technologies, and a series of White Papers and reports, that aim to inform the market about technical standardization developments in certain ICT subtopics.

Within this global framework, the current document is intended to inform the national market about relevant Cloud Computing standardization activities and their importance in the development of other ICT fields, with, notably, a view towards encouraging the national market's future involvement in the standards development process, for the benefit of Luxembourg's economy.

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Abstract

Cloud Computing is now everywhere, having risen as a platform to provide support to other Information and Communication Technologies (ICT), such as Artificial Intelligence (AI), Internet of Things (IoT) or software engineering, among many others. It guarantees the delivery of practically unlimited computing resources and services remotely.

Firstly, this document provides an overview about Cloud Computing concepts. Then, it presents, with the increasing demand for the use of Cloud Computing, some of the major challenges that have emerged, for example, in terms of security, transparency, interoperability, portability. In this context, a part of the solution is to rely on standards that provide a set of guidelines and good practices, while supporting innovation. Thus, this document introduces technical standardization and presents a set of technical committees and standards addressing Cloud Computing challenges.

Furthermore, the document considers Cloud Computing, not only as a support domain, but also as an important enabler for the development and expansion of other linked ICT technologies (AI, IoT, software engineering, etc.), with technical standardization supporting all of them both individually and in their orchestration.

Finally, to catch all this related relevant information and benefit fully from the added value of technical standardization, the document highlights, while considering the importance of using ad hoc technical standards, how to become a national expert involved into the process of standards development in Luxembourg.

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1. Cloud Computing overview

> *"If computers of the kind I have advocated become the computers of the future, then computing may someday be organized as a public utility just as the telephone system is a public utility. The computer utility could become the basis of a new and important industry."*
>
> *John McCarthy*

The concept of Cloud Computing traces back to ideas formulated in 1961 by John McCarthy[1], a visionary computer scientist who developed the concept of sharing computing resources. Since then, the development of Cloud Computing has undergone significant changes: it started as a storage infrastructure and evolved to provide secure services based on a pay-as-you-go strategy, and continued its emergence with the appearance of other technologies such as: DevOps, multi-Cloud, AI, IoT, etc.

According to the international standard ISO/IEC 22123-1:2021, Cloud Computing is a "Paradigm for enabling network access to a scalable and elastic pool of shareable physical or virtual resources with self-service provisioning and administration on-demand". Nowadays, practically unlimited storage and processing capabilities are offered by Cloud Service Providers (CSPs), and are made available over the Internet with a competitive pay-as-you-go business model. These services are characterized by high elasticity and flexibility, providing both technical and economic benefits. Table 1 summarizes the fundamental characteristics of Cloud Computing.

Characteristic	Description
Broad Network Access	Cloud Computing services are available over a network (usually the Internet) and accessed through standard mechanisms that promote use by heterogeneous client platforms.
Measured Service	The usage of Cloud services can be monitored, controlled, reported, and billed. These metrics are used to optimize resource usage and are used as input for pay-as-you-go business models.
Multi-tenancy	Physical or virtual resources are allocated in such a way that multiple tenants and their computations and data are isolated from and inaccessible to one another.
On-demand Self-service	A Cloud Service Customer (CSC) can provision computing capabilities, as needed, automatically or with minimal interaction with the CSP.
Rapid Elasticity and Scalability	Physical or virtual resources can be rapidly and elastically adjusted, in some cases automatically, to quickly increase or decrease resources. For the CSC, physical or virtual resources available for provisioning often appear to be unlimited and can be purchased in any quantity at any time automatically, subject to constraints of service agreements.
Resource Pooling	A CSP's physical or virtual resources can be aggregated in order to serve one or more CSCs.

Table 1: Characteristics of Cloud Computing[2]

[1] McCarthy is also credited with coining the term 'Artificial Intelligence'.

[2] ITU-T Y.3500 | ISO/IEC 17788:2014, Information technology - Cloud Computing - Overview and vocabulary

2. Cloud Computing challenges

Cloud Computing has been adopted by many economic sectors due to the multiple services offered by CSPs. Therefore, Cloud has become an important part of our life today; indeed, one is heavily dependent on it indirectly or directly, whether one is a student, IT developer or enterprise. Thus, it is important to know the issues and challenges encountered when adopting Cloud Computing. Some of them are shown in Figure 1:

Figure 1: Challenges in the adoption of Cloud Computing

Cloud Computing challenges have resulted in extensive studies and the emergence of relevant technical standards. Many standards bodies have approached appropriate standards in different areas of Cloud Computing in order to assess, manage risks and contribute in the development of this technology in a holistic manner, as it has become a crucial element in the ICT sector.

Next section of this report provides an overview of technical standardization and how it contributes to leverage Cloud Computing and to tackle challenges related to the technology.

3. Technical standardization and Cloud Computing

Setting the standards means setting the market

3.1. Introduction to technical standardization

3.1.1. Definition of a standard

As defined by ISO "A standard is a document, established by a consensus of subject matter experts and approved by a recognized body that provides guidance on the design, use or performance of materials, products, processes, services, systems or persons".

3.1.2. Why developing standards for the Cloud Computing?

- Standards provide common communication protocols;
- Standards bring a harmonization that promotes strength for Cloud actors and help users to evaluate options and plan with confidence;
- Standards enable interoperability between various applications and infrastructures and consequently prevent the vendor lock-in;
- Standards insure data integrity, availability and confidentiality;
- Standards support transparency and therefore build trust between CSP and CSC;
- Standards provide guidelines and good practices to improve security of Cloud services.

3.1.3. Where are technical standards developed?

Technical standards are developed by organizations that bring all interested stakeholders together and follow well-accepted principles (e.g., defined by the World Trade Organization[3]). In the European Union (EU), Regulation (EU) No 1025/2012[4] recognized the following standardization organizations:

At the international level, the three recognized standardization organizations are the:

- International Organization for Standardization (ISO).
- International Electrotechnical Commission (IEC).
- International Telecommunication Union's Telecommunication Standardization Sector (ITU-T).

At the EU level, the three recognized standardization organizations are the:

- European Committee for Standardization (CEN).
- European Committee for Electrotechnical Standardization (CENELEC).
- European Telecommunications Standards Institute (ETSI).

[3] https://www.wto.org/english/tratop_e/tbt_e/principles_standards_tbt_e.htm

[4] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32012R1025

Finally, at **national level**, the *Institut luxembourgeois de la normalisation, de l'accréditation, de la sécurité et qualité des produits et services* (ILNAS) is the national standards body representing Luxembourg in international and European standardization organizations. As such, ILNAS is a member of the following standardization organizations: CEN, CENELEC, ETSI, ISO, IEC and ITU-T.

3.2. Technical standardization addressing Cloud Computing challenges

Many standards and specifications related to Cloud Computing have been developed by standards developing organizations. These standards are developed within technical committees, with the aim to guide and propose solutions for all stakeholders involved in this technology, whether being Cloud service providers, partners or customers. The main technical committees active in Cloud Computing standardization, which notably address some of the Cloud Computing challenges, identified in Figure 1, are presented below.

3.2.1. ISO/IEC JTC 1/SC 38 "Cloud Computing and Distributed Platforms"

The ISO/IEC JTC 1, a joint technical committee between ISO and IEC dedicated to information technology standardization, notably covers Cloud Computing standardization through its sub-committee ISO/IEC JTC 1/SC 38 "Cloud Computing and Distributed platforms".

Scope

Standardization in the areas of Cloud Computing and Distributed Platforms including:

- Foundational concepts and technologies,
- Operational issues, and
- Interactions among Cloud Computing systems and with other distributed systems.

SC 38 serves as the focus, proponent, and systems integration entity on Cloud Computing, Distributed Platforms, and the application of these technologies. SC 38 provides guidance to JTC 1, IEC, ISO and other entities developing standards in these areas.

Challenges addressed and examples of standards

Transparency of Service Delivery and Billing	ISO/IEC TR 23613:2020, Information technology - Cloud Computing - Cloud Service metering elements and billing modes ISO/IEC 19086-1:2016, Information technology - Cloud Computing - Service level agreement (SLA) framework - Part 1: Overview and concepts ISO/IEC 19086-2:2018, Cloud computing - Service level agreement (SLA) framework - Part 2: Metric model ISO/IEC 19086-3:2017, Information technology - Cloud Computing - Service level agreement (SLA) framework - Part 3: Core conformance requirements
Interoperability and Portability	ISO/IEC 19941:2017, Information technology - Cloud Computing - Interoperability and portability ISO/IEC 19944-1:2020, Cloud Computing and distributed platforms - Data flow, data categories and data use - Part 1: Fundamentals ISO/IEC 19944-2:2022, Cloud computing and distributed platforms - Data flow, data categories and data use - Part 2: Guidance on application and extensibility ISO/IEC 5140 *(Project)*, Information technology - Cloud Computing - Concepts for multi-Cloud and other interoperation of multiple cloud services ISO/IEC 17826:2022, Information technology - Cloud Data Management Interface (CDMI) Version 2.0.0
Security and Privacy	ISO/IEC TR 23186:2018, Information technology - Cloud Computing - Framework of trust for processing of multi-sourced data ISO/IEC 23751:2022, Information technology - Cloud Computing and distributed platforms - Data sharing agreement (DSA) framework
Efficiency of Service Provisioning	ISO/IEC 19831:2015, Cloud Infrastructure Management Interface (CIMI) Model and RESTful HTTP-based Protocol - An Interface for Managing Cloud Infrastructure
Others	ISO/IEC TR 3445:2022, Information technology - Cloud Computing - Audit of Cloud services ISO/IEC 22123-1:2021, Information technology - Cloud Computing - Part 1: Vocabulary ISO/IEC 22123-2 *(Project)*, Information technology - Cloud Computing - Part 2: Concepts ISO/IEC TS 5928 *(Project)*, Information technology - Cloud Computing and distributed platforms - Taxonomy for digital platforms

3.2.2. ITU-T/SG 13 "Future networks and emerging network technologies"

The ITU-T covers Cloud Computing standardization through its Study Group 13 (SG 13) "Future networks and emerging network technologies".

Scope (extract)

ITU-T Study Group 13 is notably responsible for studies relating to future computing including Cloud Computing and data handling in telecommunication networks. This covers capabilities and technologies from the network side to support data utilization, exchange, sharing, and data quality assessment and computing-aware networking as well as end-to-end awareness, control and management of future computing, including cloud, cloud security and data handling.

Challenges addressed and examples of standards

Interoperability and Portability	ITU-T Y.3516:2017, Cloud Computing - Functional architecture of inter-cloud computing ITU-T Y.3518:2018, Cloud Computing - Functional requirements of inter-cloud data management ITU-T Y.3528:2022, Cloud Computing - Framework and requirements of container management in inter-cloud ITU-T Q.4041.1:2018, Cloud Computing infrastructure capabilities interoperability testing – part 1: Interoperability testing between the CSC and CSP

3.2.3. ISO/IEC JTC 1/SC 27 "Information security, cybersecurity and privacy protection"

The increasing demand of using Cloud Computing technology has introduced a range of privacy and security risks. For instance, it is challenging to ensure that sensitive data remain properly protected and that users maintain control over who could access what part of their data stored on an external Cloud server[5]. In order to mitigate privacy and security risks, the ISO/IEC JTC 1 sub-committee ISO/IEC JTC 1/SC 27 "Information security, cybersecurity and privacy protection" develops standards related to security and privacy for ICT domains including Cloud Computing.

Scope

The development of standards for the protection of information and ICT. This includes generic methods, techniques and guidelines to address both security and privacy aspects, such as:

- Security requirements capture methodology;
- Management of information and ICT security; in particular information security management systems, security processes, and security controls and services;

[5] https://portail-qualite.public.lu/fr/publications/normes-normalisation/etudes/ilnas-white-paper-data-protection-privacy-smart-ict.html

- Cryptographic and other security mechanisms, including but not limited to mechanisms for protecting the accountability, availability, integrity and confidentiality of information;
- Security management support documentation including terminology, guidelines as well as procedures for the registration of security components;
- Security aspects of identity management, biometrics and privacy;
- Conformance assessment, accreditation and auditing requirements in the area of information security management systems;
- Security evaluation criteria and methodology.

Challenges addressed and examples of standards

Security and Privacy	ISO/IEC 19086-4:2019, Cloud Computing - Service level agreement (SLA) framework - Part 4: Components of security and protection of PII ISO/IEC 27017:2015, Information technology - Security techniques - Code of practice for information security controls based on ISO/IEC 27002 for cloud services ISO/IEC 27018:2019, Information technology - Security techniques - Code of practice for protection of personally identifiable information (PII) in public Clouds acting as PII processors ISO/IEC 27036-4:2016, Information technology - Security techniques - Information security for supplier relationships - Part 4: Guidelines for security of cloud services

3.2.4. ITU-T/SG 17 "Security"

The ITU-T covers security of Cloud Computing standardization through its Study Group 17 (SG 17) "Security".

Scope (extract)

ITU-T Study Group 17 is responsible for building confidence and security in the use of information and communication technologies. It includes Cloud Computing security.

Challenges addressed and examples of standards

Security and Privacy	ITU-T X.1601:2015, Security framework for Cloud Computing ITU-T X.1602:2016, Security requirements for software as a service application environments ITU-T X.1605:2020, Security requirements of public Infrastructure as a Service (IaaS) in Cloud Computing ITU-T X.1641:2016, Guidelines for cloud service customer data security ITU-T X.1642:2016, Guidelines for the operational security of Cloud Computing

4. Cloud Computing supporting ICT developments: technical standardization as an enabler for the expansion of the interlinked ICT technologies

Cloud Computing has not only resulted in a rich ecosystem of innovative services; it has also allowed the rapid growth of major ICT paradigms such as the Internet of Things (IoT), Artificial intelligence (AI), Big data, and software engineering, among many others. Currently, many standards organizations and open source initiatives are working on these different ICT domains in order to provide useful guidelines, specifications, and requirements[6].

In this context, the huge reliance between Cloud and other ICT domains has led, for instance, ISO/IEC JTC 1/SC 38 to work closely with a number of other JTC 1 subcommittees, including ISO/IEC JTC 1/SC 7 "Software and Systems Engineering", ISO/IEC JTC 1/SC 41 "Internet of Things and Digital Twins", ISO/IEC JTC 1/SC 42 "Artificial intelligence" as well as ISO/IEC JTC 1/SC 27 "Information security, cybersecurity and privacy protection" to consider privacy and security aspects.

These collaborations are notably done through liaison coordination groups to address common challenges and avoid the replication of work. Thus, the current section explains how Cloud Computing supports the ICT development, illustrating this with AI, IoT and software engineering domains. It particularly highlights some ICT standards and projects tackling this expansion of interlinked ICT technologies and notably taking into consideration relevant Cloud Computing concepts.

As a real added value of technical standardization, the standards developed by the technical committees are based on the contributions proposed by the experts of their member's countries, and are established via consensus. This allows technical committees to act coherently and collectively to solve technical issues like interoperability, portability, security, etc., and to take up the related challenges.

[6] More information on technical standardization activities in the ICT sector is available in the ILNAS Standards Analysis "ICT Sector – Luxembourg".

4.1. Cloud and Artificial intelligence

4.1.1. What is Artificial intelligence?

ISO/IEC TR 24030:2021 defines Artificial intelligence (AI) as the capability of a system "to acquire, process, create and apply knowledge, held in the form of a model, to conduct one or more given tasks".

4.1.2. Why use AI?

AI occurs to perform manual or repetitive tasks and actions that humans can do, but in a faster and more effective way. There are many recent AI use cases used by organization including customized marketing, healthcare analysis, asset optimization and so on, which have experienced considerable efficiency thanks to AI progress.

4.1.3. How can Cloud support AI?

Cost savings

The adoption of Cloud in AI eliminates costs of setting and managing huge datacenters. It enables companies to only pay as much as they use.

Data analysis

Connecting data in the Cloud helps companies to quickly identify patterns using multiple datasets, which enable AI to increase the accuracy of their models.

Drive faster innovation

Instead of building a model from scratch that could take many months to build and train, Cloud providers offer pre-trained models that can be used to solve similar problems or can be used as a starting point for other problems.

Unlimited resources

The Cloud provides access to large data stores and computing resources (CPU, GPU, TPU...) that help store, process and analyze in real-time a huge amount of data needed for AI/ML applications.

Configured platforms

Training AI models requires a complex configuration and installation of many dependencies. Cloud Computing solves these challenges by providing on-demand AI frameworks to build and train AI applications without any prior management.

4.1.4. What are the related standardization developments?[7]

The ISO/IEC JTC 1 established the sub-committee ISO/IEC JTC 1/SC 42 "Artificial intelligence" in 2017, to consider foundational aspects, computational methods, trustworthiness and societal concerns related to AI.

Scope

Standardization in the area of Artificial Intelligence:

- Serve as the focus and proponent for JTC 1's standardization program on Artificial Intelligence;
- Provide guidance to JTC 1, IEC, and ISO committees developing Artificial Intelligence applications.

Standards related to AI

A few examples of standards that support AI developments and take into consideration Cloud Computing concepts are presented below:

Standards related to AI	ISO/IEC TR 24030:2021, Information technology - Artificial intelligence (AI) - Use cases ISO/IEC 23053 *(Project)*, Framework for Artificial Intelligence (AI) Systems Using Machine Learning (ML) ISO/IEC 22989 *(Project)*, Information technology - Artificial intelligence - Artificial intelligence concepts and terminology ISO/IEC 24668 *(Project)*, Information technology - Artificial intelligence - Process management framework for big data analytics ISO/IEC 5259-5 *(Project)*, Artificial intelligence - Data quality for analytics and machine learning (ML) - Part 5: Data quality governance

[7] More information on technical standardization in the AI domain is available in the ILNAS White Paper "Artificial Intelligence - Technology, Use Cases and Applications, Trust worthiness and Technical Standardization" (February 2021)

4.2. Cloud and Internet of Things

4.2.1. What is Internet of Things?

According to ISO/IEC 20924:2021, Internet of Things (IoT) "is an infrastructure of interconnected objects, people, systems and information resources together with intelligent services to allow them to process information of the physical and the virtual world and react".

4.2.2. Why does IoT matter?

IoT gives organizations the ability to live and work smarter and have a full control over their lives. IoT not only offers smart devices to automate homes and cities but have an evidence importance in businesses too. It provides businesses a real-time look into the whole system. They can use sensors to track every component of a supply chain, from raw materials to finished product, to get clearer insights of delays, bottlenecks or losses that may occur.

4.2.3. How can Cloud support IoT?

Remote storage

IoT devices generate a massive amount of data that needs a vast storage space and high processing speed. In this context, Cloud Computing brings all these advantages and become an integral part of IoT.

Data mobility

Data mobility is very important for IoT projects requiring real-time management of connected devices. With Cloud Computing, all data can be accessed anywhere in the world without any infrastructural or networking constraints.

Inter-device communication

Cloud Computing facilitates communication between IoT devices by proposing robust Application Programming Interface (APIs). These APIs help make the linking between connected devices and pave the growth of connected technologies.

Security measures

Cloud Computing offers many features to address the security gaps in IoT. A strong security measures are offered to protect data and the connected devices. Examples of these security measures include authentication, device identity verification and encryption protocols.

Processing capabilities

IoT Cloud integration provides unlimited virtual processing capabilities and helps analyze data with advanced AI services for data-driven decision making and improvements.

4.2.4. What are the related standardization developments?[8]

The ISO/IEC JTC 1 established the sub-committee ISO/IEC JTC 1/SC 41 "Internet of Things and Digital Twin" in 2017, which focuses on IoT and Digital Twin technical standardization.

Scope

ISO/IEC JTC 1/SC 41 is responsible for standardization in the area of Internet of Things and Digital Twin, including their related technologies. ISO/IEC JTC 1/SC 41:

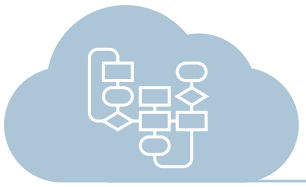
- Serves as the focus and proponent for JTC 1's standardization programme on the Internet of Things and Digital Twin, including their related technologies.
- Provides guidance to JTC 1, IEC, ISO and other entities developing Internet of Things and Digital Twin related applications.

Standards related to IoT

A few examples of standards that support IoT developments and take into consideration Cloud Computing concepts are presented below:

Standards related to IoT	ISO/IEC TR 22417:2017, Information technology - Internet of things (IoT) - IoT use cases ISO/IEC 30141:2018, Internet of Things (IoT) - Reference architecture ISO/IEC TR 30164:2020, Internet of things (IoT) - Edge computing ISO/IEC 30161-1:2020, Internet of Things (IoT) - Requirements of IoT data exchange platform for various IoT services ISO/IEC 30165:2021, Internet of things (IoT) - Real-time IoT framework

[8] More information on technical standardization in the IoT domain is available in the ILNAS National Technical Standardization Report on the IoT (June 2020)



4.3. Cloud and software engineering

4.3.1. What is software engineering?

ISO/IEC 2382:2015 defines software engineering as a "systematic application of scientific and technological knowledge, methods, and experience to the design, implementation, testing, and documentation of software". Another definition was proposed by ISO/IEC TR 19759:2015, where software engineering is defined as an "application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software; that is, the application of engineering to software".

4.3.2. What is the importance of software engineering?

The importance of software engineering continues to increase with the uptake of ICT in all market sectors, as specific software is needed in almost every business, every industry, and for every function. A small technical problem at the level of an application can cause the immediate stoppage of the functionalities of a given entity or organization.

Businesses around the world use software for many reasons and derive many benefits from it. Furthermore, it is used in everyday services, such as transportation, construction, and power grids.

4.3.3. How can Cloud support software engineering?

Monitoring applications

Cloud helps developers to easily monitor all the applications and the operations that they use. This aids to analyze application performance and identify related issues before submitting the project to the end user.

Advanced services

Cloud Computing allows developers to use advanced services that help them to focus on the core of their businesses instead of managing the underlying infrastructure. Microservices and scaling service containers represent one of the most services used by developers nowadays.

Geographic reach

Cloud allows users to host applications in servers over the world instead of relying on single server to host software.

Website management

Cloud offers the ability to manage Domain Name System (DNS), web services and web hosting.

Database services

Cloud providers offer a scalable database and high performed services like SSD for fast access to data, data redundancy and so on.

Team integration

The Cloud facilitates the exchange of information between DevOps teams by enabling comprehensive sharing of data across sectors, helping teams in their work.

4.3.4. What are the related standardization developments?

The ISO/IEC JTC 1 established the sub-committee ISO/IEC JTC 1/SC 7 "Software and systems engineering" in 1987, which focuses on technical standardization in the field of Software and systems engineering.

Scope

Standardization of processes, supporting tools and supporting technologies for the engineering of software products and systems.

Note: The processes, tools and technologies are within the scope of JTC 1 terms of references and exclude specific tools and technologies that have been assigned by JTC 1 to other of its SC's.

Standards related to software engineering

A few examples of standards that support software engineering developments and take into consideration Cloud Computing concepts are presented below:

Standards related to software engineering	ISO/IEC TS 25052-1 *(Project)*, Systems and software engineering - Systems and software Quality Requirements and Evaluation (SQuaRE): cloud services - Part 1: Quality model ISO/IEC TR 24586-series *(Project)*, Software and systems engineering - Agile and DevOps principles and practices ISO/IEC TR 29110-5-5 *(Project)*, Systems and software engineering - Lifecycle profiles for Very Small Entities (VSEs) - Part 5-5: DevOps guidelines ISO/IEC/IEEE 32675 *(Project)*, Information technology - DevOps - Building reliable and secure systems including application build, package and deployment

5. Standardization opportunities in Luxembourg

A proper understanding of the stakes associated with ICT standardization is key to adopting the appropriate position across the standardization landscape and benefit from all the related opportunities. In this frame, ILNAS aims at facilitating the appropriation of technical standards by the national stakeholders and their participation in the standardization process, for the benefit of the national economy.

5.1. How to access ICT standards?

The application and uptake of ICT standards is a key opportunity that the market can take advantage of. In order to encourage this, ILNAS allows the consultation of published standards for free and their purchase for further use.

The ILNAS e-Shop is a catalog of more than 200,000 normative documents. It offers the possibility to purchase national (ILNAS and DIN), European (CEN, CENELEC and ETSI) and international (ISO and IEC) standards in electronic format at competitive prices.

In addition, ILNAS offers the possibility to consult its entire standards' catalog free of charge through dedicated reading stations located in different places in Luxembourg. This service allows, for example, interested organizations or individuals to consult a standard before its purchase on the ILNAS e-Shop.

5.2. Who can participate in standards development in Luxembourg?

ILNAS, with the support of ANEC GIE, encourages companies, institutions, researchers, etc. to participate in the ICT standardization ecosystem. For the technical committees of ISO, IEC (such as ISO/IEC JTC 1/SC 38 "Cloud Computing and Distributed Platforms"), CEN and CENELEC, any interested stakeholder can get involved through ILNAS by becoming an active national standardization delegate free-of-charge. Interested experts can easily request to ILNAS their registration using a dedicated form.

More information about Cloud Computing committees are available on the Portail-qualité.lu.

5.3. Good reasons to participate in standards development

- Access drafts standards and influence their content based on your know-how;
- Increase your knowledge regarding the state of the art in standardization of your core business;
- Propose new standards projects;
- Anticipate the evolution of your activity sector's good practices;
- Integrate strategic network of national, European or international experts;
- Collaborate to defend common interests;
- Learn about your competitors and their positions in meetings;
- Promote your organization and your skills at national, European and international levels.

Please fill out the satisfaction survey:

https://gd.lu/4zzfKg

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