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D3.3 Report on Accessibility Standards and Legislation

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Deliverable	Deliverable (No. 13) D 3.3 Report on Accessibility Standards and Legislation
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Abstract	This deliverable is about accessibility related standards and legislation. It covers the state-of-the-art of legislation (especially where referring to standards), existing formal and informal standards and ongoing standardisation activities, as well as of pertinent (preferably standards-based) certification schemes. It provides information on efforts to coordinate standardisation activities falling under the scope of this project. The investigation extends towards harmonised or non-harmonised use of controlled (written or oral) communication across platforms, including non-linguistic forms of communication (icons, cartoons, etc.) and potential communication barriers to certain user groups. Project partners requests for specific information on the above are provided and summarized in D3.3. Latest developments about legal issues (e.g. copyright) regarding non-linguistic forms of communication content are outlined. The results of T3.3 are summarized in the final TRIPS recommendations.
Key Words	Standards and legislation; formal and informal standards; accessibility related standards and certification; legal issues with content repositories; controlled communication; non-linguistic forms of communication

Revision History

Version	Date	Author(s)	Reviewer(s)	Notes
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0.9	31 July 2020		TUE (Elvia Vasconcelos, Kristina Andersen)	Annotated review
1.0	31 July 2020	Christian Galinski (AAATE)		Final

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Executive Summary

This document comprises the summary of activities undertaken to investigate:

- The relation between legislation and standardization
- The nature of standards in relation to other authoritative documents and best practice
- Formal (de jure) standards and industry standards to be taken as "default" by the TRIPS project
- The state-of-the-art of standardization focusing on accessibility aspects (including findings of previous EU projects)
- New standardization activities under the perspective of the identified digital technology trends in relation to inclusive urban mobility
- Existing or potential gaps within and across fields of standardization

Key concepts in standardization in the various fields of accessibility are interoperability, reuse and re-purposability referring to technology as well as communication content.

The purpose of the author is to make this a living document, to be updated and used in the full course of the project. This document will also summarize, when appropriate, the results of investigations due to particular requests of project partners.

Chapter 1 outlines the issues addressed in D3.3.

Chapter 2 introduces the relations between standardization and legislation as well as formal and informal standards, as background information for the TRIPS consortium members.

Chapter 3 outlines the fundamental Internet and WWW related standards which inevitably must be taken as "default" in the TRIPS project.

Chapter 4 provides an overview on standards and standardization activities related to accessibility, which are so fundamental that their results have to be taken as "default" for TRIPS.

Chapter 5 introduces current standardization efforts related to accessibility and Assistive Technologies (AT).

Chapter 6 analyses the situation with respects to standards related to accessibility in connection with urban public transport falling within the scope of the TRIPS project.

Chapter 7 identifies gaps in standardization where TRIPS could formulate recommendations and the most suitable technical committee to address concerns or requests.

Chapter 8 summarizes the conclusions to be drawn from the deliverable and formulates recommendations.

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List of acronyms/abbreviations

Abbreviation	Explanation
3GPP	3rd Generation Partnership Project
AAATE/SIG S13N	Special Interest Group "Standardization" of the AAATE (Association for the Advancement of Assistive Technology in Europe)
AAC	Alternative and Augmentative Communication
AI	Artificial Intelligence
ANSI	American National Standards Institute
AAL	Active Assisted Living
ALLEA	All European Academies
AR	Augmented Reality
AT	assistive technology / assistive technologies
ATAG	Authoring Tool Accessibility Guidelines
CEN	European Committee for Standardization
CLC or CENELEC	European Committee for Electrotechnical Standardization

Abbreviation	Explanation
content IOp	content interoperability
CRPD	(United Nations) Convention of the Rights of People with Disabilities
CWA	CEN Workshop Agreement
DfA	Design for all
DOI	Digital object identifier
EAA	European Accessibility Act
EC	European Commission
EDF	European Disability Forum
EDS	European Disability Strategy
EEA	European Economic Area
EFTA	European Free Trade Association
EN	European Standard
EP	European Parliament
ESS	European Standardization System
ESOs	European Standards Organizations
ETSI	European Telecommunications Standards
FAIR	Findable, Accessible, Interoperable, Re-usable
GDPR	General Data Protection Regulation
HTML	HyperText Markup Language
HTTP	Hypertext Transfer Protocol
ICCPR	International Covenant on Civil and Political Rights
ICT	Information and Communications Technologies
IEC	International Electrotechnical Commission
IEEE SA	Institute of Electrical and Electronics Engineers Standards Association
IETF	Internet Engineering Task Force
IN LIFE	INdependent LIving support Functions for the Elderly (EU project)
IP	Internet protocol

Abbreviation	Explanation
IOp	Interoperability
IoT	Internet of Things
ISO	International Organization for Standardization
ITR	International Telecommunication Regulations (ITU)
ITU	International Telecommunication Union
ITU-T	International Telecommunication Union, Telecommunication standardization sector
ITS	Intelligent Transport System
LSP	Language service provider
Maas	Mobility as a service
NLP	Natural language processing
NSO	National standards organization
NUI	Natural user interface
OA	Open access
OASIS	Organization for Advancing open standards for the information society
OJ	Official Journal (of the EU)
OMG	Object Management Group
OPC Foundation	Object Linking and Embedding for Process Control Foundation
OWL	Web Ontology Language
PDF	Portable document format
PwD	Person with disabilities
QA	Quality assurance
RDF	Resource Description Framework
RFC	Request for Comments
RPIS	EU Rolling Plan for ICT standardization
SDO	Standards developing organization
SAG	Strategic Advisory Group

Abbreviation	Explanation
SLA	Service level agreement
SoA	Service-oriented architecture
SOAP	Simple Object Access Protocol
TBT	Technical Barriers to Trade
TFEU	Treaty on the Functioning of the European Union
TSP	Transport service providers
UA	Universal Accessibility
UCUM	Unified Code for Units of Measure
UDHR	Universal Declaration of Human Rights
UN	United Nations Centre for Trade Facilitation and Electronic Business
UN CEFACT	United Nations
URI	Uniform Resource Identifier
WAI	Web Accessibility Initiative
W3C	World Wide Web Consortium
WCAG	Web Content Accessibility Guidelines
WP	Work Package
WSC	World Standards Cooperation
WTO	World Trade Organization
W3C	World Wide Web (WWW) Consortium
WWW	World Wide Web
XML	eXtensible Markup Language

Glossary of terms

Term	Explanation
accessibility	The degree to which a product, device, service, or environment (virtual or real) is available to as many people as possible [SOURCE: ITU-T F.791:2015-11, 3.2]
accessibility content	The accessibility of the content delivered by an audiovisual media solution, i.e., captions, subtitles, audio description, audio subtitles, etc., and differentiated from the solution's interface accessibility Access services are a primary means of delivering content so that it will be accessible to PWDs as well as persons with specific needs. [SOURCE: ITU-T F.791:2015-11, 3.3]
assistive technology; assistive technologies; AT	Field of technologies comprising assistive, adaptive, and rehabilitative devices for people with disabilities or the elderly population who have disabilities making it difficult to perform activities of daily living (ADLs) independently, or even with assistance NOTE 1: AT promotes greater independence by enabling people to perform tasks they were formerly unable to accomplish, or had great difficulty accomplishing, by providing enhancements to, or changing methods of interacting with, the technology needed to accomplish such tasks. Due to AT, people with disabilities have an opportunity of a more positive and easygoing lifestyle, with an increase in "social participation," "security and control," and a greater chance to "reduce institutional costs without significantly increasing household expenses". [SOURCE: https://www.tandfonline.com/doi/abs/10.1080/17483107.2016.1218555?journalCode=iidt20] NOTE 2: ADLs are self-care activities that include toileting, mobility (ambulation), eating, bathing, dressing, grooming, and personal device care. Assistive technology can ameliorate the effects of disabilities that limit the ability to perform ADLs. NOTE 3: In the framework of TRIPS, AT can also be of help in cases of health conditions which usually would not be subsumed under disabilities.
accessibility barrier; barrier	Anything that interacts with that impairment in a way that may hinder the person's full and effective participation in society on an equal basis [SOURCE: Accessibility for Manitobans Act, Canada: https://web2.gov.mb.ca/bills/40-2/b026e.php] Anything that prevents a person with a disability from fully participating in all aspects of society because of his or her disability, including a physical barrier, an architectural barrier, an information or communications barrier, an attitudinal barrier, a technological barrier, a policy or a practice; ("obstacle") [SOURCE: Accessibility for Ontarians with Disability Act, Canada https://www.ontario.ca/laws/statute/05a11] NOTE: For eliminating and preventing accessibility barriers it is necessary first to identify them and then to design reasonable plans consistent with their resources to remove these barriers and to prevent new ones from being created, all within reasonable timelines. [SOURCE: https://en.wikipedia.org/wiki/Accessibility_for_Ontarians_with_Disabilities_Act,_2005#Ontarians_with_Disabilities_Act]

Term	Explanation
disability	Disability is an evolving concept that results from the interaction between persons with impairments and attitudinal and environmental barriers that hinders their full and effective participation in society on an equal basis with others. [UN Convention on the Rights of Persons with Disabilities. Preamble letter e). 2006.]
eAccessibility; electronic accessibility	Refers to the ease of use of information and communication technologies (ICTs), such as the Internet, by people with disability [SOURCE: https://www.who.int/news-room/q-a-detail/what-is-e-accessibility]
eInclusion	Refers to the situation where everyone in society can participate in the information society NOTE: This requires affordable access to technologies, the accessibility and usability of ICT tools and services, and the ability and skills of all individuals to use these tools. [SOURCE: https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:E-inclusion]
interface accessibility	The accessibility of the set of provisions that allow a user to operate and control audiovisual media solutions. [SOURCE: ITU-T F.791:2015-11, 3.19]
metadata	Data that describes other data e.g. a written document might contain information (metadata) such as author, file size, the date the document was created, and keywords to describe the document
mobility service	Public or private means of transport that is suitable for transporting people individually or collectively. The system view also includes the systems and components required for booking, operation, use, payment and complaints.
personal data	Any data relating to an identified or identifiable natural person ('data subject'); whereby an identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person. [SOURCE: European Parliament and the Council of the European Union, Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data and repealing Directive 95/46/EC (General Data Protection Regulation)]; [SOURCE: OJ L, 4 May 2016, pp. 1-88, Art. 4(1)]
sensitive personal data	Categories of "sensitive" data: racial or ethnic origin; political opinions; religious or philosophical beliefs; trade union membership; data concerning health or sex life and sexual orientation; genetic data; and biometric data [SOURCE: OJ L, 4 May 2016, pp. 1-88, Art. 9(1)]
service-oriented architecture	SoA, software architecture consisting of coupled services. The most common SOAs in use today are Web services (using SOAP, UDDI, and WSDL), CORBA and DCOM [SOURCE: ISO 19132:2007]

1. Introduction

Standardization is defined as the "activity of establishing, with regard to actual or potential problems, provisions for common and repeated use, aimed at the achievement of the optimum degree of order in a given context"(ISO Guide 2, 2004[1], clause 1.1). Standard is defined (ibidem, clause 3.2) as "document, established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results…" as aimed at by standardization. ***Therefore, not following standards can be seriously harmful to results in R&D or technical development***.

This deliverable is part of the four WP3 deliverables providing state of the art information on different knowledge domains relevant for the TRIPS project. Relevance for the TRIPS project can be demonstrated by having an impact on other deliverables and activity results of TRIPS and being incorporated into the recommendations geared towards transport service providers (TSPs).

D13 is primarily based on new material and data from EU sources, together with national sources from several parts of the world. It partly refers to and builds further on results of previous EU projects highlighting aspects of accessibility relevant for mobility and mobility services. The results are therefore updated and geared to the scope and needs of TRIPS. As there are enormous differences in the degree of acceptance of standards in various scientific and technical communities, D13 starts with explaining standardization in relation to legislation, the role and nature of standards and the complexity of the standardization system at international, European and national levels. This also includes the description of the complex interconnection of international policies and agreements (such as the Convention on the Rights of Persons with Disabilities – CRPD) and European policies, legislation and standardisation (including standardisation policies as manifested in the European Mandates or standardisation requests – see section 1.7).

Deliverable D13 is of particular importance since the European Disability Forum (EDF 2019) rightfully states in chapter VI: *Harmonized standards and technical specifications of products and services*:

> *"European harmonised standards, meaning those referred to in the Official Journal of the EU for the purpose of proving compliance with EU harmonised legislation such as this Directive, will be a way for economic operators to meet the accessibility requirements in Annexes of the Act.*
>
> *It is generally positive that the European Commission can adopt implementing acts[2] establishing technical specifications under certain conditions. Those conditions are, for example, related to unnecessary delays with developing the relevant harmonised standards or if there is a technical specification that already fulfils the requirements of the Accessibility Act (Article 15.2 – 15.3). These conditions are very important because in practice, Disabled Persons' Organisations are often excluded from the standardisation processes, which are dominated by industry."*

[1] ISO/IEC Guide 2:2004 Standardization and related activities - General vocabulary

[2] Implementing acts are established via the Comitology procedure. Stakeholders can give feedback but are not actively involved.

1.1 Methodology

The methodology of D13 followed two phases of desk research:

1. Selecting and updating results of past EU-projects, such as
   - ASK-IT – Ambient intelligence system of agents for knowledge-based and integrated services for mobility impaired users; Oct 2004~September 2008, Grant agreement ID: 511298
   - IN-SAFETY – INfrastructure and SAFETY; December 2004~December 2007, Grant agreement ID: 506716
   - OASIS – Open Architecture for Accessible Services Integration and Standardisation; January 2008~December 2011, Grant agreement ID: 215754
   - IN LIFE – INdependent LIving support Functions for the Elderly; February 2015~January 2018, Grant agreement ID: 643442

   These projects were all highly coordinated with other pertinent project activities taking place at that time.
2. Investigation of latest developments in standardization, from a strategic-political viewpoint (top-down) as well as from the development of standardization activities viewpoint (bottom-up).

PHASE 1 not only covered the revisiting of a selection of information and results of past EU-projects, but also their re-evaluation and updating, together with contextualising the information with the TRIPS objectives. The investigation extended towards those related projects as well as to new projects and developments. This necessitated looking into new materials and websites, some of which are not accessible without special access rights. The information was updated to reflect the state-of-the-art of the development under the scope of this Deliverable. Phase 1 also revisited gaps in standardization as identified in past projects and how they were filled or continued to exist.

PHASE 2 investigations focused on latest developments of standardization in the fields of accessibility and assistive technologies (AT) as well as in major application fields as identified by WP 3. As standardization as a whole is fast developing in line with industrial development, standardization activities at committee level is very dynamic. Standards today are developed according to prescribed timeframes averaging 24~36 months. Thereafter, each standard is subjected to a systematic review every five years at international level which results in a confirmation, decision for revision or withdrawal of the standard. Phase 2 identified a great number of new standards and standardization activities at international as well as EU level – proving the dynamic nature of the standardization process.

PHASE 3 focused on evaluating the results of the investigations so far and condensing them into aspects and considerations of relevance for TRIPS. The investigations showed that some gaps have already been taken up by the management of standardization organizations and also at political level. A few others are lagging behind, while new gaps emerged. This resulted in considerations, which could be useful to follow in TRIPS, relevant also to decision makers at policy level and to urban public service systems.

1.2 Introduction to standards, policies and legislation

This introductory part summarizes fundamental facts about the highly complex field of standardization, specifically:

- The relation between a) legislation and law and b) standardization and standards
- The relation among standards developing organizations (SDO) at international, regional (here focus on the EU) and national levels
- The EU policies concerning accessibility and accessibility related standards in general and then focusing on pertinent policies in the field of transport

TRIPS D11 identified 12 Technological domains and 11 major Application areas. Figure 1 shows the complex relations between the Technological domains each with one or more Application areas. The same applies to the Application areas each with relation to two or more Technological domains. Although only technologies emerge in the figure it is important to understand that behind each of these technologies there are users that might look for information, have to use devices, need to talk to other people, such as personnel of all kind of transport service providers (TSP), etc.

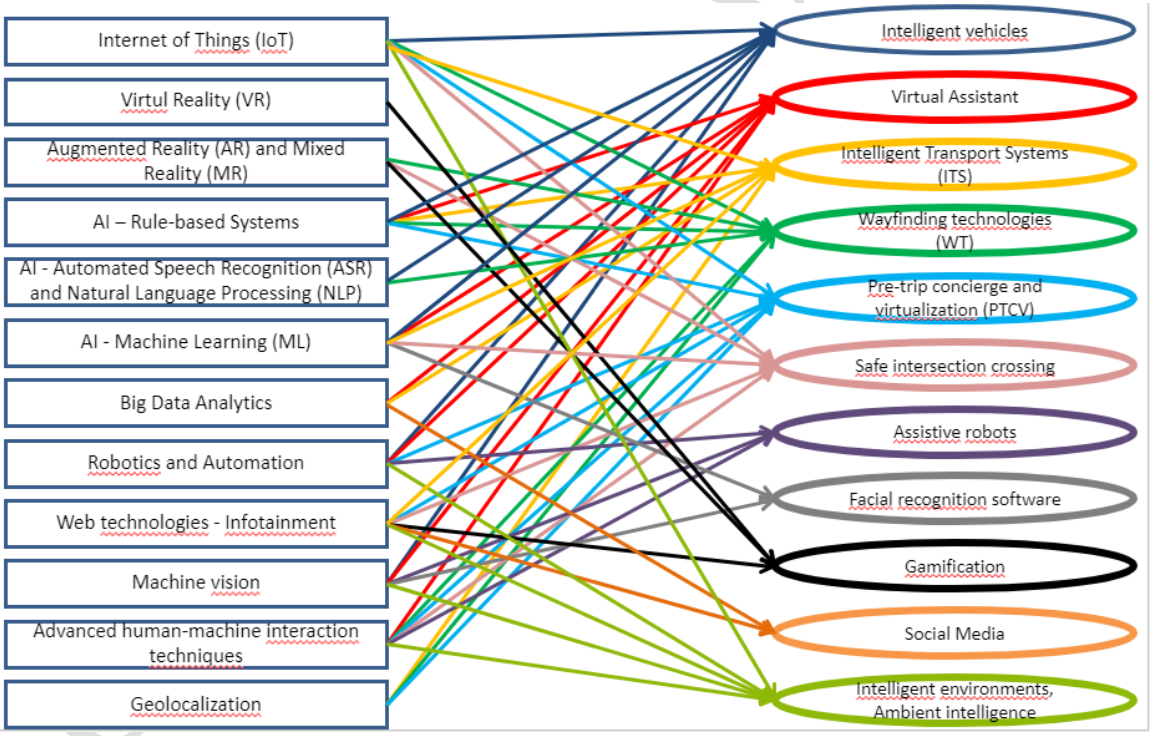


Figure 1: Relations between technological domains and major application areas

Figure 2 indicates two main levels of viewpoints when looking for policies and regulations of relevance to this picture: a policy-strategic level (top-down view) and operational level (bottom-up view). The top-down view – upper right box – is dealt with here in Chapter 1 and covers broad fields of standardisation based on the EU Rolling Plan for ICT Standardisation (RPIS) 2020 and Internet related technology standards. The bottom-up view – lower right box – is dealt with in Chapter 2 as a whole. Standards related to applications related technologies (systems, tools, devices, services) are dealt with in Sections 2.1 to 2.4. Those related to user interfaces and content are explored in Chapter 3 of this deliverable. In the lower box in the

middle, the important aspect of interhuman communication and information content exchange is added.

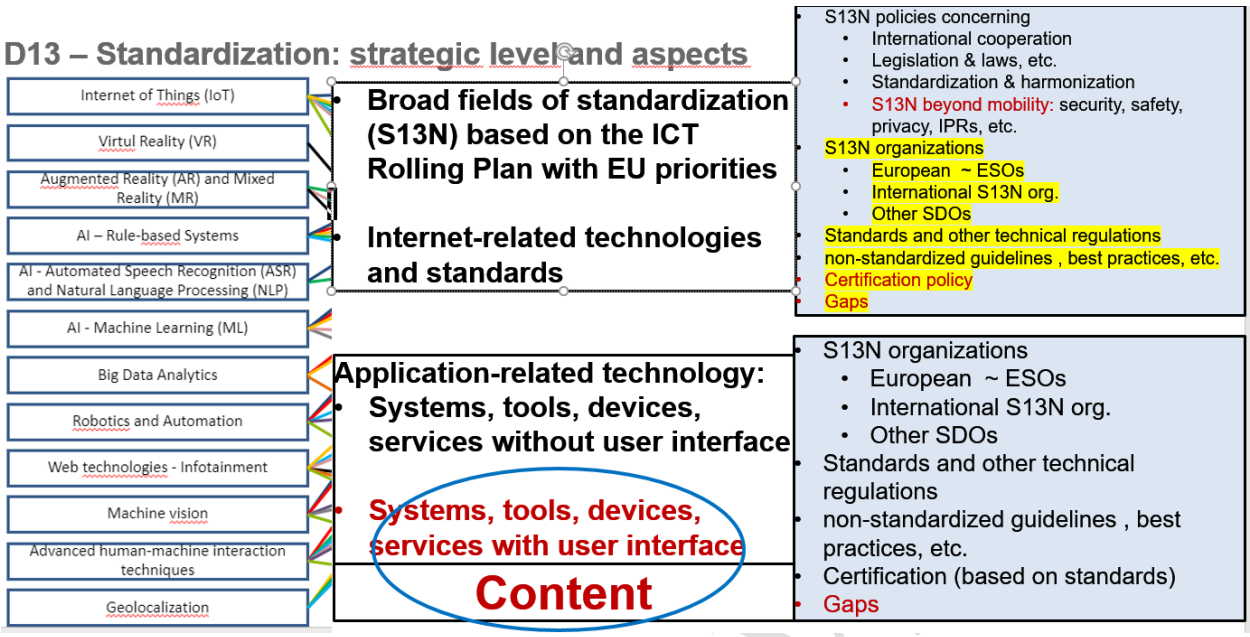


Figure 2: Sources of relevance to the strategic level and to the operational level

Sources identified under the view of the policy-strategic level cover standardization policies, broad harmonization activities, broader views across all accessibility issues, etc. Sources identified under the operational view refer to individual applications and systems as well as tools and devices which mostly rely on "content" for different modes of communication and information access and exchange.

Increasingly "interoperability" is a key issue for larger system environments at policy-strategic level. In this connection, one must know "The accessibility of the content delivered /should be/ differentiated from the solution's interface accessibility"[3]. The same source states "An accessible interface does not automatically imply content accessibility." This largely underestimated aspect is dealt with in Chapter 3 of this deliverable.

1.3 European union law and international law referring to accessibility

The European Union is based on the rule of law which means that every action taken by the EU is founded:

a) on the treaties known in the EU as primary law, i.e. the "Treaty on the Functioning of the EU" (TFEU) (OJ C 326/47)
b) on a body of secondary law that comes from the principles and objectives of the treaties. Secondary law includes regulations, directives, decisions, recommendations, and opinions.

According to Article 288 of the TFEU regulations, directives and decisions are binding acts, recommendations and opinions are not legally binding upon those to whom they are

[3] ITU-T F.791:2015-11 Accessibility terms and definitions: Series F: Non-telephone telecommunication services. Audiovisual services

addressed[4]. In any case***, if standards are referred to in secondary law, they become part of the law***.

Legislative acts are adopted following one of the legislative procedures set out in the EU treaties (ordinary or special). Non-legislative acts do not follow these procedures and can be adopted by EU institutions according to specific rules. In all this, the EU can pass laws only in those areas where its members have authorised it to do so, via the EU treaties. Given this complex system, the number and volumes of EU legal instruments are difficult to calculate or estimate – not to mention changes over time among others due to structural reforms. EU legal instruments reached a peak of over 14,000 in the early 1980s and there was a lower peak in the mid-1990s. In 2010 it stood at around 10,300. (House of Commons – Library, 2010). There are different estimates when translating these figures into number of pages ranging from 80.000 pages (EU Commission) to 170.000 pages (and even to more than 500.000 pages) (Cudd et al, 2018).

Similarly, it is difficult to estimate the proportion of national law based on EU law, as "*some EC measures are directly applicable in the member states. Others require incorporation into national law. This is sometimes done by legislation, but on other occasions by administrative means. In yet other situations, domestic legislation which is being amended for other purposes, may also incorporate changes to reflect EU directives*" (Miller, 2010). Thus, at least for some areas of society or fields of economy the influence of EU law on national law is estimated in some countries of passing the 80% threshold. In others, it is less than 10% – however, the implementation rate may also largely differ depending on the policy area in a country.

There is another reason, why it is difficult to estimate the number and volume of EU legal instruments: there are international legal instruments to which the EU acceded as regional organization in addition to each of its member states. International law – here referring to public international law also known as law of nations – Is the set of rules, norms, and standards generally accepted in relations between nations. Of high relevance to TRIPS are those international legal instruments that are originally based on or derived from the International human rights instruments[5] of the United Nations (UN), such as the Convention on the Rights of Persons with Disabilities[6] (CRPD) intended to protect the rights and dignity of persons with disabilities (UN CRPD, 2006).

In 2019 the European Accessibility Act (EAA – Directive (EU) 2019/882) became law reflecting the obligations of the CRPD and complementing the web accessibility Directive (EU) 2016/2102 of the same year. The EAA aims to improve the trade between members of the EU for accessible products and services, by removing country specific rules, thus benefitting a) persons with disabilities and elderly people with more accessible products and services in the market at more competitive prices, and b) businesses with a greater market for accessible products and services. The laws, regulations and administrative provisions necessary to

[4] http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=uriserv:ai0032

[5] https://en.wikipedia.org/wiki/International_human_rights_instruments

[6] Parties to the CRPD are required to promote, protect, and ensure the full enjoyment of human rights by persons with disabilities and ensure that they enjoy full equality under the law. CRPD has an impact on legislative regulations and standardization activities.
https://www.un.org/disabilities/documents/convention/convoptprot-e.pdf

comply with this Directive have to be adopted and published by the Member States by 28 June 2022.

The UN further recognized the importance of freedom of movement in documents, such as the Universal Declaration of Human Rights (UDHR, 1948) and the International Covenant on Civil and Political Rights (ICCPR, 1966). The EU further specified these rights in the TFEU and freedom of movement Directive 2004/38/EC through which residents are guaranteed the right to freely move within the EU's internal borders. In these laws, transport is a key issue. Governed by Title VI (Articles 90 to 100) of the TFEU, "transport" is one of the EU's most strategic common policies. It aims to ensure the smooth, efficient, safe, and free movement of people and goods throughout the EU by means of integrated networks using all modes of transport (road, rail, water and air). Under this policy numerous directives and regulations deal with various aspects of transport, also covering issues as wide-ranging as climate change, passenger rights, clean fuels, and cutting customs-related red tape at ports.

Key takeaway[7]:

- ***There are legal norms at international (e.g. in the form of international treaties or conventions), regional (for instance in the European Union) and national level – sometimes also at provincial or state level***
- ***Some international treaties or conventions oblige signatories (state or a regional organisations, such as the EU) to incorporate the respective rules into their legal system***
- ***Technical standards can become part of a legal norm, if they are referred to in the respective law or other legal regulation***

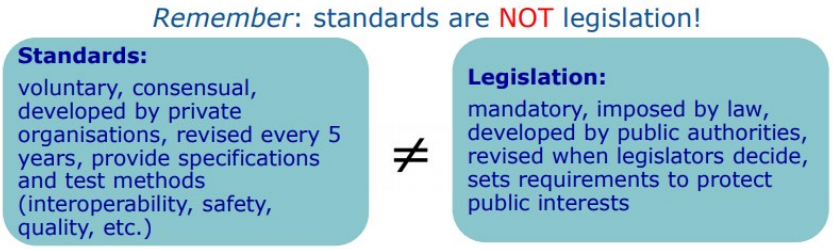
Besides the relation between legislation and standardization, the EU (and many national governments) regards standards as tools to support policies. From the perspective of the EU[8]:

- European standards (ENs) support the functioning of the Single Market, because
  - One EN replaces 34 different national standards
  - National Standardization Bodies are obliged to adopt ENs as national standards and withdraw conflicting ones
- Standards' references, if referred to in legal text, are published in the respective legal act
- Harmonized standards confer presumption of conformity

This has been applicable to EU policies concerning accessibility in general and under the viewpoint of different aspects or sectors of society and industry – keeping a clear distinction between standards and legal acts:

[7] All key takeaways will be summarized in a systematic way in chapter 5

[8] EU Standardisation Policy https://www.digitalsme.eu/digital/uploads/2-AC-Turin-4-July-2019.pdf



(Conte, 2019)

Figure 3: The fundamental difference between standardization and legislation

1.4 The nature of standards and standardization in general

Everybody is aware of the obligation to abide by law or other legal regulations. Legal norms issued by the state (or other kind of legal) authority are generally binding rules of conduct:

- which are intended for the regulation of social relations
- which determine the rights and duties of the subjects of legal relations
- whose abidance is guaranteed by the state coercion

Technical standards identify the state-of-the-art of scientific, technical or methodological development. Only if they are referred to in a law or other legal regulation, they can become part of the respective legal instrument.

Whereas legal norms are issued by state authority (or other legal body), "technical standards" are issued by formal standardizing bodies or other kinds of standards developing organization (SDO) at international, regional or national level similar to the legal system. In some countries such standardizing body is a national authority. In European countries all standardizing bodies are operating formally in the private sector – usually based on a national law referring to technical standardization.

Usually people are not aware that technical standards are governing our lives as much as law does, and although standards are of a different nature than legal norms, they are also complementary. The legal acts of an advanced administration may well amount to more than 20,000[9]. By comparison, probably about 70~80,000 technical standards (including adopted international, regional and possibly other national standards) are applied in individual countries in Europe. For instance, the total body of standards and other deliverables available through DIN (German Institute of Standardization) is around 35,000 of which only 15% are of national nature. The share of the latter has been shrinking continuously over the years, while the total number of international and European standards approved as German standards is increasing steadily.

In some countries the total page volume of standards documents exceeds that of legislation. Depending on the size of a country, its legal and technical regulations system, and the degree of development of its administration, the number of legal acts may be outnumbered by standards by 2 to 5 times. At international and regional level that ratio may even be much higher. But this ratio – which anyhow cannot easily be quantified – is only one of the indicators of the importance of standards in relation to law.

[9] According to the figures from the French legislative database, Legifrance, on 1 July 2008, 26,777 national laws, orders and decrees were in force in France

Another common misconception is about the nature of "technical standards". Although the main purpose of standardization activities is to develop standards, there are different kinds of documents falling under this term which range from the standards of formal standardizing bodies (including basic standards, publicly available specifications, technical reports, codes of practice, etc.) via more or less normative guidelines, recommendations to best practices of all kinds of SDOs, some of which are considered as quasi-standards. Besides, in addition to the historical technical standards only referring to "hardware", later also "software" (in the traditional sense) there are several distinct types of standards in different fields of standardization (viz. "vertical standards") today:

- Methodology standards (probably already comprising more than 50% of all standards)
- Terminology standards (or a part on terms and definitions in subject standards),
- Product/process/service standards
- Interface standards
- Testing standards
- Standardized coding systems
- Data standards

Many existing standards are a mixture of the above. This also applies to a certain number of "horizontal standards" which impact several or all fields of standardization. In the mid-1990s methodology standards outnumbered all other kinds of technical standards – lately, data standards (including standardized data of all sorts and the respective metadata) are on the rise.

Non-legal high-level guidelines or regulatory or non-regulatory documents can also become highly authoritative, although from a formal viewpoint they are neither legal instruments nor standards. ***For TRIPS this could apply to local or regional guidelines on accessible public urban transport.***

Engineers and other technical experts consider standardization as the basis of efficiency, effectiveness and innovation in industry and trade. ETSI[10] states:

"Standards provide

- ***Safety and reliability*** *– Adherence to standards helps ensure safety, reliability and environmental care. As a result, users perceive standardized products and services as more dependable – this in turn raises user confidence, increasing sales and the take-up of new technologies.*
- ***Support of government policies and legislation*** *– Standards are frequently referenced by regulators and legislators for protecting user and business interests, and to support government policies. Standards play a central role in the European Union's policy for a Single Market.*
- ***Interoperability***[11] *– the ability of devices to work together relies on products and services complying with standards.*
- ***Business benefits*** *– standardization provides a solid foundation upon which to develop new technologies and to enhance existing practices. Specifically, standards:*
  - *Open up market access;*
  - *Provide economies of scale;*

[10] European Telecommunications Standards Institute https://www.etsi.org/standards/why-standards

[11] *Interoperability* in the ETSI quote is obviously used in the narrow sense of *technical interoperability.*

- *Encourage innovation;*
- *Increase awareness of technical developments and initiatives.*

- ***Consumer choice** – standards provide the foundation for new features and options, thus contributing to the enhancement of our daily lives. Mass production based on standards provides a greater variety of accessible products to consumers.*

Consider what the world would be without standards:

- *Products might not work as expected;*
- *They may be of inferior quality;*
- *They may be incompatible with other equipment – in fact they may not even connect with them;*
- *In extreme cases, non-standardized products may be dangerous;*
- *Customers would be restricted to one manufacturer or supplier;*
- *Manufacturers would be obliged to invent their own individual solutions to even the simplest needs, with limited opportunity to compete with others."*

The ETSI conclusion *"Society needs standards"* is true in general (not only from the point of view of engineers and technicians). However, this is not widely recognized nor acknowledged in some scientific quarters and society at large. Particularly experts of humanities and social sciences often shun standardization, because they consider it adverse to their conceptions of creativity and freedom of research. Sadly, this also applies to many AT experts which results in not only self-exclusion, but also in the matter that ***"Disabled Persons' Organisations are often excluded from the standardisation processes, which are dominated by industry"*** (EDF, June 2019). The ideal of standardization is to include all major stakeholders of society: industry, academia, consumers and administration in any given standard development activity.

Key takeaway:

- ***Technical standards identify the state-of-the-art of scientific, technical or scientific-technical methodology development. They can refer to all aspects of technology, industry, society and economy. The scope of a standard can be as broad as that of a law, but usually a standard does not foresee sanctions for non-compliance***
- ***The ideal of standardization is to include all major stakeholders of society: industry, academia, consumers and administration in any given standard development activity. However, Disabled Persons' Organisations, PwD and AT experts so far are often excluded from the standardisation processes***
- ***If standards are developed considering accessibility principles, they can be useful tools in support of existing law. They can contribute to the design of better products and the saving of financial resources by integrating accessibility features into new products (and services) from the start so as to avoid significantly higher costs for retrofitting products in later stages of their life cycle***

1.5 Standardization organizations at international level

Besides the formal standardization bodies issuing formal standards (also called de jure standards) there are probably thousands other SDOs in all kinds of fields. Schneiderman (2015) ConsortiumInfor.org[12] lists 1120 (including some national standardization bodies), the vast

[12] https://www.consortiuminfo.org/links/#.Xrmwqmgzaun accessed 2020-05-10

majority of them based in the US, followed by Europe and then Asia. This list concentrates on high-tech industries with a strong focus on ICT – it does not cover agriculture, mining and other more traditional fields. "Intel participates in over 250 standards and industry groups worldwide including industry alliances, regional standards organizations, international industry standards groups and formal international standards bodies."[13]. The same applies to probably all other large ICT related companies. They often are not only active at expert level in technical committees but are also represented in the board of the respective organization or even running it. This shows the importance of standards for the industry.

For TRIPS the most important technical standards (and other deliverables) are first those of:

- the international standards organizations: ISO[14], IEC[15] and ITU[16]
- the European Standards Organisations (ESO – see 1.4): CEN[17], CENELEC[18] and ETSI

Second, those of a few other SDO of global outreach, such as W3C[19], IETF[20], IEEE SA[21] and OASIS[22]. The above-mentioned international standards organizations and the ESOs have agreed to mutually acknowledge their standards as formal international standards and to coordinate standardization activities in such a way that duplication of efforts can be avoided (see 1.4). Notwithstanding, any overview can only give a glimpse of the total picture, since:

- there are also international organizations (such as WHO, UNECE, etc.) developing standards or standards-like documents, some having international legal force
- there are also other regional standards organizations in other parts of the world
- there is quite some variety at national level with respect to formal standards organizations, other standards developing organizations (SDOs) and various legal forms of the national standards organizations (NSOs)
- there is a plethora of industry consortia and other SDOs in various fields of ICT industry

All these SDOs are competing on the one hand and are on the other, interconnected in various ways. In the field of ICT standardization there are hundreds of industry consortia claiming to be SDOs. In the EU-Project IN LIFE (Cudd et al, 2018) more than 250 such SDOs were identified which directly or indirectly have an impact on the development of ICT platforms for developing services linking health- and AT-related products and services. Some of them develop technical standards so powerful that they are just taken as given state-of-the-art without the possibility to adapt. In some cases, standards are adopted into the system of the formal international standardization organizations (or of the ESOs), such as ISO/IEC 40500:2012 *Information technology – W3C Web Content Accessibility Guidelines (WCAG) 2.0* which is based on the W3C standard WCAG 2.0 (also freely available at W3C under http://www.w3.org/TR/WCAG20/). The ESOs have already adopted the latest version WCAG 2.1 as EN 301 549 V2.1.2 (2018-08).

[13] https://www.intel.com/content/dam/www/public/us/en/documents/brief/standards-business-brief.pdf
[14] International Organization for Standardization https://www.iso.org/about-us.html
[15] International Electrotechnical Commission https://www.iec.ch/
[16] International Telecommunication Union https://www.itu.int/en/about/Pages/default.aspx
[17] European Committee for Standardization https://www.cen.eu/Pages/default.aspx
[18] European Committee for Electrotechnical Standardization https://www.cenelec.eu/
[19] World Wide Web Consortium http://www.w3.org/WAI/
[20] Internet Engineering Task Force https://www.ietf.org/
[21] Institute of Electrical and Electronics Engineers Standards Association http://standards.ieee.org/findstds/index.html
[22] Organization for Advancing open standards for the information society https://www.oasis-open.org/standards

On the basis of a number of international agreements – especially the Technical Barriers to Trade (TBT) Agreement – which are binding for its present 161 member countries, the World Trade Organization (WTO) aims to ensure that technical regulations, standards, and conformity assessment procedures are non-discriminatory and do not create unnecessary (sometimes also called 'hidden') obstacles to trade. At the same time, it recognises WTO members' right to implement measures to achieve legitimate policy objectives, such as the protection of human health and safety, or protection of the environment. The TBT Agreement strongly encourages members to base their measures on international standards as a means to facilitate trade. This gives International standards a strong authority with respect to the standards-conformance of goods and services. In order to be able to put this authority into effect, competing or contradicting standards and other regulations need harmonization.

For the purpose of harmonization of closely related standards, ISO and IEC were compelled to develop the two-part normative document:

- ISO/IEC Guide 21-1:2005 Regional or national adoption of International Standards and other International Deliverables – Part 1: Adoption of International Standards
- ISO/IEC Guide 21-2:2005 Regional or national adoption of International Standards and other International Deliverables – Part 2: Adoption of International Deliverables other than International Standards

In ISO/IEC Guide 21 detailed rules are laid down to identify whether adopted international standards (or other deliverables) are 'identical', 'modified' or 'not equivalent'. If they have been modified, it has to be clearly and in detail stated where in a given standards document and to which extent rules/provisions have been modified. ISO and IEC are also represented in the Committee on Technical Barriers to Trade (under the Council for Trade in Goods). Both are entrusted by WTO for monitoring the national and regional organizations agreeing to use their international standards as the basis for national or regional standards as part of the WTO's TBT Agreement.

1.6 The European Standardization System (ESS)

The ESS is a major stakeholder and driver in an intricate network of large SDOs at the strategic level and hundreds of technical committees at the operational level.

The ESS comprises three formal ESOs officially recognized by the European Commission: CEN, CENELEC and ETSI. Together they act as a European platform through which European Standards are developed in the interest of European harmonization, creating both standards requested by the market and harmonized standards in support of European legislation.

CEN and CENELEC are the regional (European) mirror bodies to their international counterparts, i.e. ISO and IEC respectively. The Vienna Agreement of 1991 between ISO and CEN and the Frankfurt Agreement of 2016 (based on and replacing the Dresden Agreement of 1991 amended 1996) between IEC and CENELEC, provide rules and procedures to enable for input, to avoid double work or to speed up standardization work. Thus, ISO and CEN, IEC and CENELEC recognize each other's standards as international standards and sometimes publish joint deliverables such as "ISO EN" or "IEC EN".

This is niftily outlined in the following graph of the EU Commission of 2019 showing the great complexity of the world's standardization system:

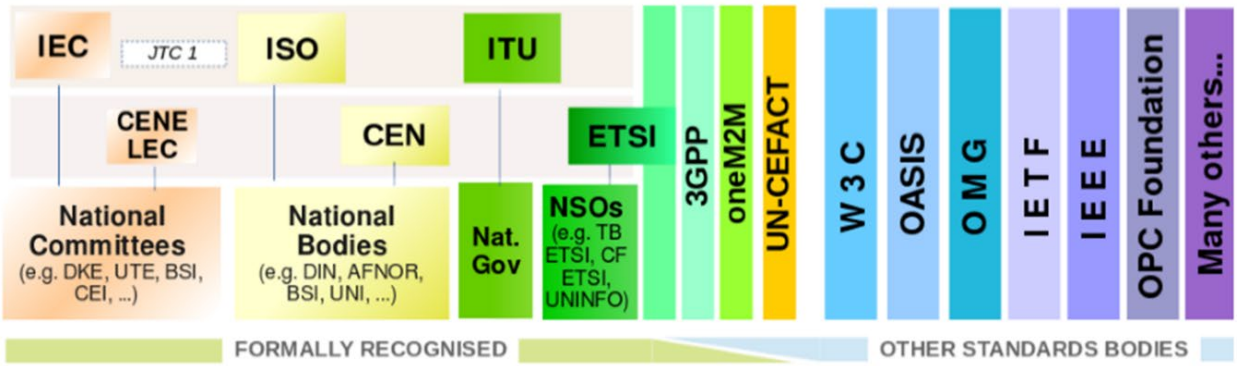


Figure 4: High-level Overview of the global standardization ecosystem *(Taken from Conte, 2019)*

Compared to the above, the relation between ETSI and ITU-T (the International Telecommunication Union, telecommunication standardization sector) differs insofar as the ITU-T is part of the ITU, which is a United Nations specialized agency, its standards carry more formal international weight than those of most other SDOs that publish technical specifications of a similar form. The ITU-T mission is to ensure the efficient and timely production of standards covering all fields of telecommunications on a worldwide basis, as well as defining tariff and accounting principles for international telecommunication services. In addition to the international standards that are produced by the ITU-T which are referred to as "Recommendations" and have non-mandatory status until they are adopted in national laws. ITU-T is also the custodian of a binding international treaty, the International Telecommunication Regulations (ITR).

CEN with its 31 National Members (being standardizing bodies) provides a platform for the development of voluntary European Standards and other specifications in various sectors (excluding electrotechnology and telecommunication) with the general aims to:

- remove trade barriers for European stakeholders such as industry, public administration, service providers, consumers and other stakeholders
- foster the European economy in global trading, the welfare of European citizens, and the environment
- build a European Internal Market for goods and services and to position Europe in the global economy

By supporting research, and helping disseminate innovation, standards are a powerful tool for economic growth. More than 60.000 technical experts as well as business federations, consumer and other societal interest organizations are involved in the CEN network that reaches over 480 million people. The number of 'living documents' (i.e. active standards) of CEN amounts to 15,733 (June 2015) (CEN/CLC 2015 Q2).

CENELEC with its members, the National Electrotechnical Committees of 33 European countries, offers an inclusive platform in the field of electrotechnology that is accessible to all interested stakeholders: companies of all sizes – including small and medium-sized enterprises (SMEs), consumer groups, societal and environmental interests, public sector organizations, academics and researchers. The total number of 'active deliverables' (or valid / in-force / living documents), including 6.519 CENELEC standards, reached 6.849 (June 2015). About 26% of these deliverables are 'homegrown' documents, which means they are referring to or

reflecting specific European requirements (ibidem). It is reckoned that more than 95% of CEN and CENELEC standards are implemented by the national member bodies (NMB) of CEN and CENELEC (ibidem).

Since 2010 CEN and CENELEC are under a joint management umbrella, the CEN-CLC Management Centre (CCMC) located in Brussels, which oversees the daily operations, coordination and promotion of all CEN and CENELEC activities. CCMC is also responsible for correspondence and liaison with the services of the European Commission and the EFTA Secretariat.

ETSI, the European Telecommunications Standards Institute, is an independent, not-for-profit association with 740 member companies and organizations, drawn from 62 countries across 5 continents worldwide. ETSI produces globally-applicable standards for Information and Communications Technologies (ICT), including fixed, mobile, radio, converged, aeronautical, broadcast and internet technologies. It publishes between 2,000 and 2,500 standards every year, which since its establishment in 1988, amounts to over 30,000 – including the standards that enable key global technologies such as GSM™, 3G, 4G, DECT™, smart cards and many more standards success stories.

ETSI produces a variety of deliverables (standards, specifications and reports) to suit different purposes, in response to market demand: European Standards (EN), ETSI Standards (ES), ETSI Guides (EG), ETSI Technical Specifications (TS), ETSI Technical Reports (TR), ETSI Special Reports (SR) and ETSI Group Specifications (GS). These different types of standards deliverables are produced in different ways in line with their respective purposes, and the time taken to draft and approve them varies (ETSI).

The total number of CEN (15,733), CENELEC (6.849) and ETSI (all-time total 30,000) standards and similar deliverables probably amounts to more than 40,000. Together with the standards of ISO (almost 21,000) and IEC (about 7000) – not to mention other standards developing organizations (SDO) at international level – the total body of international standards may well exceed 70~75,000 standards documents.

Key takeaway:

- ***The total body of international standards of ISO, IEC, CEN and CENELEC standards (not to mention those of other SDOs) may well exceed 70~75,000 standards documents – a volume larger than some national legislation***
- ***ISO, IEC, CEN and CENELEC mutually acknowledge their standards as "international standards" and have put mechanisms in place to avoid duplication of standardizing work as well as competing or conflicting standards***

1.7 EU policy, legislation and standardization policy

In Europe – EU and other countries of the EEA – legislation, policy and standardization are closely intertwined.

Standardisation has played a leading role in the creation of the EU Single Market, particularly since the beginning of the 1990s. European Mandates, also called standardization requests, are the mechanism by which the European Commission (EC) and the EFTA Secretariat request the European Standards Organizations (ESOs) to develop and adopt European standards in support of European policies and legislation. To date, the EUs Mandates Database[23] counts 564 mandates on all kinds of topics in support of the Single Market. The recent ones are usually based on a Council decision which is implemented by the EC. The ESOs evaluate the mandates and can – if they so decide – decline a mandate. However, most of the mandates are taken up by one or more of the ESOs and turned into the requested results.

Standards support market-based competition and help ensure the interoperability of complementary products and services. They reduce costs, improve safety, and enhance competition. Due to their role in protecting health, safety, security, and the environment, standards are important to the public. That is why the EU has an active standardisation policy that promotes standards as a way to better regulation and enhance the competitiveness of European industry. The "Joint Initiative on Standardisation: responding to a changing marketplace"[24] published on 13 June 2016 as part of the "Single Market Strategy" states:

> *"**Standards are all around us, they affect all our lives even if we are often unaware of them. Standards set requirements for specific items, materials, components, systems and services, or describe a method or procedure. They facilitate international trade by ensuring compatibility and the interoperability of components, products and services. Although they are voluntary and market driven, when used they have shown to reduce costs for business and consumers, enhance performance, and improve safety.***
> *Standards are key for innovation and progress in the Single Market, and are essential to supporting European competitiveness, jobs and growth. They also allow Europe to maintain its leadership in technical development and global trade as the European hub for global standardisation."* (European Commission 2016)

Since the "Annual European standardisation work programme 2012" (European Commissions 2012 and subsequent editions) the EC publishes an Annual Work Programme for European standardisation. The programme lays down the Commission's intentions to use standardisation in support of new or existing legislation and policies. These intentions can lead among others to the above-mentioned formal standardisation requests (mandates). The obligation to identify strategic priorities for European Standardisation for the upcoming year comes from Regulation (EU) No 1025/2012. But as already mentioned, the active standardization policy using "mandates" had started already 20 years earlier.

1.7.1 Standardization policy in the field of accessibility

With respect to accessibility, standardization policy started with mandates 273 and 283, and has become increasingly more relevant to the development of accessibility related standards:

- M/273 (1998) Mandate to the European Standards Bodies for Standardization in the field of **information and communications technologies (ICT) for disabled and elderly people**
- M/283 (1999) Mandate to the European Standards Bodies for a guidance document in the field of **safety and usability of products by people with special needs (e.g. elderly and disabled)**

[23] https://ec.europa.eu/growth/tools-databases/mandates/index.cfm?fuseaction=refSearch.search
[24] https://ec.europa.eu/growth/single-market/european-standards/policy_en

- M/376 (2005) Standardisation Mandate to CEN, CENELEC and ETSI in Support of European **Accessibility Requirements for Public Procurement of Products and Services in the ICT Domain -** (resulting in the European Standard **EN 301 549:2014** Accessibility requirements for public procurement of ICT products and services in Europe)
- M/420 (2007) Standardisation mandate to CEN, CENELEC and ETSI in support of European **accessibility requirements for public procurement in the built environment -** (resulting in EN 17210:2019 Accessibility and usability of the built environment. Functional requirements)
- M/473 (2010) Standardisation mandate to CEN, CENELEC and ETSI to include **"Design for All"** in relevant standardization initiatives - (resulting in European Standard EN 17161:2019 Design for All – Accessibility following a Design for All approach in products, goods and services - Extending the range of users)
- M/554 (2017) Commission Implementing Decision C(2017)2585 of 27.4.2017 on a standardisation request to the European standardisation organisations in support of Directive (EU) 2016/2102 of the European Parliament and of the Council on the **accessibility of the websites and mobile applications of public sector bodies** - (requesting the development of harmonised standard(s) based on EN 301 549 V1.1.2 (2015-04)

A search with the term "accessibility" produced a total of 20 mandates of which the following (in addition to the above) might also be of relevance to TRIPS:

- M/549 (2016) "COMMISSION IMPLEMENTING DECISION C(2016) 5884 final of 21.9.2016 on a standardisation request to the European Committee for Standardisation as regards **lifts and safety components for lifts** in support of Directive 2014/33/EU of the European Parliament and of the Council" – aiming to draft harmonised standards in support of the implementation of essential health and safety requirements on lifts and safety components for lifts, in particular by revising existing harmonised standards in order to make them fully compatible with Directive 2014/33/EU.
- M/530 (2015) "COMMISSION IMPLEMENTING DECISION C(2015) 102 final of 20.1.2015 on a standardisation request to the European standardisation organisations as regards European standards and European standardisation deliverables for privacy and personal data protection management pursuant to Article 10(1) of Regulation (EU) No 1025/2012 of the European Parliament and of the Council in support of Directive 95/46/EC of the European Parliament and of the Council and in support of Union's security industrial policy" – aiming to develop European standards, which shall cover the following aspects:
    - i) How to address and manage privacy and personal data protection issues during the design and development and the production and service provision processes of security technologies and services, allowing manufacturers and service providers to develop, implement and execute a widely recognised "Privacy by Design" (PbD) approach in their processes; and
    - ii) European standards addressed to the manufacturers and service providers when specifying the privacy and personal data protection management processes with an explanation how to realise them, including descriptions of the necessary roles, tasks, documentation, hardware and software requirements, and templates to be used when applying the requested standard(s).
- M/517 Mandate addressed to CEN, CENELEC and ETSI for the Programming and Development of **Horizontal Service Standards –** mentions among others customer communication channels, dispute resolution methods, accessibility information Safety risks of the service
- M/505 Standardisation Mandate issued to the European Standardisation Organisations (ESOs) to develop European standards in order to address **certain risks posed to children by internal blinds, corded window coverings and safety devices** – standardisation mandate issued to the ESOs to develop european standards in order to address certain risks posed to children by internal blinds, corded window coverings and safety devices

- M/487 Programming Mandate addressed to CEN, CENELEC and ETSI to establish **security standards –** mentions "...functional requirements (e.g. relating to environmental aspects or to accessibility for all), thus stimulating the search for innovative technologies that provide best value for money in the long term, while ensuring safety and interoperability."
- M/466 Programming mandate addressed to CEN in the fields of the **Structural Eurocodes – m**entions "…take into account new societal demands and needs; Footnote: Accessibility for persons with disabilities and older persons is an essential component of social sustainability given the demographic change."
- M/338 Standardisation mandate to CEN, CENELEC and ETSI in support of **Interoperability of electronic road toll systems** in the Community – postulates "Consumer requirements and generic e-accessibility principles shall be implemented."
- M/331 Standardisation mandate to CEN, CENELEC and ETSI in support of **digital TV and interactive services**

Some earlier legal acts paved the way for the implementation of the CRPD in the EU and later for further legislation and standardization activities in support of legislation:

- Council Directive 76/207/EEC of 9 February 1976 on the implementation of the principle of **equal treatment for men and women** as regards access to employment, vocational training and promotion, and working conditions (European Union EUR-Lex, 1976)
  (resulting in: Proposal for a Directive of the European Parliament and of the Council amending Council Directive 76/207/EEC on the implementation of the principle of equal treatment for men and women as regards access to employment, vocational training and promotion, and working conditions (2000/C 337 E/33)
- Directive 2014/23/EU of the European Parliament and of the Council of 26 February 2014 on the **award of concession contracts** (Text with EEA relevance) (OJ L94/1, 2014)
- Directive 2014/24/EU of the European Parliament and of the Council of 26 February 2014 on **public procurement** and repealing Directive 2004/18/EC (OJ L94/65, 2014)
- Directive 2014/25/EU of the European Parliament and of the Council of 26 February 2014 on **procurement by entities operating in the water, energy, transport and postal services sectors** and repealing Directive 2004/17/EC Text with EEA relevance (Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive by 18 April 2016. They shall forthwith communicate to the Commission the text of those measures.) (OJ L94/243, 2014)
- Directive 2016/2102 of the European Parliament and of the Council of 26 October 2016 on the **accessibility of the websites and mobile applications of public sector bodies** (OJ L 327, 2016)
- Directive (EU) 2018/1808 of the European Parliament and of the Council of 14 November 2018 amending Directive 2010/13/EU on the coordination of certain provisions laid down by law, regulation or administrative action in Member States concerning the **provision of audiovisual media services** (Audiovisual Media Services Directive) in view of changing market realities (OJ L 303/69, 2018)
- European Union. Directive (EU) 2019/882 of the European Parliament and of the Council of 17 April 2019 on the **accessibility requirements for products and services** (OJ L 151/70, 2019) "Europan Accessibility Act"

Accessibility to the built environment, Information and Communication (notably ICT), and transport is addressed by article 9 of the CRPD which reads:

> *"1. To enable persons with disabilities to live independently and participate fully in all aspects of life, States Parties shall take appropriate measures to ensure to persons with disabilities access, on an equal basis with others, to the physical environment, to transportation, to information and communications, including information and communications technologies and systems, and to other facilities and services open or provided to the public, both in urban and in rural areas.*

These measures, which shall include the identification and elimination of obstacles and barriers to accessibility, shall apply to, inter alia:

a) Buildings, roads, transportation and other indoor and outdoor facilities, including schools, housing, medical facilities and workplaces;

b) Information, communications and other services, including electronic services and emergency services.

2. States Parties shall also take appropriate measures:

a) To develop, promulgate and monitor the implementation of minimum standards and guidelines for the accessibility of facilities and services open or provided to the public;

b) To ensure that private entities that offer facilities and services which are open or provided to the public take into account all aspects of accessibility for persons with disabilities;

c) To provide training for stakeholders on accessibility issues facing persons with disabilities;

d) To provide in buildings and other facilities open to the public signage in Braille and in easy to read and understand forms;

e) To provide forms of live assistance and intermediaries, including guides, readers and professional sign language interpreters, to facilitate accessibility to buildings and other facilities open to the public;

f) To promote other appropriate forms of assistance and support to persons with disabilities to ensure their access to information;

g) To promote access for persons with disabilities to new information and communications technologies and systems, including the Internet;

h) To promote the design, development, production and distribution of accessible information and communications technologies and systems at an early stage, so that these technologies and systems become accessible at minimum cost." (UN CDPR, 2006)

Reading this text, it becomes clear that the European signatories (each of the EU member states and the EU as a whole) have to comply with these rules at a strategic (viz. policy) level as well as at operational levels including standardization. The need to coordinate compliance activities at European level became apparent already at the time when the CRPD was still under discussion at the UN. At policy level the "Regulation (EU) No 1025/2012 of the European Parliament and of the Council of 25 October 2012 on European standardisation" established the legal basis for coordination at EU level. (OJ L316/12)

According to TFEU articles 10 and 19 the Union shall aim (and Parliament may take action) "to combat discrimination based on sex, racial or ethnic origin, religion or belief, disability, age or sexual orientation"(OJ L. 326/47-326/390; 26.10.2012). Based on this fundamental principle, it is clear that the obligations of the CRPD had to be integrated into the political, legal and institutional framework of the EU. Besides, they also needed to be integrated into the framework of EU core policies (e.g. EU Single Market, innovation, R&D programmes, eGovernment, etc.), such as the policy regarding ICT development whose impact on accessibility became more and more obvious. This on the one hand led to the formulation of the European disability strategy 2010-2020 (European Commission 2010) and on the other hand to the annual RPIS (as from 2013). The latter listed under "societal challenges" Web accessibility and accessibility of ICT products and services. From the Commission perspective, pertinent standardization needs are twofold:

> *"First, the UN Convention requires in Article 9 the development of accessibility standards and in the general obligations the promotion of universal design in the development of standards. Work on this area needs to advance at European level to increase market coherence. Second, accessibility standards might be needed to support the European Accessibility Act."* (EU RPIS 2013, p. 26 – repeated in RPIS 2018)

There are discussions for a post-horizon 2020 disability strategy 2030 in the European Parliament (EP) to succeed the EDS.

The "List of standardization actions needed" (derived from views expressed by some Member States and experts in the field) in the Rolling Plan for ICT standardization 2013 reveals a high interest for standards related to eAccessibility and eInclusion:

- *"Design of ICT that better addresses the needs of persons with cognitive and learning disabilities*
- *Approaches to addressing the reported intelligibility problems experienced by some people with hearing impairments when using modern networks and equipment*
- *Mapping of character repertoires on soft, non-standard and reduced keypads*
- *User interfaces to enable a consistent user experience for domains like m-payments.*
- *Identification of Mobility needs like the usage of mobile devices by people with impaired movements*
- *Specification of requests for user interface devices including presentation techniques, it may be for bus tickets, access to social and commercial services, not only communications systems:*
    - *Display requests, in public and private domains*
    - *Possible usage of RFID to facilitate access*
    - *Voice recognition for devices control*
    - *Audio description for control keys*
- *Specification of Communications systems requests*
    - *'total conversation' and 'accessible TV distribution' transmission needs including how many and which real time voice/audio, video, text, eventually others synchronized streams are needed to ensure accessibility features like subtitling, messaging, audio description and sign language for all citizens*
    - *standardisation of broadcasters accessible interfaces to IP (and other) systems*
    - *convergence and interoperability of video relay services o accessible Hybrid TV services*
    - *total conversation including for emergency services*
- *Specification of requests for translation among languages*
    - *voice to text like automation of relay services for telephony and capturing/ subtitling TV transmissions*
    - *interoperability of the most common text transmission techniques like IM – SMS- eMail*
    - *text to voice like in automatic generated audio description*
    - *text to sign language like in automatic generated sign language" (ibidem)*

As a more general aspect, the participation of persons with disabilities, their carers and service providers (and their respective organizations) in standardization activities – not to mention access to existing standards pertinent to them – is increasingly raised as a major problem. So far, several existing documents on the benefits of standardization are focusing on the economic benefits. The recent "Preliminary study on benefits of consumer participation in standardisation to all stakeholders" (ANEC, 2014), the European Association for the Coordination of Consumers Representation in Standardisation (ANEC (2014) also take into account the needs of persons with disabilities. ISO/IEC GUIDE 71:2014 Guide for addressing accessibility in standards provides guidance to standards developers on addressing accessibility requirements and recommendations in standards that focus, whether directly or indirectly, on systems (i.e. products, services and built environments) used by people. However, there are still big barriers for persons with disabilities, their caregivers and service providers, as well as the respective organizations, to engage actively in standardization activities.

1.7.2 Strategic cooperation with respect to accessibility related standardization

Concerning accessibility issues, a high-level collaboration between the IEC, ISO and ITU, namely the World Standards Cooperation (WSC), is attempting under this banner to preserve their common interests in strengthening and advancing the voluntary consensus-based International Standards system. WSC became aware of the importance of standardization related to "accessibility" and organized an international workshop on "Accessibility and the contribution of International Standards" in Geneva, on November 3rd and 4th 2010. The purpose of the Workshop was to review and examine the standards needed for facilitating the development of accessible solutions around the world. It was followed by a meeting especially organized for standards developers (but also open to other stakeholders) on 5 November 2010. These events were also aiming at raising awareness of accessibility in in conjunction with the World Standards Day, celebrated each year on 14 October, which in 2010 had the theme "Standards make the world accessible for all"[25].

The primary goal of the meetings was to prepare a standardization strategy for the international standards bodies regarding 'accessibility' for the next years. In line with the UN/CRPD (UN Convention on the Rights of Persons with Disabilities) (UN CRPD, 2006), many disabled persons' organizations (DPOs) were invited – following the widely-accepted requirement on the part of these organisations "if about us, not without us". The workshop addressed three key subject areas:

- accessibility in the field of everyday products
- accessibility and buildings
- eAccessibility and eInclusion (in ICT)

The participants of the above-mentioned WSC Workshop called for a coordinated comprehensive accessibility strategy of ISO, IEC and ITU, which should extend down to their national member bodies. The WSC organizations received many (some quite outspoken) comments and recommendations from the floor. One major input to the eAccessibility and eInclusion part of the Workshop was the "Recommendation on software and content development principles 2010" (MoU/MG, 2012) which had been jointly formulated by experts of the EU-project OASIS[26] and the ISO/TC 37[27] on the occasion of the International Conference on Computers Helping People with Special Needs (ICCHP 2010 – taking place in Vienna, 14-16 July 2010).

As part of the follow-up requested by the participants, an internal business case for the support of 'accessibility' in ISO was formulated putting accessibility in a wider context and suggesting a number of specific actions under the following headings:

- Demographic dynamics: Growing ageing population
- Trends in product design: Accessible products are better products
- Regulatory frameworks and governmental policies such as:
  - UN's CRPD and its ratification into national law;
  - Government procurement rules include increasingly accessibility requirements;

[25] https://www.worldstandardscooperation.org/world-standards-day/world-standards-day-2010/
[26] EU-Project: Open architecture for Accessible Services Integration and Standardisation
[27] ISO technical committee 37 Language and terminology

- Wider policy framework: Sustainable development & the UN's Millennium Development Goals (MDG).

The business case also referred to the European Disability Strategy 2010-2020[28] (EDS) with its intention to support accessibility by means of legislative instruments as well as standardization and public procurement programs that include requirements on accessibility. The business case concludes that:

- There is a global trend and a growing demand for accessible products, services and environments.
  "This is due to an increase in the ageing population as well as to policies that give more weight to accessibility concerns and translate such concerns e.g. into concrete governmental procurement rules. Related and in addition to such concerns there is the general sustainability agenda which may impose increasingly stricter restrictions to those development agendas which are pre-dominantly defined by economic priorities only."
- Standards can play an important role in support of the implementation of the policy trends outlined above (regarding procurement, infrastructure design, buildings, transport chains, design of everyday products etc.)

Two major results of the WSC 2010 Workshop "Accessibility and the contribution of International Standards" were:

- **IEC/ISO/ITU Policy on Standardization and accessibility** 2014
  [Source: http://www.iso.org/iso/iec_iso_itu_joint_policy_statement.pdf]
- **ISO/IEC GUIDE 71:2014 Guide for addressing accessibility in standards**, a thorough revision of the ISO/IEC Guide 71:2001.

1.7.3 Standardization policy in the field of traffic and transport

In the field of transport about 25 Mandates have been published, of which M/546 is the one of highest relevance for TRIPS:

> M/546 (2016) COMMISSION IMPLEMENTING DECISION C(2016)808 of 12.2.2016 on a standardisation request to the European standardisation organisations as regards Intelligent Transport Systems (ITS) in urban areas in support of Directive 2010/40/EU of the European Parliament and of the Council of 7 July 2010 on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport:
> ESOs are requested to draft new European standards and European standardisation deliverables in support of the implementation of Article 8 of Directive 2010/40/EU for multimodal information, traffic management and urban logistics in the urban ITS domain.

Another mandate that could also be of relevance is:

> M/293 (1999) Mandate to the European standards bodies for a guidance document in the field of safety of consumers and child safety – mentions "accessibility", but focuses on (children) traffic accidents

As already mentioned, transport policy has been one of the EU's common policies for more than 30 years. Alongside the opening-up of transport markets and the creation of the Trans-

[28] https://ec.europa.eu/social/main.jsp?catId=1484&langId=en

European Transport Network, the 'sustainable mobility' model will take on even greater importance – particularly in view of the constant rise in greenhouse gas emissions from the transport sector. Today's legal basis is Article 4(2)(g) and Title VI of the TFEU, but transport was therefore one of the Community's first common policy areas as long ago as the Treaty of Rome. As transport markets open up, it is vital to create fair competitive conditions both within individual modes of transport and between them.

In fact, harmonization policy set in with Mandate M/270 (1998) "Standardisation mandate to CEN/CENELEC/ETSI for Road Transport Telematics (RTT) including interfaces with other means of transport for passengers and freight". One of the identified five priority areas was human/machine interface and system architecture. Three more mandates referred to air traffic management which is probably away from the scope of TRIPS. Since then, the harmonisation of laws and other regulations concerning transport has become more and more important. Today it covers national laws, regulations and administrative provisions, and the technological, social and tax environment in which transport services are provided. Today's economically successful and dynamic transport sector is facing ever tighter social and environmental constraints, so the 'sustainable mobility' model has become more important than ever before.

The way forward to common legislation in the transport sector was only cleared when the European Parliament brought proceedings against the Council for failure to act in 1985. On 2 December 1992, the Commission adopted its "White Paper on the future development of the common transport policy" (COM(1992)0494). The subsequent White Paper of 22 July 1998 "Fair payment for infrastructure use: a phased approach to a common transport infrastructure charging framework in the EU" (COM(1998)0466), drew attention to the significant differences between Member States in charging for transport services, which was leading to distortions of competition in intra-modal and intermodal transport. In the September 2001 White Paper entitled "European Transport Policy for 2010: Time to decide" (COM(2001)0370), the Commission analysed the problems and challenges facing European transport policy – in particular with regard to the then forthcoming eastern enlargement of the EU. It predicted a massive rise in the volume of traffic, which would go hand in hand with traffic jams, congestion (particularly in the case of road and air transport) and increasing health and environmental costs. The 2001 White Paper also focused on the rights and obligations of transport users, made provisions for an action plan on road safety, and consolidated users' rights and cost transparency through the harmonisation of charging principles. The many years of debate on the long-term future of transport (looking 20 to 40 years ahead) finally resulted in the Commission communication entitled "A sustainable future for transport: Towards an integrated, technology-led and user friendly system" (COM(2009)0279).

The European Parliament adopted two resolutions following the publication of the 2011 White Paper assessing the main objectives outlined in the White Paper 2011 (Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system) (COM/2011/0144final), and emphasizing the importance of a system that focuses on interconnection and interoperability. EP approved the 10 objectives for a competitive and resource-efficient transport system and the goals set in the White Paper for 2030 and 2050. 2015 in a second resolution the European Parliament:

- called on the Commission to come up with additional legislative measures and a comprehensive strategy for the development of low-carbon transport so that the

objective of a minimum 60% reduction in GHG emissions from transport could be achieved by 2050, and

- made a series of recommendations seeking to integrate all transport modes in order to create a more efficient, sustainable, competitive, accessible and user-friendly transport system. The main points included modal shift and co-modality, modern infrastructure and smart funding, urban mobility, placing people at the heart of transport policy, and the global dimension of transport.

IN 2018, EP's Policy Department for Structural and Cohesion Policies has recently published a study entitled "Research for TRAN Committee – Modal shift in European transport: a way forward" (Pastori et al., 2018).

1.7.4 Standardization policy in the field of the ICTs: The EU Rolling Plan for ICT Standardization (RPIS) 2020

The annual RPIS over the years became a living document periodically updated. It is of high relevance for TRIPS, as it identifies priority fields of standardisation in the fields of the ICT in relation to policies and legislation.

The previous RPIS 2019 introduced four new chapters: "Artificial intelligence" and the "European Global Navigation Satellite System (EGNSS)" have been added under "Key enablers and security" and "Water management Digitisation" and "Single European Sky" under "Sustainable growth". RPIS 2020 identifies 170 actions grouped into four thematic areas: key enablers and security, societal challenges, innovation for the single market and sustainable growth. The Rolling Plan is a living document. RPIS 2020 covers the following chapters and paragraphs of which several have or could have a bearing on accessibility and transport related to the scope of TRIPS:

Key enablers and security:

- 5G
- Cloud computing
- Public sector information, open data and big data
- Internet of Things
- Cybersecurity / network and information security
- Electronic identification and trust services including e-signatures
- ePrivacy
- e-Infrastructures for research data and computing intensive science
- Broadband infrastructure mapping
- Accessibility of ICT products and services
- Artificial Intelligence
- European Global Navigation Satellite System (EGNSS)

Societal challenges:

- eHealth, healthy living and ageing
- e-Skills and e-Learning
- Emergency communications
- eGovernment
- eCall

Innovation for the Digital Single Market:

- e-Procurement – pre- and post-award
- e-Invoicing
- Card, internet and mobile payments
- Preservation of digital cinema

- Fintech and Regtech Standardization
- Blockchain and Distributed Digital Ledger Technologies

Sustainable growth:

- Smart grids and smart metering
- Smart cities / technologies and services for smart and efficient energy use
- ICT Environmental impact
- European Electronic Toll Service (EETS)
- Intelligent Transport Systems (ITS)
- Advanced manufacturing
- Robotics and autonomous systems
- Construction – building information modelling
- Common Information Sharing Environment (CISE) for the EU maritime domain
- Water management digitisation
- Single European Sky

RPIS 2020 is introduced in detail in Annex A. The 12 Technology Domains of major interest identified by TRIPS (T3.2) are mapped against the 170 RPIS actions. It can already be said here that a few general societal issues or other problem areas probably should not be neglected by TRIPS although not being in the focus of the project. Such areas may include among others:

- Cybersecurity / network and information security
- Electronic identification and trust services including e-signatures
- ePrivacy
- (accessibility-related aspects of) e-Skills and e-Learning
- e-Invoicing

The parts of the RPIS 2020 most relevant to TRIPS are discussed in section 2.3.

1.7.5 Cooperation at ESO level

The European standard EN 301549:2019 "Accessibility requirements for ICT products and services" is a good example of cooperation between the three ESOs, CEN, CENELEC and ETSI. It was developed through an inclusive process with the active involvement of relevant stakeholders under the stewardship of CEN/CLC/ETSI/JWG eAcc – eAccessibility. Through JWG eAcc the ESOs have jointly addressed the European Commission Mandate M/376, which was dealing in Phase II, with the development of a new European standard making ICT products and services accessible for all.

The new standard is intended in particular for use by public authorities and other public sector bodies during procurement, to ensure that websites, software and digital devices are more accessible – so they can be used by persons with a wide range of disabling conditions. EN 301549:2019 is complemented by a series of three ETSI Technical Reports (TR 101 550, TR 101 551 and TR 101 552), which were also adopted by CEN and CENELEC. Together these documents set out accessibility requirements that can be applied to a broad range of products and services related to ICT, including computers, smartphones and other digital devices, ticketing machines, websites and emails.

EN 301549:2019 provides further alignment with related standardization developments, notably in W3C, with references to the new Web Content Accessibility Guidelines (WCAG). It was developed with the aim to be offered for citation in the "Directive (EU) 2016/2102 of the European Parliament and of the Council of 26 October 2016 on the accessibility of the

websites and mobile applications of public sector bodies" (OJ L 327, 2.12.2016). ***Once the EN is cited in the OJ, compliance with the normative clauses confers a presumption of conformity with the corresponding essential requirements of the Directive. This will be a strong incentive to develop standards-based certification schemes for many ICT products and services.***

Key takeaway:
(quote summarizing the importance of standards and standardizing activities, especially for Europe)

> ***"Standards are all around us, they affect all our lives even if we are often unaware of them. Standards set requirements for specific items, materials, components, systems and services, or describe a method or procedure. They facilitate international trade by ensuring compatibility and the interoperability of components, products and services. Although they are voluntary and market driven, when used they have shown to reduce costs for business and consumers, enhance performance, and improve safety.***
> *Standards are key for innovation and progress in the Single Market, and are essential to supporting European competitiveness, jobs and growth. They also allow Europe to maintain its leadership in technical development and global trade as the European hub for global standardisation."* (European Commission 2016)

Concerning projects, not considering standards can be seriously detrimental to the results of R&D or technical development.

2. Standards and standardization activities of general relevance to TRIPS

Chapter 2 covers the following aspects of standardization in the fields of accessibility and accessible transport from a bottom-up view:

- Technical standards fundamental to the Internet and WWW – section 2.1
- Other standards and standardization activities in the fields of the ICT of general relevance to TRIPS – section 2.2
- New technology domains/trends identified by TRIPS – section 2.3
- Standards related to accessibility and AT – section 2.4
- Standards and guidelines related to accessibility and transport – section 2.5
- Obstacles to engage in standardization activities in fields of accessibility and AT – section 2.6

Standards related to content and interhuman communication which were until lately rather neglected, are emerging as a new strategic focus in standardisation. They will be dealt with in Chapter 3.

Previous projects revealed:

- Experts were aware of the highly general and generic ICT standards, such as XML, HTTP, GSM, etc. which must be used by default anyhow, as they are already most widely integrated in networks and platforms, software packages or devices)

- Some de-facto standards mentioned were widely used scientific practice or documents issued by highly renowned (e.g. American Diabetes Association) or even authoritative (e.g. WHO) organizations primarily or among others established for data exchange purposes
- Few standards were indicated which focus on eAccessibility&eInclusion and related aspects from the perspective of an end-user with disabilities
- Some (content-related) standards referred to controlled vocabularies (e.g. SNOMED), classification schemes (e.g. ICF) or exchange formats and are included in the AALIANCE² data collection. Indeed, only few standards are focusing on eAccessibility & eInclusion from the perspective of inter-human communication content. ***However, (mostly non-standardized) communication resources and methods, such as sign language element repositories, sign language notation methods, various AAC systems and the description of the respective methodologies, do exist in reality. To some of the above controlled language – or better 'controlled communication' – approaches would apply. Seen under this perspective, standards here would be useful, but do not yet exist.***

Key takeaway:
The examples under sections 2.1 and 2.2 show that there are dynamic fields of international ICT-related standards developed in their 'universes' of standards which are not easy to follow, and if included in a collection of information on standards, should be updated on a regular basis.

2.1 Technical standards fundamental to the Internet and WWW

The big family of technical standards and specifications belonging to the TCP/IP Suite (Transmission Control Protocol – often incorrectly used as equivalent for Internet Protocol) – are a complex 'universe' of technical standards. They belong to 4 categories or layers: application layer, transport layer, Internet layer and link layer. Technically speaking, the Internet is based on them. For further details see Annex B.

Most experts are using many or most of the standards of the Internet Protocol Suite without much being aware of it – because they must be used as default anyhow. The Internet Protocol Suite guarantees the fundamental technical interoperability of the Internet.

Another complex of several families of standards constitute the technical basis of the World Wide Web (WWW) developed by the WWW Consortium (W3C). Various W3C Working Groups develop different kinds of standards called Recommendations, Notes, Guidelines and Initiatives. Even if some standards were deprecated, they are still maintained. For further details see Annex B.

Some W3C standards have development versions or constitute families of versions or releases, some are competing with each other or with industry standards. Thus, different ICT vendors offer incompatible versions of HTML which causes inconsistencies in how web pages are displayed. Other dynamically emerging W3C standards' fields where interoperability issues can occur are:

- Web services

- Resource Description Framework (RDF)
- Web Ontology Language (OWL)

Depending on the TRIPS recommendation on how barriers for Persons with disabilities to using public urban transport can be overcome, some or many of the W3C standards (or their offspring) may have to be applied ***– especially those that were turned into formal standards, such as ISO/IEC 40500:2012 WCAG2. However, if different systems/tools and services geared to and used by persons with disabilities are connected or even managed through Internet-based platforms, this may cause non-trivial problems of how to integrate those systems/tools and services that are developed on the basis of not-aligned design decisions.***

The W3C standards concerning web accessible content will be dealt with later in this document.

2.2 Other ICT related standards of general relevance to TRIPS

In addition to section 2.1 above, there are standards and standardization activities in different kinds of SDOs which are of general relevance to TRIPS. Experts in previous projects observed that they faced difficulties when searching for such – and even more so for more specific – standards. These difficulties were even aggravated when they wanted to select the standards most pertinent to their needs or topics of interest. This starts with the very term "standard" which in today's ICT speak can among other things refer to software (programmes, suites, tools) or technologies which are widely used. Many of them are industry or industry consortium standards some of which are so widely used that they have to be taken as default.

Examples for the above are "MySQL" or "Bluetooth" or Laravel Framework PHP. MySQL is an open-source relational database management system (RDBMS) – the standards underlying MySQL are not specifically relevant to eAccessibility&eInclusion. The Bluetooth Special Interest Group (Bluetooth SIG) maintains the standard IEEE 802.15.1 *Wireless medium access control (MAC) and physical layer (PHY) specifications for wireless personal area networks (WPANs)* on which Bluetooth originally was based. Bluetooth Low Energy (BLE) may be of higher relevance to certain eAccessibility&eInclusion related developments – the pertinent 'standard' consists of specifications which are accessible through the Bluetooth SIG. If Bluetooth needs to be used the respective "standards" apply by default.

The same applies to some standardization activities and standards referring to the technical formats for content rendered by image, audio, video and multimedia some of which could be pertinent to TRIPS:

Image formats:

- ISO/IEC 10918-1:1994 *Information technology – Digital compression and coding of continuous-tone still images: Requirements and guidelines;* (**JPEG**: originally ITU-T Recommendation T.81 *Information technology – Digital compression and coding of continuous-tone still images – Requirements and guidelines)*
- ISO/IEC 15948:2004 *Information technology – Computer graphics and image processing — Portable Network Graphics (PNG): Functional specification* — evolved out of W3C

- **BMP** file (bitmap file or bitmap image file) format[29]: part of the Windows metafile (WMF) specification, is a raster graphics image file format used to store bitmap digital images
- **GIF** (Graphics Interchange Format[30]) – GIF Specification by CompuServe
- ISO 12234-2:2001 *Electronic still-picture imaging – Removable memory – Part 2: TIFF/EP image data format* - raw image files (**RAW**) based on Digital Negative (DNG) is based on ISO 12234-2:2001
- Tag Image File Format/Electronic Photography (**TIFF/EP**) – a computer file format for storing raster graphics images, popular among graphic artists, the publishing industry, and photographers extended from Tagged Image File Format (**TIFF** or TIF) see ISO 12234-2:2001

***Audio formats**:*

- (big family of) ETSI **GSM** standards[31]: *Digital cellular telecommunications system* (for SMS and Calls) – recognized as international standards
- **MP3:** MPEG-1 and/or MPEG-2 Audio Layer III – audio coding format for digital audio which uses a form of lossy data compression; standardized in ISO/IEC 11172-3:1993 *Information technology — Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s — Part 3: Audio* and ISO/IEC 13818-3:1995 *Information technology — Generic coding of moving pictures and associated audio information — Part 3: Audio*
- **AAC**: *(not to confuse with alternative and augmentative communication, also abbreviated AAC)* Advanced Audio Coding – audio coding standards for lossy digital audio compression designed to be the successor of the MP3 format; standardized in ISO/IEC 14496-3:2005 *Information technology – Coding of audio-visual objects – Part 3: Audio* (and Amendments) and ISO/IEC 14496-7:2006 *Information technology – Generic coding of moving pictures and associated audio information – Part 7: Advanced Audio Coding (AAC)* (and Amendments) (based on ISO/IEC 14496-12:2004 *Information technology – Coding of audio-visual objects – Part 12: ISO base media file format* identical version published as ISO/IEC 15444-12:2004 *Information technology – JPEG 2000 image coding system – Part 12: ISO base media file format* (also known as JPEG 2000, Part 12)

Probably, many more of the numerous parts of multipart ISO/IEC 14496 and ISO/IEC 15444 standards in the field of eHealth are relevant in connection with platform-based services as they could be used by interurban transport information systems.

***Video formats**:*

- **FLV**: Flash Video[32] (AVC) – Adobe Systems; based on ISO/IEC 14496-10:2014 *Information technology — Coding of audio-visual objects — Part 10: Advanced Video Coding* (and Amendments) now supports video compressed in H.264 (MPEG-4 Part 10), audio compressed using AAC (MPEG-4 Part 3), the F4V, MP4 (MPEG-4 Part 14), M4V, M4A, 3GP and MOV multimedia container formats, 3GPP Timed Text specification (MPEG-4 Part 17)

Key takeaway:

[29] https://en.wikipedia.org/wiki/BMP_file_format
[30] https://en.wikipedia.org/wiki/GIF
[31] Many standards to be found under: https://www.etsi.org/standards-search#page=1&search=&title=1&etsiNumber=1&content=1&version=1&onApproval=1&published=1&historical=1&startDate=1988-01-15&endDate=2018-11-06&harmonized=0&keyword=&TB=&stdType=&frequency=&mandate=&collection=&sort=4
[32] https://en.wikipedia.org/wiki/Flash_Video

The standards concerning the coding of audio-visual objects comprise numerous parts each with several amendments and/or corrections and refer to many formats. The above-mentioned and other existing varieties of file formats might cause interoperability problems, if too many of them co-occur in a large system or if data from different sources/formats must be converted.

Standards and standardization activities of primary relevance to TRIPS, such as standards related to AT, accessible transport and content (incl. semantics, content resources and natural language processing, NLP), will be dealt with in sections 2.4, 2.5 and 2.6.

2.3 New technology domains/trends identified by TRIPS

TRIPS D3.2 identified 12 ICT trends for inclusive urban mobility:

1. Internet of Things (IoT)
2. Virtual Reality (VR)
3. Augmented Reality (AR) and Mixed Reality (MR)
4. AI – Rule-based systems
5. AI – Automated Speech Recognition (ASR) and Natural Language Processing (NLP)
6. AI – Machine Learning (ML)
7. Big Data analytics
8. Robotics and automation
9. Web technologies – Infotainment
10. Machine Vision
11. Advanced human-machine interaction techniques
12. Geolocation

These 12 new technology domains/trends are dealt with in the EU RPIS 2020 as follows:

TRIPS new technology domains/trends	Dealt with in the EU Rolling Plan
Internet of Things (IoT)	Covered largely in "Key enablers and security" chapter "**Internet of Things**" also mentioned in other sections.
Virtual Reality (VR)	Mentioned under "Sustainable Growth" chapter "**ICT Environmental impact**" referring to ITU-T Focus Group "Environmental efficiency for artificial intelligence and frontier technologies" (FG-AI4EEE).
Augmented Reality (AR) and Mixed Reality (MR)	AR dealt with in "Key enablers and security" in Action 7 under chapter "**Accessibility of ICT products and services**" and referring to ITU-T Focus Group "Environmental efficiency for artificial intelligence and frontier technologies" (FG-AI4EEE) under "ICT Environmental impact". No mention of MR in the RPIS.
AI – Rule-based systems – Automated Speech Recognition (ASR) and Natural Language Processing (NLP) – Machine Learning (ML)	Mentioned in general under "Key enablers and security" chapter "**Artificial Intelligence**" referring to the EU strategy on AI (COM (2018) 237: Artificial Intelligence for Europe) and mentioned in many other sections. Speech recognition mentioned under "Robotics and autonomous systems". No mention of: – rule-based systems – NLP in the RPIS New standard under development by ISO/IEC-JTC 1/SC 42 *Artificial Intelligence*: ISO/IEC CD 23053 **Framework for Artificial Intelligence (AI) Systems Using Machine Learning (ML)** New ITU standards provide an architectural framework for the integration of machine learning into 5G and future networks (ITU Y.3172), a framework to evaluate intelligence levels across different parts of the network (ITU Y.3173), and a framework for data handling in support of machine learning (ITU Y.3174). The 'Machine Learning for 5G' standards are also guiding contributions to a new **ITU Global Challenge on AI and Machine Learning in 5G**.
Big Data analytics	Occurring in a different context under "Key enablers and security" chapter "**Public sector information, open data and big data**" (ITU-T SG 17 has approved several standards on big data and open data including "Security requirements and framework for big data analytics in mobile internet services" (Recommendation ITU-T X.1147) and "Data security

	requirements for the monitoring service of cloud computing" (Recommendation ITU-T X.1603)) and under AI mentioning ISO/IEC 24688: Information technology -- Artificial Intelligence -- Process management framework for Big data analytics.
Robotics and automation	Covered largely under "Sustainable growth" chapter "**Robotics and autonomous systems**" and mentioned under AI.
Web technologies – Infotainment	Mentioned under "Sustainable Growth" chapter "**Intelligent Transport Systems - Cooperative, Connected and Automated Mobility (ITS-CCAM) and Electromobility**".
Machine Vision	Mentioned under "Advanced Manufacturing" referring to IEEE P2671, Standard for General Requirements of Online Detection Based on Machine Vision in Intelligent Manufacturing under "Activities and additional information".
Advanced human-machine interaction techniques	Mentioned under "Key enablers and security" chapter "**Accessibility of ICT products and services**".
Geolocation	Covered under "Sustainable Growth" chapter "**Intelligent Transport Systems - Cooperative, Connected and Automated Mobility (ITS-CCAM) and Electromobility**" and RPIS "Societal challenges" chapter "Emergency communication".

Table 3: Mapping 12 new technology domains/trends identified in TRIPS with RPIS 2020

Consequently Annex A.1 provides an overview of the RPIS 2020 focused on those RPIS chapters dealing with the following technology domains/trends:

1. Internet of Things (IoT) under "Key enablers and security"
2. Accessibility of ICT products and services under "Key enablers and security"
3. Artificial Intelligence (AI) under "Key enablers and security"
4. Public sector information, open data and big data under "Key enablers and security"
5. Robotics and autonomous systems under "Sustainable Growth"
6. Intelligent Transport Systems - Cooperative, Connected and Automated Mobility (ITS-CCAM) and Electromobility under "Sustainable Growth"

Table 3 for the time being does not comprise the RIPS 2020 topics "5G", "Broadband infrastructure", Cloud computing", "eHealth, healthy living and ageing", "Blockchain and distributed digital ledger technologies", "Smart cities and communities/ technologies and services for smart and efficient energy use" which also occur in the RPIS and might turn out to be of relevance to TRIPS.

It also does not comprise topics that are only indirectly of relevance to TRIPS, but which are highly topical from a societal and user protection point of view, such as privacy protection, data security, etc. Besides, aspects of machine safety (re. Directive 2006/42/EC) have an impact on the liability of transport service providers in case of accidents, etc.

2.4 Standards related to accessibility and AT

About 150 standards can be easily identified as being related to accessibility and AT. Many more are difficult to discover. In addition, there are thousands of standards on technologies which are of significant benefit for persons with disabilities. The number of committees standardizing accessibility related subjects is constantly increasing. It lacks a mechanism to organize cooperation and coordination across many committees and SDOs.

The following standards were indicated as used by EU projects for instance under the topics of accessibility and user interface (incl. usability, ergonomics and DfA):

Accessibility

- EN 301 549:2014 *Accessibility requirements suitable for public procurement of ICT products and services in Europe*
- (multipart) EN ISO 14915:2002 *Software ergonomics for multimedia user interfaces*
- (multipart) EN ISO 9241: *Ergonomics of Human System Interaction*
- ISO/IEC 24786: 2009Information technology -- User interfaces-- Accessible user interface for accessibility settings

User Interfaces: Usability, Ergonomics, Design for All

- CEN/CENELEC Guide 6. Guidelines for standards developers to address the needs of older persons and persons with disabilities (Identical to ISO/IEC Guide 71)
- EG 202 116:2009 *Human Factors -- Guidelines for ICT products and services "Design for all"* (DfA)
- ISO/IEC TR 19766:2007 Information technology – Guidelines for the design of icons and symbols accessible to all users, including the elderly and persons with disabilities
- (multipart) ISO 20282-1:2006 Ease of operation of everyday products
- ISO/TS 20282-2:2013 Usability of consumer products and products for public use—Part 2: Summative test method
- HSS: U.S. Department of Health and Human Services: Research-based Web Design & Usability Guidelines on web design for carer monitoring and supervision
- (multipart) ISO/IEC TR 29138:2007 Information technology – Accessibility considerations for people with disabilities
- ICC A117.1:2009 Standard and Commentary: Accessible and Usable Buildings and Facilities boasts being the first standard in this field; it is the basis for the current ANSI standard A117.1:2017 with the same title

Furthermore, some national standards or regulations were indicated:

- The Canadian Common Look and Feel 2.0 (CLF 2.0) Standards (Government of Canada) cover:
    - Part 1: Standard on Web Addresses (tbs-sct.gc.ca)
    - Part 2: Standard on the Accessibility, Interoperability and Usability of Web sites – coding practices for accessibility
    - Part 3: Standard on Common Web Page Formats – to create a common look and feel of Web pages so that they could be easily identified as belonging to the Government of Canada
    - Part 4: Standard on Email – for consistent identification of government employees

- Swedish National Guidelines for Public Sector Websites, in particular the development of web content for mobile devices extending the accessibility guidelines for the mobile internet
- United States Environmental Protection Agency (EPA) Section 508 *Accessibility* stipulates that Persons with disabilities should have comparable access to electronic and information technology accessibility

The Australian Government's "The Whole Journey. A guide for thinking beyond compliance to create accessible public transport journeys" (©Commonwealth Australia, 2017) mentions all academic approaches to AT and accessible design referring to "Important elements of universal design (based on Audirac, 2008):

- **Accessible design**: designing for equal usability for all with regard to mobility, facilities, devices and services, and incorporating disability access standards
- **Inclusive design**: designing products and services for the needs of the widest possible audience.
- **User-centred design**: placing users' perspectives and needs at the centre of the design process.
- **Barrier-free design**: constructing or retro-fitting infrastructure and vehicles to eliminate barriers and obstacles that would otherwise restrict the range of users and purposes for which the space can be used.
- **Trans-generational design**: improving quality of life for people of all ages and level of mobility both now and into the future.
- **Assistive technology**: engineering that supports improved access for people with disability to complete tasks by increasing, maintaining, or improving the functional capabilities and independence to facilitate accessibility and participation."

One could add Design for All (DfA) and universal design. The TRIPS approach of Co-design-for-All and the respective methodology is a further development of these approaches. The ***Australian Government's approach is not only pragmatic, but most helpfully useful, as its Guide lists recommendations that fall under any of these names.***

In some cases, the concept of "accessibility" is extended towards other circumstances which de facto can have a disabling effect on users:

> *"Delivering an accessible, whole public transport journey is important not only for those with permanent disability, but also for people who may have a temporary disability—such as an injury—as well as older people, pregnant women, people travelling with children, and people who are in unfamiliar locations or carrying luggage, goods or equipment." (©Commonwealth Australia, 2017, p.2)*

The Transportation Research Board (TRB), a program unit of the USA's National Academy of Sciences, Engineering and Medicine, also takes a broader view on disabilities concerning "Making travel more equitable for people with disabilities"[33]. It includes for instance persons with allergies as somehow equivalent to persons with disabilities.

Manitoba (Canada), too, takes a very broad approach to accessibility of persons with disabilities in all walks of life: "A disability, aging, an injury and other life events may temporarily or permanently affect: Mobility, Dexterity (use of hands), Vision, Hearing,

[33] http://www.trb.org/main/blurbs/180346.aspx

Communication, Understanding, Mental health"[34]. "People with disabilities often can't do activities that most of us take for granted. It's not because they don't want to. It's because they can't … because barriers stop them." The 6 main kind barriers identified for Manitobans with disabilities are multifaceted, including:

- attitudinal – *probably no AT-related standards exist, but guidelines*
- information and communication – *beyond WCAG2.0 standards exist on narrow application aspects (usually not well coordinated), more generic standards (such as WCAG2.0) need to be developed*
- architectural – *broadly considered in standardization: many standards exist, we only need to identify and refer to existing collections of standards (e.g. ISO Handbooks), pertinent literature*
- physical – *some standards exist concerning tools/equipment, classification, etc.*
- technological – *many standards exist on individual specific AT aspects*
- systemic/organizational – *AT-related aspects are hardly mentioned e.g. in standards concerning management, corporate social responsibility, ethics, etc., maybe mentioned in official regulations?*

This led to the Accessibility for Manitobans Act stating:

> ***"Purpose***
> *2(1) The purpose of this Act is to achieve accessibility by preventing and removing barriers that disable people with respect to*
> *(a) employment*
> *(b) accommodation*
> *(c) the built environment, including*
> *(i) facilities, buildings, structures, and premises, and*
> *(ii) public transportation and transportation infrastructure*
> *(d) the delivery and receipt of goods, services and information; and*
> *(e) a prescribed activity or undertaking."* (AMA 2013)

The ISO Strategic Advisory Group (SAG) on Accessibility was created by ISO/TMB in 2018 with the **Mandate** to align work on accessibility issues within IEC, ITU and ISO, in line with the recommendations from 2010, to address, decide and monitor key issues related to accessibility. This covers:

- Map existing ISO standards related to accessibility;
- Map ongoing standardization work in ISO, IEC and ITU relating to accessibility;
- Take into account other relevant international initiatives;
- Develop recommendations on tools to assist the TC community in developing standards that take accessibility into consideration;
- Liaise with CEN and CLC to exchange best practices and study results from CEN Strategic advisory group on accessibility;
- Give recommendations to ISO on the development of new standards on accessibility.

The ISO/SAG was further asked to:
1) Re-open the question of the 'check-box' on accessibility in Form 4 to be discussed at the Directives Maintenance Team (DMT) meeting.

[34] http://www.accessibilitymb.ca/accessibility-barriers.html

2) To investigate the possibility to create new ICS codes to categorize standards with accessibility focus or elements of accessibility to enable committees and standard users to find these elements more easily.

Annex C provides an extract of the standards collected and evaluated by ISO/SAG Accessibility from the xls file "Mapping_SAG_2020_20_jan_to_SAG"[35]. Compared to the information in Annex A extracted from the EU Rolling Plan for ICT Standardization (RPIS 2020) this still represents a fraction of potential standards of relevance to TRIPS.

Interesting in the above-mentioned examples for comprehensive public accessibility strategies and regulations is a ***strong focus on interhuman communication, information, understanding*** – not only a focus on technology. It is also conspicuous that hardly any technical standard is mentioned ("technical standard" here understood as covering the broad range of standardization topics). Moreover, these examples take a more ***"scenario-oriented" approach***, not the normal standard development approach of focusing on a more or less isolated topic.

2.5 Standards and guidelines related to accessibility & transport

Under the IN LIFE project a Database of Information on Standards Concerning Accessibility and eInclusion was started based on several collections of information on standards, such as ISO/IEC TR 29138-2:2009 *Information technology – Accessibility considerations for people with disabilities – Part 2: Standards inventory.* This inventory was weak in terms of structuring and categorization. The data were merged with those of ETSI SR 001996 V6.1.1:2013-08 *Human Factors (HF); An annotated bibliography of documents dealing with Human Factors and disability* and later updated and extended by consulting standards evaluations of several EU projects and other sources, such as atis4all which lists the important standards concerning international organizations (ISO, ETSI, Guidelines and technical specifications, CEN/CENELEC standards and National databases of standards). In 2016 several other projects' collections of information on standards were analysed and – as far as necessary – integrated, also taking into account the summary of standards found in AALIANCE² whose repository shows a more systematic categorization. Thereafter, a new source of information on standards related to AAL aspects emerged in the standards section of the European Innovation Partnership (EIP).

> "*This section contains a complete overview of the present situation of European and International standardization in the topics related to Active and Healthy Ageing (AHA), covering standards, technical reports and technical specifications, but also guidance documents, industry standards, databases and scientific methodologies and tools*."
> (European Commission, EIP on AHA, standards, n.d.)

The EU project PROGRESSIVE[36] also developed a website offering access to information on over 250 relevant standards. The focus of its section on standards is on technologies that support active and healthy ageing. Users can search for standards and guidance across 8 key areas. Some of the information on pertinent standards was incorporated into the IN LIFE database. This database seems to be the most comprehensive collection of this sort focused on eAccessibility&eInclusion. In addition to the data collection of the ISO SAG Accessibility

[35] https://connect.iso.org/
[36] https://progressivestandards.org/standards/ or https://progressivestandards.org/standards-database/

(See Annex C), a search in the database with the keyword "transport" resulted in the following additional standards or other regulations or guidelines:

Accessibility Guidelines for Transportation Vehicles **Name:** Americans With Disabilities Act (ADA) Accessibility Guidelines for Transportation Vehicles	https://www.federalregister.gov/documents/2016/12/14/2016-28867/americans-with-disabilities-act-ada-accessibility-guidelines-for-transportation-vehicles	**Availability:** Free to Access **Type:** Guidelines **Issue Year:** 2017
Accessible Bus Stop Design Guidance **Issuing Organisation:** Transport for London	http://content.tfl.gov.uk/bus-stop-design-guidance.pdf	**Availability:** Free to Access **Type:** Guidance **Issue Year:** 2017
Accessible tourism for all — Requirements and recommendations **Issuing Organisation:** ISO **ISO/DIS 21902 (2019)**	https://www.iso.org/obp/ui/#iso:std:iso:21902:dis:ed-1:v1:en	**Availability: Available to Purchase** **Type: Standard** **Issue Year: Under development**
Assistive products for persons with vision impairments and persons with vision and hearing impairments -- Acoustic and tactile signals for pedestrian traffic light Identifier: ISO 23600:2007	https://www.iso.org/standard/41683.html	**Availability: Available to Purchase** **Type: Standard** ***THIS STANDARD WAS LAST REVIEWED AND CONFIRMED IN 2016. THEREFORE, THIS VERSION REMAINS CURRENT***
Americans with Disabilities Act (ADA) Standards for Transportation Facilities	https://www.access-board.gov/guidelines-and-standards/transportation/facilities/ada-standards-for-transportation-facilities	**Availability:** Free to Access **Type:** National Regulation **Issue Year:** 2006
City Resilience Development – Maturity Model CWA 17301: 2018	https://www.cencenelec.eu/research/CWA/Pages/default.aspx	**Availability:** Free to Access **Type:** European standard **Issue Year:** 2018
City Resilience Development – Operational Guidance CWA 17300:2018	https://www.cencenelec.eu/research/CWA/Pages/default.aspx	**Availability:** Free to Access **Type:** European standard **Issue Year:** 2018
Design for All Protocol CEN and CENELEC	ftp://ftp.cencenelec.eu/EN/EuropeanStandardization/Fields/Accessibility/DfA/protocol/Doc_1TheProtocol.pdf	**Availability: Free to Access** **Type: Guidelines** **Issue Year: 2017**
Disability Standards for Accessible Public Transport Australian Government	https://www.legislation.gov.au/Details/F2011C00213	**Availability: Free to Access** **Type: National legislation** **Issue Year: 2002 (Reissued 2011)**
Wheelchairs -- Part 10: Determination of obstacle-climbing ability of electrically powered wheelchairs ISO 7176-10:2008	https://www.iso.org/standard/45984.html	**Availability: Available to Purchase** **Type: International Standard** **Issue Year: 2008** ***THIS STANDARD WAS LAST REVIEWED AND CONFIRMED IN 2018. THEREFORE, THIS VERSION REMAINS CURRENT.***
Sustainable cities and communities - Guidance on establishing smart city operating models for sustainable communities	https://www.iso.org/standard/62065.html	**Availability: Available to Purchase** **Type: International standard**

ISO 37106		**Issue Year: 2018**
Guidelines to standardisers of Collective Transport Systems - Needs of older people and persons with disabilities - Part 1: Basic Guidelines -	https://www.nen.nl/NEN-Shop-2/Standard/CWA-4554612004-en.htm	**Availability: Available to Purchase** **Type: Guidelines** **Issue Year: 2004**
Indicators for city services and quality of life ISO 37120:2018	https://www.iso.org/standard/68498.html	**Availability: Available to Purchase** **Type: International standard** **Issue Year: 2018**
Information presentation using electronic guiding and wayfinding system JIS T 0901	https://ia801903.us.archive.org/17/items/jis.t.0901.e.2011/jis.t.0901.e.2011.pdf	Availability: **Free to Access** Type: **Standard** Issue Year: **2005 (2011)**
Public information guidance systems -- Part 2: Guidelines for the design and use of location signs and direction signs ISO 28564-2:2016	https://www.iso.org/standard/56797.html	**Availability: Available to Purchase** **Type: International standard** **Issue Year: 2016**
M/473 Standardisation mandate to CEN, CENELEC and ETSI to include "Design for All" in relevant standardisation initiatives	https://ec.europa.eu/growth/tools-databases/mandates/index.cfm?fuseaction=search.detail&id=461	**Availability: Free to Access** **Type: Standardisation Request** **Issue Year: 2010**
Mobility of the elderly through OV-bureau Groningen Drenthe	https://sociaalplanbureaugroningen.nl/wordpress/wp-content/uploads/2018/01/ITRACT-Mobility-of-the-elderly-through-ICT-support.pdf	Availability: **Free to Access** Type: **Publication** Issue Year: **2014**
Public Information Guidance Systems ISO 28564-1:2010	https://www.iso.org/standard/44762.html	**Availability:** Available to Purchase **Type:** International standard **Issue Year:** 2010 ***THIS STANDARD WAS LAST REVIEWED AND CONFIRMED IN 2018. THEREFORE, THIS VERSION REMAINS CURRENT.***
Final recommendations: 2018 Review of the Accessibility Transportation Standards, Transportation Standards Development Committee - Ontario, Canada	https://www.ontario.ca/page/final-recommendations-2018-review-accessibility-transportation-standards	**Availability:** Free to Access **Type:** National recommendations **Issue Year:** 2018
Smart City Guidance Package for integrated planning and management European Innovation Partnership on Smart Cities and Communities version 3.29, 10/06/2017	https://eu-smartcities.eu/sites/default/files/2017-09/SCGP%20Intermediate%20version%20June%202017.pdf	**Availability: Free to Access** **Type: Guide** **Issue Year: 2017**
Intelligent transport systems - Public transport - Traveller Information for Visually Impaired People (TI-VIP) CEN/TR 16427:2013	https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:36788,6259&cs=1434BFFC1158A07DD47494001059C99D9	**Availability: Available to Purchase** **Type: Technical Report** **Issue Year: 2013**

Table 4: Standards or other regulations or guidelines not included in the collection of the ISO/SAG Accessibility and extracted from the IN LIFE Database of information on standards

Annex C: Extract of standards identified by ISO/SAG "Strategic Advisory Group (SAG) on Accessibility" under the keywords "Transport", "Accessibility deliverables", "Guide to

standards developers", "Consumer products (incl. information)" and "Other than ISO IEC" reveals:

- There are many committees and other groups in the field of formal standardization as well as in all kinds of consortia and other organizations active in standardizing accessibility and AT aspects
- Most committees/groups work quite autonomously, which results in a comparative lack of semantic coherence among standards – very few standardization fields traditionally cooperate and coordinate their activities, since recently a few are starting to cooperate and coordinate across committees and SDOs
- **In the fields of *accessibility there is a lack of cross-referencing in standards and coordination across committees and SDOs***
- Access to information on standards is very difficult – even for people strongly engaged in standardization activities since decades
- Many documents are not called standards, but they are of the nature of standards – some standards figure under guide, guidelines, specification, technical report, etc.

The three biggest problems with regard to access to pertinent standards are:

- Information on standards are difficult to find and pose a great barrier to applying standards and engaging in standardization activities
- Even, if somebody can find information on standards dealing with accessibility and AT issues, there are probably many more standards, where these issues are neither mentioned in the title, introduction or scope – not even in the clause dealing with the terminology used in the respective standard
- Standards are mostly developed by non-disabled experts naively assuming for non-disabled users; there are thousands of standards where accessibility issues should be dealt with at least here and there by being mentioned
- Several EU projects developed collections or databases/platforms of information on standards in the field of accessibility, but they are not maintained and updated after the end of the project

2.6 Obstacles to engage in standardization activities in fields of accessibility and AT

Although it is a recognized principle "if about us, not without us"[37], persons with disabilities, their caregivers and service providers as well as the organizations active in the field face barriers and obstacles against active participation in pertinent standardization activities, such as:

- Problems to find and access information on standards and standardizing activities
- Access to information on upcoming standardisation activities

Key takeaway:
Besides, the number of standards of relevance to accessibility is growing year after year, dedicated committees (and their subcommittees or working groups) increase and other

[37] Often called 'Nothing about us, without us' 'https://en.wikipedia.org/wiki/Nothing_About_Us_Without_Us

committees are taking up accessibility aspects, more and more SDOs are getting engaged in the topic for standardization activities, etc.

Obviously, this development also triggers the need for coordination activities and cooperation. The WSC is one example at the level of the international standardization organizations. The EU Commission Mandate M/376 resulted in the establishment of the CEN/CLC/ETSI/JWG eAcc – eAccessibility and a number of EN standards. The need for some ISO-internal coordination resulted in ISO/TC 314 *Aging societies* established 2017 and some standards documents on inclusion aspects, such as ISO/IWA 18:2016(en) "Framework for integrated community-based life-long health and care services in aged societies" or ISO 37105:2019(en) "Sustainable cities and communities — Descriptive framework for cities and communities". ISO/TC 314 has started work on:

- ISO/CD 23617 Ageing societies — Guidelines for an age inclusive work force
- ISO/CD 23623 Ageing Societies — Framework for Dementia-inclusive communities
- ISO/CD 23889 Ageing Societies — Carer-inclusive and accommodating organizations

One of the reasons behind this development taking up speed lies in the fact that more and more industry quarters are recognizing a business case for accessibility. Business arguments for accessibility need to answer affirmatively at least one of the following questions:

1. Will it make us money?
2. Will it save us money?
3. Will it reduce risk?

Karl Groves[38] (2011~2012) outlines a range of potential arguments for web accessibility:

- **Improved search engine optimization:** Customers will be able to find your site more easily because search engines can index it more effectively.
- **Improved usability:** Customers will have a more satisfying experience, thus spend more or return to your site more often.
- **Reduced website costs:** Developing to standard reduces bugs and interoperability issues, reducing development costs and problems integrating with other systems.
- **People with disabilities have buying power:** They won't spend if they have difficulty accessing your site; they will go to the competition that *does* place importance on accessibility.
- **Reduced resource utilization:** Building to standard reduces use of resources.
- **Support for low bandwidth:** If your site takes too long to load, people will go elsewhere.
- **Social responsibility:** Customers will come if they see you doing good for the world, and you are thinking of people with disabilities as full citizens.
- **Support for aging populations:** Aging populations also have money to spend and will come to your site over the less accessible, less usable competition.
- **Reduced legal risk:** You may be sued if you prevent equal access for citizens/customers or discriminate against people with disabilities.

Key takeaway:

[38] https://pressbooks.library.ryerson.ca/dabp/chapter/the-business-case-for-accessibility/

As shown in this chapter, topics related to accessibility and AT have become scattered over many standardization activities falling also under keywords like "sustainability", "smart …", etc. Seen from its basics, the fields of AT would be well advised to further focus on eAccessibility&eInclusion under a broad perspective, and also engage in standards coordination and cooperation of standardizing activities.
In this relation it must be mentioned that the EU Commission has financed a large number of R&D activities over the last decades which positively pushed this development – not only in the EU, but world-wide.

3. Standards related to content and human communication

This section gives an overview on potentially useful or necessary standards concerning interhuman communication content and the methodologies to be used in conjunction with them. Most and probably many more, are usually applied more or less unknowingly because they are implemented as 'default' in software or tools applied in AT applications/devices/services.

This section includes new standardization activities, and also takes into account new documents and project activities related to the role of human communication and its content under the perspective of '*comprehensive interoperability*'. As already mentioned, "*interoperability*" is increasingly a key issue for larger system environments at the strategic policy level. The international standard ITU-T F.791:2015-11[39] clearly states: "*The accessibility of the content delivered /should be/ differentiated from the solution's interface accessibility*". The same source states "*An accessible interface does not automatically imply content accessibility.*" Under the perspective of interoperability one can say that ICT platforms, systems, tools, devices which cannot guarantee the uncorrupted transfer of content – increasingly including conversion into other communication modalities – lack a whole dimension of interoperability.

Under a commercial perspective (from the point of view of standardizing bodies) fundamental standards related to content tend to be underestimated or even overlooked, because they hardly appear in the ranking of sales figures for standards. Under the perspective of a growing need for eAccessibility, ISO/IEC 40500:2012 "Information technology – W3C Web Content Accessibility Guidelines (WCAG) 2.0" (identical with and freely available under http://www.w3.org/TR/WCAG20/) can be considered not only as a basic and fundamental standard, but also as a breakthrough with respect to the acknowledgement of the importance of content for persons with disabilities.

The "Recommendation on software and content development principles 2010" (See Annex F) points in a direction which is highly relevant for TRIPS. It is geared towards decision makers in public as well as private frameworks, software developers, the content industry and developers of pertinent standards to make them

> *"…aware that multilinguality, multimodality, eInclusion and eAccessibility need to be considered from the outset in software and content development. These considerations*

[39] ITU-T F.791:2015-11 Accessibility terms and definitions: Series F: Non-telephone telecommunication services. Audiovisual services

are required in order to avoid the need for additional or remedial engineering or redesign at the time of adaptation, which tend to be very costly and often prove to be impossible."

Chapter 3 outlines various dimensions and aspects of structured and unstructured content from the point of view of persons with disabilities as users who need to communicate with or without technology support. It also outlines possible solutions to problems which might overwhelm people engaged in operating transport systems and services.

3.1 "Standards on data to be provided" and interoperability

ISO/IEC Guide 2:2004[40] defines 'standard on data to be provided' as:

> *"standard that contains a list of characteristics for which values or other data are to be stated for specifying the product, process or service*
> *NOTE Some standards, typically, provide for data to be stated by suppliers, others by purchasers."* (ISO/IEC, 2004)

However, this definition of 'data to be provided' is far too narrow in view of all the kinds of structured content – micro-content of all sorts – necessary for the emerging eApplications, such as eComerce&eBusiness, eHealth, eLearning, etc.

Standards related to structured content can be subdivided into

- methodology standards, such as metadata-related standards, or standardized rules for all kinds of coding systems
- ***standardized entities of micro-content*** (i.e. content entities at the level of lexical semantics), such as terminological and lexicographical data, codings (e.g. language codes, country codes, airport and harbor codes, etc.), controlled dialogues, micro-LOs (micro learning objects), factual data of all sorts (e.g. times of timetables, train stations or bus stops, etc.) which may not necessarily be standardized, but usually follow standards

Such standards are of high importance with respect to eAccessibility in combination with interoperability for communication:

- among Persons with disabilities, their carers and people around (strongly relying on Human-Human communication)
- between Persons with disabilities & their carers and the devices used to support this communication (Human-Machine communication)
- among the devices to support the communication between the humans involved (Machine-Machine communication).

Megatrends in the development of standards indicate that the 'object' of standardization shifted over the last years:

- from technical standards (in the old meaning of hardware and software) around 1900 to methodology standards (incl. management standards of all sorts) after 1950
- to content standards referring to standardized content – first of all micro-content – of all sorts in the course of the development of the Internet, today.

Due to the emergence of ICTs the implementation of an ever-increasing number of types of standards relies to a large degree on the application of such ICTs. However, it is also being

[40] ISO/IEC Guide 2:2004(en) Standardization and related activities — General vocabulary

increasingly recognized that semantic IOp has more dimensions than assumed in the past, and data quality strongly depends on content IOp. Data quality of structured content thus also heavily depends on the quality of the metadata, and content IOp largely depends on the interoperability of data models and ontologies (according to data quality monitoring project for open data ADEQUATe (Donau-Universität Krems, 2015).

In connection with content IOp the EU project universAAL offered a technical approach to cope with new dimensions of interoperability. Confirming what has been stated above, it starts off from:

> *"There are three forms of cooperation of systems: compatibility, interactions with de-facto standards and interoperability through standards (see Figure 3.1).*
> ***Compatibility** means the tolerance of different systems. From the technical point of view, it describes either the interchangeability of modules, the compatibility or the equivalence of properties.*
> ***A de-facto-standard** is a technical standard which has proved technically useful and correct over the years by the practice of many different manufacturers and users: to comply certain pragmatic rules and standards when you have a certain problem. But a (inter-)national standardisation procedure was not carried out.*
> ***Interoperability** is the ability to work together from different systems, technologies and organisations. For this, usually it is necessary that common norms and standards are observed."*

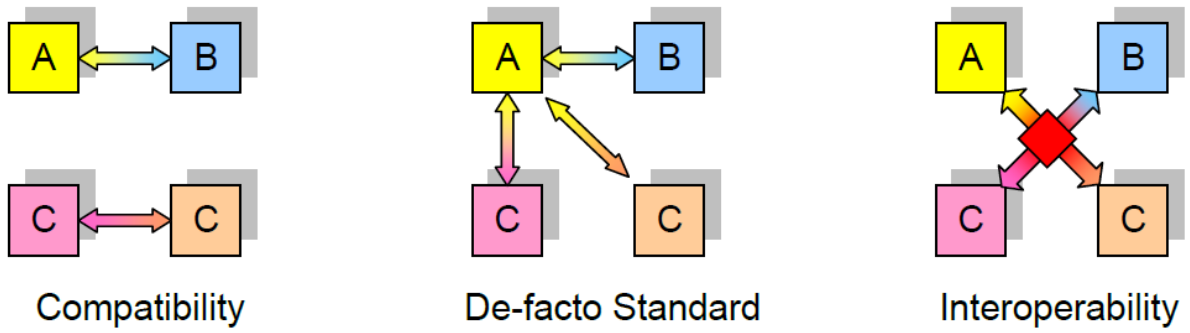


Figure 5: Three forms of cooperation of systems

> *"If you look at the applications in AAL, you quickly realize that the products are most closely related to each other, although they come from different sectors and from different manufacturers. Also, their functions are at first sight quite different.*
> *The interaction of each device is often essential. As assistant systems of AAL always must be adjusted to the actual life situation of the user, which can change over time, for example the occurrence of chronic diseases and deterioration of mental or physical health. The assistance systems need to evolve in parallel. It must be easy and cost-effective to retrofit or expand existing systems. This will require long-term stability through manufacturers‟ interoperable interfaces that enable a "plug and play" of components."* (universAAL Consortium, 2012)

There is no uniform definition for the term interoperability. A report by the European Telecommunications Standards Institute[41] refers to a description in which interoperability is divided in four different levels, which clearly establish each other:

[41] Taken from: BMBF/VDE Innovationspartnerschaft AAL (Hrsg.). (2010) Interoperabilität von AAL-Systemkomponenten. Teil 1: Stand der Technik. VDE Verlag, 2010

- Protocol Interoperability: The ability to share, bits and bytes over a network
- Service Interoperability: The ability to exchange messages in well-defined format
- Application Interoperability: The ability to interpret the exchanged data uniformity
- User Perceived Interoperability: The components of a system to communicate effectively, accurately and provide the services expected by the user.

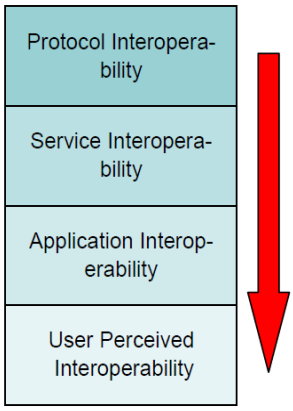


Figure 6: Model interoperability levels

> *"The four different classes are based on each other. Interoperability from the perspective of a human user will only be possible if the application systems and the applications used by him are interoperable. This in turn requires that the network services used by these applications to exchange messages, commands, files, images and sounds are interoperable. In addition, this requires that the actual exchange of raw data ("bits and bytes ") is interoperable, which is only possible if the electrical and electronic components (connectors and cables) or wireless components are."* (universAAL Consortium, 2012)

As some standards focus on only one or a few related issues and others, complex ones, are covering broad horizontal issues, it is difficult to map the complex standards to the four levels. Thus,

- Some telecommunication standards cover mostly the protocol interoperability level, very often the service interoperability level and sometimes even the application interoperability level
- Some messaging and healthcare standards as well as security standards may go up to the service interoperability level.

UniversAAL (D8.3.B, Table 3.1) provides a detailed mapping of the standards described in this deliverable to the four levels:

Standard	**Protocol IOp**	**Service IOp**	**Application IOp**	**User Perceived IOp**
Bluetooth (IEEE 802.15)	X	X		
Wi-Fi (IEEE 802.11)	X	X		
ZigBee	X	X		
Global System for Mo-bile Communication (GSM)	X	X	X	
General Packet Radio Services (GPRS)	X	X	X	
Universal Mobile Tele-communications System (UMTS)	X	X	X	

Standard	Protocol IOp	Service IOp	Application IOp	User Perceived IOp
Mobile Data Services: Short Message Service (SMS)		X	X	
Mobile Data Services: Wireless Application Protocol (WAP)	X	X		
Mobile Data Services: Multimedia Message Service (MMS)		X	X	
Ethernet (IEEE 802.3)	X	X		
USB	X			
Internet Message Format (RFC2822)		X	X	
Multipurpose Internet Mail Extensions (MIME, RFC2045 – 2049)		X		
E-Mail Protocols Simple Mail Transfer Protocol (SMTP, RFC2821)	X	X		
Post Office Protocol version 3 (POP3, RFC1939)	X	X		
Internet Message Access Protocol (IMAP, Version 4: RFC3501)		X		
SOAP		X	X	
EXtensible Markup Language (XML)		X	X	
HTTP The Hypertext Transfer Protocol	X	X	X	
ISO 15000 - Electronic Business using eXtensible Markup Language (ebXML)		X	X	
ISO EN 11073 family		X	X	
Cross-enterprise Clinical Document Sharing (IHE XDS)		X		
IHE Patient Care Device Technical Framework (PCD)		X		
Universal Plug and Play (UPnP)			X	X
Universal Remote Con-sole (URC)			X	X
Web Ontology Language (OWL)			X	X
Resource Description Framework (RDF)			X	X
Devices Profile for Web Services (DPWS)			X	X
Unified Modeling Language (UML)			X	X
Transport Layer Security (TLS)		X		
Security Assertion Markup Language (SAML)		X		
Audit Trail and Node Authentication (ATNA)		X		
Public Key Infrastructure (PKI)		X		
Web Services Security (WS-Security)		X		

Table 5: Assignment of standards to the four layers of universAAL

UniversAAL (D8.3.B) concludes:

"Interoperability can have important consequences in the economy, because monopolies can be built or removed by patents, trade secrets or errors in the coordination. For the governments, it may therefore be advantageous to support and promote interoperability." (universAAL Consortium, 2012)

From a linguistic perspective these are standards on technicalities rather than true interhuman communication semantics. ***The above indicates that there is a gap in semantic IOp with respect to content IOp which needs to be extended towards human content resources (HCRs), in order to take into account truly "semantic" aspects and variations of language use as well as of communication modalities beyond spoken and written.***

Key takeaway:
From the above, it may be necessary to take into account a higher degree of real-life interhuman communication variation on the one hand, while trying to find methods to constrain variation by standardizing approaches and content as much as necessary for the intended use. In this connection, it might be also worthwhile to consider an efficient reuse and re-purposing of content which requires standardization activities aiming at methodology standards focused on content as well as data/content standards aiming at the standardization of content.

Communication of content in the form of data exchange/interchange takes place in systems related to eAccessibility&eInclusion or eHealth and other fields where among others human safety and security is at stake. Here communication must be as frictionless and flawless as possible. This means that data (content) must retain its semantics across all processes and transmissions. Increasingly one uses all kinds of structured content at the level of lexical semantics – also called microcontent. Such microcontent may be used for communicative purposes, for the purpose of supporting human communication, for structuring data or organizing ICT systems. At word level, many microcontent entities look similar and may be used for similar purposes, such as for machine translation. But they have also other functions with the respective methods each. They may belong to different degrees of granularity.

At the most granular level standards refer to symbols and/or identification codes representing individual information objects of comparatively low complexity, such as:

- ISO 10646 *Information technology - Universal Coded Character Set (UCS)* (the Unicode standard is developed in close coordination with ISO 10646): all individual characters or glyphs have a code (=ID) which makes them uniquely identifiable irrespective of their form of rendering, such as font or style
  EXAMPLE: **U+1D4AB** stands for $\mathcal{P}$ MATHEMATICAL SCRIPT CAPITAL P
- Codes for proper names, such as
  - (multipart) ISO 3166 *Codes for the representation of names of countries and their subdivisions*, in particular ISO 3166-1:2013 *Codes for the representation of names of countries and their subdivisions – Part 1 Country codes*
    <u>EXAMPLE</u>: the ISO 3166-1 unique country code for Finland is **246 (numeric)** among others standing for FI (alpha-2), FIN alphs-3), EF (ICAO airport prefix), OFA-03Z (ITU calling prefix), +358 (telephone prefix)
  - (multipart) ISO 639 *Codes for the Representation of Names of Languages*
    EXAMPLE: **fr-CA** (or its numeric representation) means Canadian French

- ISO 15924:2004 *Information and documentation – Codes for the representation of names of scripts*
  EXAMPLE: **Cyrl** for Cyrillic or **Hant** for Han (i.e. Chinese in traditional characters)
- similar codes exist for numerous types of proper names such as airports, maritime ports, cities, individual ships, containers, cars, persons (e.g. citizen card number), book publications, quantities and units (see UCUM: Unified Code for Units of Measure), time zones, institutions, organizations, companies, etc.

The above-mentioned standards not only comprise unique codes for the entities covered by them, but also the methodology of how to name and use them. At this basic level of 'semantics' eApplications (such as eHealth, eBusiness/eCommerce, eLearning etc.) are full of coding systems with all kinds of identifiers (IDs) for '*information objects*'.

The standards on units and measures are a good example for how standards emerged originally based on ISO 2955:1983, ANSI X3.50:1986, and HL7's extensions called ISO+. Later they had to be adapted to new needs in eHealth and other eApplications. Because these early standards used limited character sets, they seem to be of less value today where graphical user interface and high-resolution printers are in wide-spread use, which is why the ENV 12435 declares ISO 2955 obsolete. The issue about displaying units in the common style defined by the 9th Conférence Générale des Poids et Mesures (CGPM) in 1947 is not just the character set to be used. Although the Unicode Standard and its predecessor ISO/IEC 10646 is the richest character set ever, it is still not enough to specify the presentation of units because there are important typographical details such as superscripts, subscripts, roman and italics. Besides, there exist large amounts of legacy data using the limited character sets. The new Unified Code for Units of Measure (UCUM) is based on the ISO 80000 (series) *Quantities and Units* that specify the use of System International (SI) units in publications. ISO 80000 series standards are developed by ISO/TC 12 *Quantities and units* in co-operation with IEC/TC 25 *Quantities and Units*. UCUM is very stable in content and has already been adopted by some standard organizations such as DICOM, HL7 and has been referenced as best practice by the Open Geospatial Consortium in their Web Map Service (WMS) and Geography Markup Language (GML) implementation specifications.

The specification is maintained electronically so that the printed version is guaranteed to contain consistent and tested data that is free from severe name conflicts or random errors.

- The full specification is now available as an HTML document (whereas it used to be only a PDF file).
- The new XML format of the specification allows for XML releases of the formal part of the specification, and besides, has better sorting and indexing capabilities, etc.

Key takeaway:
The above-mentioned and similar standards are so fundamental to the whole of the Internet and WWW that they should be used as default in all developments – if possible, in the standardized representation. In cases where local language equivalents or other modalities are used, the exchange of data/content should be done through the respective IDs/codes representing the respective information objects. If not data exchange would encounter serious 'semantic' problems – particularly, if used in eAccessibility&eInclusion or related fields. Most of these standards are anyhow implemented as 'defaults' in widely used ICT hardware, software and applications.

In addition to UCUM, past project partners mentioned other 'standards' – some at a higher level of granularity – refer to individual 'information objects' e.g. as in many (medical or other) nomenclatures, such as:

- ICF: International Classification of Functioning Disability and Health
- ICD: International Statistical Classification of Diseases and Related Health Problems
- SNOMED: Systematized Nomenclature of Medicine
- ATC/DDD: Anatomical Therapeutic Chemical classification system/ Defined Daily Dose
- UMLS: Unified Medical Language System (USA)
- International Standard Classification of Education – ISCED 2017 (UNESCO)
- American Diabetes Association Standards of Medical Care in Diabetes—2016 – in particular Chapter 2 Classification and Diagnosis of Diabetes
- GOLD 2017 guidelines for COPD– in particular the parts containing classification or vocabulary

Key takeaway:
Most of the above can be used for different purposes (with different functions), such as for describing patients' cases, (record) documentation, indexing and retrieval, classification for statistics. In any case, BEWARE: they are not 'terminologies', although they may look similar and are sometimes referenced as such.

An ever-growing share of standards is dealing with structured content (ICT experts would say 'structured data') of all sorts. Some are identification schemes for all kinds of proper names (e.g. geographical names, like country names according to ISO 3166) entries of specific nomenclatures and classification schemes, metadata about structured content, etc. They are mostly considered as 'information objects' which can and need to be identified and coded. From a point of view of 'semantics' such structured content is rather flat, but the respective ID schemes serve their purpose.

Infoterm, also in its capacity as "Twinned Secretariat" of ISO/TC 37, is often consulted concerning multilingual issues, coding methodology, naming principles and so on in connection with such codes which are indispensable for data interchange in eCommerce&eBusiness, eHealth, eGovernment etc. Infoterm is frequently pointing out that there may be unexpected eAccessibility&eInclusion issues with respect to people who must work with and use the codes. Nonetheless, these 'codings' have become a huge field of 'semantic' standardization of its own. In the earlier mentioned IN LIFE Database they are only considered, if they are really pertinent to eAccessibility&eInclusion and related aspects.

Another big area of 'structured content', namely terminologies/vocabularies, may be useful in many cases. Generally speaking, terminologies occur in domain- or subject-specific communication for the sake of transparent written or spoken communication and representation of conceptual knowledge. Standardized terminology as occurring in most of existing standards, usually are necessary to understand the content of the respective standard. Their potential use as indexing terms is largely underestimated.

Standardized terminologies (or vocabularies) are for instance:

- ISO 17115:2007 *Health informatics – Vocabulary of compositional terminological systems*

- ETSI ES 202 076:2009 *Human Factors (HF); User Interfaces; Generic spoken command vocabulary for ICT devices and services*
- EN 13940-1:2007 *Health Informatics - System of concepts to support Continuity of care - Part 1: Basic concepts*

…and in addition, the parts (normally in chapter 3 "Terms and definitions") on terminology in thousands of standards. In ISO 9999:2016 *Assistive products for persons with disability — Classification and terminology*, the terminology for understanding the standard is defined in chapter 2, while the classification is contained in chapter 6. From the above it becomes clear that the standardized 'terminologies' mentioned so far could be seen as 'meta-terminologies' about the domain or subject on which the respective standard focuses.

Other terminologies/vocabularies – sometimes extended towards mini-statements (or messages) – standardize verbal or non-verbal communication elements, such as for instance the Aviation English of ICAO (International Civil Aviation Organization) requiring aviation professionals involved in international operations to demonstrate a certain level of English language proficiency – or more precisely the English for special purposes (ESP) of aviation. There is even a test for *English Language Proficiency for Aeronautical Communication* (*ELPAC*) based on defined standards. Aviation English can also be seen as a sort of 'controlled language' with different levels of proficiency. Often such kinds of controlled language are designed for and used in circumstances of 'critical communication'. Within the sphere of eAccessibility&eInclusion there are probably many circumstances which would benefit from the existence of a controlled language (also in multilingual applications).

However, communication is not only through 'words', but also through other communication modalities. Some traffic signs refer to persons with disabilities, even more so graphical symbols, such as in ISO 7001:2007 *Graphical symbols – Public information sy*mbols. The standard on *Pictograms of the Aragonese Portal of Augmentative and Alternative Communication* (AAC) at national level is clearly focusing on the aspect of communication content with respect to eAccessibility&eInclusion. CWA 14835:2003 *Guidelines for making information accessible through sign language on the web* (today replaced by WCAG2.0) pioneered with respect to methods of managing such content. Such kinds of 'controlled communication' (in analogy to 'controlled language' – is applied for instance in AAC.

All accross standardization, the share of 'content-related' standards (especially in the eApplications, such as eHealth, eBusiness&eCommerce) is growing. However, standards concerning the content of inter-human communication in the field of eAccessibility&eInclusion are clearly underrepresented. This refers to standards:

- containing content elements of such communication (e.g. in the form of 'controlled communication' not confined only to verbal-linguistic communication)
- about the methods to develop and maintain the above
- about the ICT-support systems/tools for the above

Such standards in their totality should take into consideration the multidimensional and multifaceted categories of human communication across all needs and modalities.

The need or usefulness for such kind of standard is evidenced by previous project partner's comment which explicitly refers to Blisssymbols and other such means for communication with intellectually disabled persons which should be standardized as soon as possible. For the sake of world-wide harmonization, the methods applied for Blisssymbols should also be

standardized – including the symbols and the procedures for establishing and maintaining the respective content resources. On the basis of such a methodology standard the consistency of such repositories and their sustainability would largely benefit.

An 'unofficial source' at ISO: *Inventory of accessibility and accessibility-related information technology standards and specifications* exemplifies the evaluation given so far. It lists under ***content-oriented standards*** focused on accessibility:

ISO and ISO/IEC standards:

- ISO 14289-1:2012 *Document management applications — Electronic document file format enhancement for accessibility — Part 1: Use of* ISO 32000-1 *(PDF/UA-1)*
- ISO/IEC 15897:2011 *Information technology — User interfaces — Procedures for registration of cultural elements*
- ISO/IEC 20016-1:2014 *Information technology for learning, education and training – Language accessibility and human interface equivalencies (HIEs) in e-learning applications – Part 1: Framework and reference model for semantic interoperability*
- ISO/IEC 21000-7:2007 *Information technology — Multimedia framework (MPEG-21) — Part 7: Digital Item Adaptation* (and Amd.1:2008 as well as Cor.1:2008)
- ISO/IEC/TR 30112:2012 *Information technology — Specification methods for cultural conventions*
- ISO/IEC 40500:2012 *Information technology — W3C Web Content Accessibility Guidelines (WCAG) 2.0*
- IEC 62665:2012 *Multimedia systems and equipment — Multimedia e-publishing and e-books technologies — Texture map for auditory presentation of printed texts*

Other global standards and guidelines

- ITU-T H. Sup. 1 1999 *Video Quality for sign language and lip reading*
- WCAG1.0:1999 *Web Content Accessibility Guidelines 1.0*
- WCAG2.0:2012 *Web Content Accessibility Guidelines 2.0 – identical with ISO/IEC 40500:2012*

Regional and national standards, guidelines and regulations

- CWA 14835:2003 *Guidelines for making information accessible through sign language on the web*
- JIS X 8341-3:2016 *Guidelines for older persons and persons with disabilities — Information and communications equipment, software and services — Part 3: Web Content* (JAPAN)
- KICS.OT-10.0003:2013 *Korean Web Content Accessibility Guidelines 2.0* (Korea)
- UNE 139803:2004 *Computer applications for people with disabilities. Web content accessibility requirements* (Spain)
- UNE 139804:2007 *Guidance on the use of the Spanish Sign Language on computer networks* (Spain)

Content-oriented standards containing some accessibility provisions

- ISO/IEC 15944-7:2009 *Information technology — Business Operational View — Part 7: eBusiness vocabulary*
- ISO/IEC 23009-1:2012 *Information technology — Dynamic adaptive streaming over HTTP (DASH) — Part 1: Media presentation description and segment formats*

Among hundreds of information entries on standards in this Inventory, those referring to content standards are very few as can be seen from the above list. ***Existing ones were not mentioned indicating that they are not considered relevant or could not be found due to the barriers to find information on standards.***

Character sets:

- *ANSI INCITS 4-1986 (R2012) American National Standard for Information Systems – Coded Character Sets – 7-Bit American National Standard Code for Information Interchange (7-Bit **ASCII**)*
- ISO 646 *Information Processing – ISO 7-bit coded character set for information interchange*
- *Codepage Windows-1252* (**CP 1252**) (often wrongly taken as equivalent to ASCII)
- ISO 10646 *Information technology – Universal Coded Character Set (**UCS**)* (the Unicode standard is developed in close coordination with ISO 10646 under established maintenance and updating procedures)

Whenever possible, the first 3 standards above which are dealing with 7-bit coded character sets should not be used any longer. ISO 10646 is the most authoritative character set standard of today. It accommodates not only different writing systems, but also many graphical elements, such as icons, emoticons, smileys, etc. It could also accommodate graphical elements of AAC if the respective communities would pull their act together.

Contrary to earlier assumptions, WCAG2.0 (ISO 40500:2012) which should be considered mandatory – even legally obligatory – was less indicated as being applied in EU projects than expected. Concerning content itself, WCAG2.0 may not yet guarantee content interoperability, when individual WCAG2.0 compliant content is exchanged or reused or re-purposed in another WCAG2.0 compliant system. PDF/UA compliant documents should also be WCAG2.0 compliant on the one hand, but also WCAG2.0-compliant in such a way that they are content interoperable, i.e. interchangeable, reusable, and re-purposable. *The Guidelines for accessible information. ICT for information accessibility in learning* (ICT4IAL) and CEN CWA 15778:2008 Document processing for accessibility provide valuable guidance on how to make content accessible from the outset. ICT4IAL broadly addresses content in several modalities beyond written text whereby the latter may include or not include non-linguistic representations.

Key takeaway:
Such guidelines need further development and respective requirements and specifications to be introduced as default in major software products in order to reliably result in accessible content that can be interchanged, re-used and re-purposed without any corruption of the content. It would also be useful, if there would be many good practice cases available for different application scenarios. This would pave the way for further harmonization of the practical application of pertinent standards.

Not least due to the impact of accessibility requirements, "interoperability" assumed over the last few years new dimensions, including more and more interhuman communication aspects.

> ***"The success of the Transport Standards is about achieving access for the 'whole journey'.*** *The standards are only a means to an end. Success is not achieved with partial implementation: for example, a train door may be wide enough but if a person cannot access timetable information they cannot use the train. Real success is only achieved when people are able to make the whole journey. Whole-of-journey accessibility requires that accessible provision is consistent and reliable**. It only takes one 'stranding' or one barrier along the journey for a person to lose confidence with the transport system and to disable further participation**."* (The whole journey 2014, p.3)

This also includes aspects of access to information, interhuman communication, messages and announcements of all sorts, etc.

Another upcoming standard of ISO/IEC-JTC 1, namely ISO/IEC NP 5087-3 "Information technology – City data model – Part 3: Part 3: Service level concepts -Transportation planning" is aiming at providing

> *"A common data model /that/ enables city software applications to share information, plan, coordinate, and execute city tasks, and support decision making within and across city services, by providing a precise, unambiguous representation of information and knowledge commonly shared across city services. This requires a clear understanding of the terms used in defining the data, as well as how they relate to one another. This requirement goes beyond syntactic integration (e.g. common data types and protocols), it requires semantic integration: a consistent, shared understanding of the meaning of information. …*
> *Cities deliver physical and social services that traditionally have operated as silos. If during the process of becoming smarter, transportation, social services, utilities, etc. were to develop their own data models, then we would have smarter silos. To create truly smart cities data must be shared across these silos which can only be accomplished through the use of a common data model."*

It could be worthwhile to organize input into this standard by experts of TRIPS.

Beyond the above-mentioned common data model, when the needs of persons with disabilities need to be considered, designers of a public transport system must think about a harmonized use of colours, sounds (alarms etc.), arrows (and their conversion into other modalities), ... ***This might be aggravated by the fact that some urban transport systems consist of public and private service providers, which might necessitate a big harmonization effort across enterprise cultures, data and systems. From the point of view of the technological state-of-the-art of content management systems for structured content this is a challenge, but not unsurmountable.***

From the quantitative point of view, in a city of the size of Vienna (2 million inhabitants) you may have:

- about 50 bus lines of the city transport services running during the day and 30 nightlines connected to about 600 bus stop names (sometimes with variants) and additional information; in addition, there may be many regional bus lines – often run by private enterprises – entering and leaving the city from/in all directions
- 5 metro lines with more than 110 stations
- several train lines (integrated into the interurban public transport system) with about 50 stations
- 6,842 streets, 1,700 bridges, hundreds of places, hundreds of other kinds of buildings/places of interest, hundreds of "historical" names still in use (plus orthographic conventions having changed from the late 1800s to the late 1900s)

These and other names – all falling under "microcontent" – certainly exist today as repositories and can (hopefully) be reused or made reusable. However, it definitely needs is a common data model and a strategy to integrate all resources virtually or physically.

In addition, there may be about 600~1,000 short messages or announcements (which after integration and harmonization could sum up to a few thousand). These would need to be translated into the languages most used in the urban public transport system (as much as possible including private transport services) duly considering languages of major migrant communities and tourists' origins. When harmonizing and integrating such content resources, the number of short messages or announcements or the like may increase to a few thousand.

This looks like a big endeavour, but once done, it will only need little content maintenance and updating effort over the years to come.

The endeavour may be bigger with respect to larger and more complex messages or announcements, as well as with those dealing with unexpected, but often occurring incidents of all sorts. How to deal with rather unlikely unexpected, but – according to Murphy's Law nevertheless possible – incidents, accidents or disasters will be mentioned later.

According to the basic principles of content management: 'single source' and 'resource sharing', the content of more or less "regular" written or oral messages, announcements and similar considered here as micro-content can be distinguished into:

- short word strings that are unchangeable
    - in any situation just as stand-alone messages or announcements (e.g. "doors are closing")
    - also, in a (fixed or adaptable) sequence/combination of other messages or announcements (e.g. "doors are closing" + "please step back")
- short word strings which have one or more 'variable' elements referring to time indication, street indication, transfer to other line, etc.)
- longer word strings of the above nature

A large number of sort of 'regular' (in the meaning of always occurring/needed) messages/announcements – even to some extent 'irregular/unexpected' ones (e.g. warning of pick- pockets in station…, short interruption of trip due to a person fainted in …) can be covered by this approach. This applies also to these messages/announcements in different languages.

Key takeaway:
A (possibly bigger) challenge is to integrate various AT technologies or ICTs adapted to the needs (including to individual needs) of persons with disabilities on the one hand and different varieties of presentational rendering of such content (for different user groups) on the other hand into such a city-wide harmonized content management system.

Of course, it is not the function of individual urban transport service providers to solve all accessibility issues of the world. Therefore, they will need to focus on those accessibility aspects which are of high relevance to their service. For this purpose, it could be useful to (in priority):

1. look for and study existing best practices, especially with respect to approaches of other cities using a scenario approach actively involving the users
2. consult experienced experts concerning the formulation of a strategy/policy and its practical implementations
3. consult national standards bodies or other standards related organizations or experts to identify standards to be observed

The clearer the best practices are – if possible based on scenarios –the better experts or consultants of the field can be briefed for their task. The clearer the strategy or policy for accessible urban transport is formulated, the more efficient standardization experts or organizations can come up with the most relevant standards to be followed (duly observing also legal provisions to be followed).

WHO's ICF (International Classification of Functioning, Disability and Health) could be a good starting point for disabling factors most pertinent to TRIPS. The ICF is the most recent official classification of the World Health Organisation (2001) relevant to the field of disability. In ICF disability and functioning are viewed as outcomes of interactions between health conditions (diseases, disorders and injuries) and contextual factors. In other words, people are disabled in their environment and by their environment. For further details see section 3.2.

The above and perhaps other aspects are important when conceiving "personas", i.e. types of users in the framework of TRIPS:

1. the individual's situation
    a. the variety of disabling conditions
    b. kind, number and availability of AT devices *(intended to be)* used
    c. kind, number and availability of services *(intended to be)* utilized
2. the kind of barriers expected *(or unexpected)* on the trip
3. the need and means to communicate during the trip
4. the situation at the destination (incl. purpose of going there)
5. which transport means are available / intended to be used?

The above would show that the aspect of overcoming "barriers" by AT means and services (and other technologies and services) has 2 sides of a coin:

- the viewpoint of individuals, their abilities and the kinds of AT devices and services available to them
- the viewpoint of the public urban transport (means and services) providers, their consciousness of the issue and the solutions they can offer (in terms of technologies and services)

In this connection, technology – though being an important factor – needs to take societal, demographic, economic, cultural etc. aspects into account (not to forget individual human factors). For example, "organisational" (societal, cultural and other intangible) barriers could be tackled by training personnel to be customer-friendly, formulating messages in a "pleasant" way, etc.

3.2 Standards on interhuman communication

WHO's ICF (International Classification of Functioning, Disability and Health) tries to classify disabilities and their degrees in a pathologically "non-discriminating" way. Concerning communication modalities, ICF appears to follow the basic conception of ITU-T X.1081:

> *"Interactions across the biosphere are classified into ten modalities (see clause 7), representing interactions arising from the five human senses (seeing, hearing, touching, tasting and smelling), but generalized to all known categories of interactions. The five become ten, because effects of the environment on the human being (e.g. VIDEO-IN – bright lights, or flashing lights) are modeled as distinct modalities from the effect of a human being on the environment or a sensor (e.g. VIDEO-OUT – gestures or facial expressions)."* (ITU-T X1081:2004, clause 5.3)

This is a big advance compared to previous approaches when most phenomena deviating from "normal" communication were considered as disability or impairment. ITU-T X1081 is focused on Human-Machine communication, while ICF is emphasizing Human-Human communication, though not neglecting the use of devices/tools. Admittedly ATs are also applied for curing

communication problems or restoring lost communication abilities. However, when they are applied to support or enable human communication, the approach of the ICF is certainly more suitable. This applies to virtually all applications identified in the following figure:

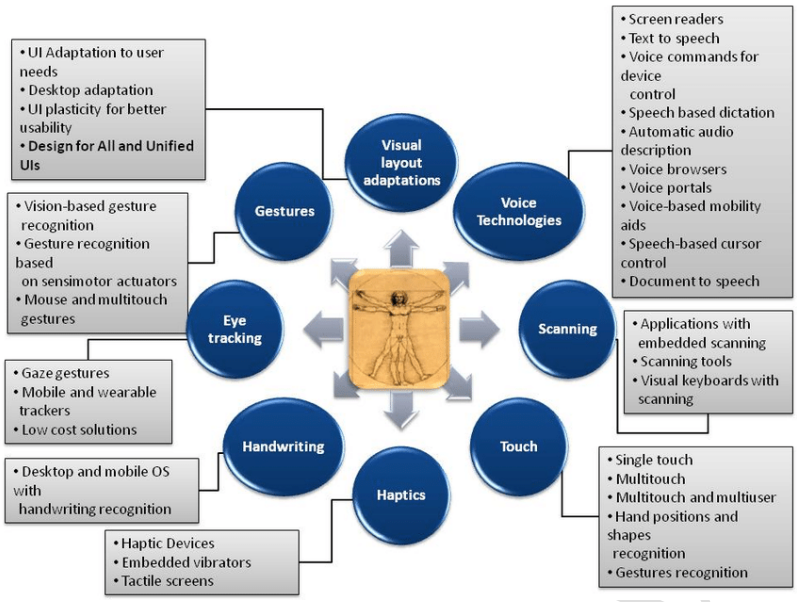


Figure 7: Assistive technology categories (taken from Margetis et al. 2012)

If an AT-governed ecosystem for AT-related standardization activities could emerge, it would greatly support the realization of the conception of Figure 7. Such an ecosystem could look like the Figure 8 presented at AAATE 2019 Conference, in Bologna. Two options were indicated:

- activating the existing AAATE Standardisation (AAAE/S13N)
- establishing a technical committee on AT standards at European or international level.

Human communication and its content as well as the presentation of this content to users with disabilities would have an important role to play in this picture.

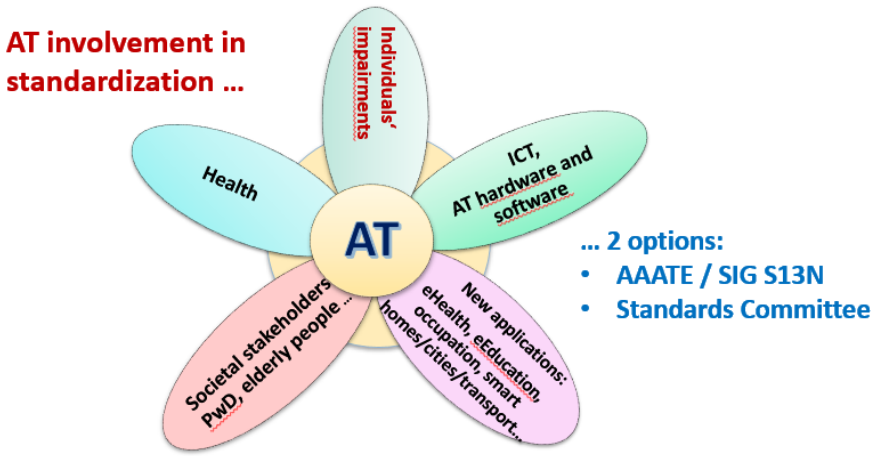


Figure 8: AT-related standardization ecosystem (Galinski/Giraldo presentation at AAATE 2019 Conference, in Bologna)

WHO's ICF would be an important reference in this connection. It distinguishes between classes for "Communicating – receiving" (d310-d329) (Table 6) and Table 7 those for "Communicating – producing" (d330-d349). ICF can cover outstanding abilities as well as regular and constrained abilities.

- d3 COMMUNICATION
  - d310-d329 Communicating - receiving (d310-d329)
    - d310 Communicating with - receiving - spoken messages
      - d3100 Communicating with - receiving - simple spoken messages
      - d3101 Communicating with - receiving - complex spoken messages
      - d3108 Communicating with - receiving - spoken messages, other specified
      - d3109 Communicating with - receiving - spoken messages,unspecified
    - d315 Communicating with - receiving - nonverbal messages
      - d3150 Communicating with - receiving - body gestures
      - d3151 Communicating with - receiving - general signs and symbols
      - d3152 Communicating with - receiving - drawings and photographs
      - d3158 Communicating with - receiving - nonverbal messages, other specified
      - d3159 Communicating with - receiving - nonverbal messages, unspecified
    - d320 Communicating with - receiving - formal sign language messages
    - d325 Communicating with - receiving - written messages
    - d329 Communicating - receiving, other specified and unspecified

Figure 9: ICF classes d310~d329 falling under "Communicating – receiving"

- d330-d349 Communicating - producing (d330-d349)
  - d330 Speaking
    - d3300 Producing meaningful sounds
    - d3301 Producing simple spoken messages
    - d3302 Producing complex spoken messages
    - d3308 Speaking, other specified
    - d3309 Speaking, unspecified
  - d331 Non-speech vocal expression
  - d332 Singing
  - d335 Producing nonverbal messages
    - d3350 Producing body language
    - d3351 Producing signs and symbols
    - d3352 Producing drawings and photographs
    - d3358 Producing nonverbal messages, other specified
    - d3359 Producing nonverbal messages, unspecified
  - d340 Producing messages in formal sign language
  - d345 Writing messages
  - d349 Communication - producing, other specified and unspecified
- d350-d369 Conversation and use of communication devices and techniques (d350-d369)
  - d350 Conversation
    - d3500 Starting a conversation
    - d3501 Sustaining a conversation
    - d3502 Ending a conversation
    - d3503 Conversing with one person
    - d3504 Conversing with many people
    - d3508 Conversation, other specified
    - d3509 Conversation, unspecified
  - d355 Discussion
    - d3550 Discussion with one person
    - d3551 Discussion with many people
    - d3558 Discussion, other specified
    - d3559 Discussion, unspecified
  - d360 Using communication devices and techniques
    - d3600 Using telecommunication devices
    - d3601 Using writing machines
    - d3602 Using communication techniques
    - d3608 Using communication devices and techniques, other specified
    - d3609 Using communication devices and techniques, unspecified
  - d369 Conversation and use of communication devices and techniques, other specified and unspecified
  - d398 Communication, other specified
  - d399 Communication, unspecified

Figure 10: ICF classes d330~d349 falling under "Communicating – producing"

ICF's view on human communication is very broad and refers to verbal and non-verbal messages and other signs or symbols. This in fact refers to "content" in whatever communication modality. But the approach lacks linguistic aspects, for which purpose it was not developed. On the other hand, linguistics so far failed to produce a full-fledged systematics for language varieties used in interhuman communication. This has become the topic of a new standardization activity in ISO/TC 37 *Language and terminology*: ISO/TR 21636 "Identification and description of language varieties" which can close the gap between the systematic approach of ITU-T X1081 and ICF on the one side and a similar systematic approach for the language part of human communication.

Human communication certainly co-evolved with human brain development. Language is closely interconnected with overall interhuman communication but evolved at a later stage – it is not necessarily just spoken or written, it can be signed or rendered in another language modality. ISO/TR 21636 defines human language as a *"means of communication characterized by a systematic use of sounds, movements or gestures, characters or other written symbols or signs that can be combined to express or communicate meaning or a message between*

humans". Note 2 to the entry "spoken language" states that "*Spoken language is usually also multimodal (3.5.2), as gestures, facial expressions and other similar phenomena almost always accompany speech, even when speaking on the telephone or into a microphone for a pure audio recording"*. In fact, paralinguistic features apply to any modality and are decisive for the success of communication. Thus, the standard acknowledges the fact that human language covers part of interhuman communication and is unavoidably influenced by other means or modalities of human communication.

By making a difference between "human language" and individual languages, the multilingual aspect is clearly addressed, thus making the standard complementary to the ISO 639 series (new title) "Codes for the representation of individual languages and languages groups". However, ISO/TR 21636 goes far beyond identifying individual languages by stipulating that linguistic manifestations such as language resources and the events of language use themselves can be characterized according to the following dimensions of linguistic variation:

1) Space dimension
2) Time dimension
3) Social group dimension
4) Medium dimension
5) Situation dimension
6) Individual speaker dimension
7) Proficiency dimension
8) Performance dimension

Dimension 8 "Performance" (described as "communicative functioning constraints") was added to the other truly related to language in all its possible manifestations in given acts or events of language use, although is not a characteristic of the linguistic system of an individual language. But it in fact affects all other dimensions in each events of language use.

ISO/TR 21636 states that:

> *"Increasingly all constrained communicative functioning varieties – even the ones related to paralinguistic features as well as mental and psychological features – can be identified and correctly interpreted by ICT devices and software. Thus, the identification of types and patterns of communicative functioning constraints independent from their causes can enhance or facilitate the adaptation or training of ICTs to support human communication."*

On the other hand, dimension 8 could also serve to recognize and identify communicative functioning constraints of a speaker or otherwise communicating person. This opens the way to a systematic coding of language varieties beyond the traditional aspects, such as dialects or language register (e.g. language of academics), including also specific communicative functioning constraints (e.g. stuttering) – as well as the individual degree of a communicative functioning constraint whether as permanent characteristic or in a given moment. With such a systematic coding, ICT systems can be trained to recognize language varieties and communicative functioning constraints. They also can be trained to assist 'communication producing' (WHO wording) as well as 'communication receiving' to better understand each other.

The two documents ISO 639-4 "Codes for the representation of individual languages and language groups — Part 4: General principles and guidelines" and ISO/TR 21636 were closely coordinated with respect to the terminology to be used in the standards. Sign languages and signed modality of an individual language were – following the state-of-the-art of knowledge

in this field – considered different. Sign languages are considered as individual languages, while using the signed modality in a given individual language is just a different way of spelling the language by signing.

In any case, a future coding scheme for language varieties would fit into the family of coding systems for country names (e.g. for identifying the nationality of a person), script code (e.g. for identifying or producing a message in a different writing system), language code (e.g. for identifying or producing messages in different languages), etc.

Additional devices/tools which already exist could be integrated into such a methodological as well as technological environment, such as:

- eEyetracking according to the international industry standard[42],
- lipreading according to ITU-T SG 16 document ITU-T H Supplement 1 (05/1999) Application profile – Sign language and lip-reading real-time conversation using low bit rate video communication
- systems which can recognize a person's mood, nervousness or psychic disposition
- devices/tools for subtitling, sign language conversion and interpretation, etc. as well as electronic programming guides (i.e. the menus outlining the list and schedule of programs)

Such systems/devices/tools will have to be analysed whether they fit (or can be adapted to) communication needs for certain communicative functioning constraints in various AAL situations – including mobility in urban public transport.

ISO/TC 37/SC 4 *Language resource management* embarked on standardizing the fundamentals of "controlled communication", a topic which has many facets and application fields from oral communication in risky environments, via user manuals or package inserts for medical drugs in simplified language down to various forms of controlled written communication. The following standards are under development (or revision):

- ISO/TS 24620-1 Language resource management – Controlled human communication (CHC) – Part 1: Basic concepts and principles (under revision)
- ISO 24620-2 Controlled human communication (CHC) — Part 2: Controlled written communication (CWC)
- ISO 24620-3 Controlled human communication (CHC) — Part 3: Controlled oral communication (COralCom)
- ISO 24620-4 Controlled human communication (CHC) — Part 4: Multilingual technical requirements (MTR)

These standards are fundamental for developing systematically short and unambiguous messages or announcements for instance in public transport systems. They mention that different individual languages may need adaptation of the rules, and refer to the need of adaptation, if controlled language is going to be applied to persons with communicative functioning constraints. In addition, the new ISO/TC 37/WG 11 *Plain language* started work on ISO 24495-1 "Plain Language — Part 1: Governing Principles and Guidelines". This document is aiming at plain language for a broad range of use, from teaching school children via communicating with persons having certain communicative functioning constraints down to clear communication in technical writing.

[42] https://blog.tobii.com/usb-hid-standard-eye-tracking-9720ea461bb5

Finally, ISO/TC 37/SC 5 Translation, interpreting and related technology has to be mentioned which develops standards in the field of translation, interpreting, as well as translation and interpreting related technology, technical writing, content management, localization, globalization, internationalization. About 20 standards have been published or are under development. They are of relevance, if TSPs need external assistance concerning different means of communication in different languages.

Clear and unambiguous signage is important for public transport from train stations, via traffic signs to harmonized airport public information guidance systems. This is the domain of ISO/TC 145/SC 1 Public information symbols – a field where it still needs a lot of efforts towards international harmonization. Besides public information symbols the field comprises numerous symbols for use on equipment and for safety identification. Even the right use of colors, arrows, shapes, etc. are an issue in this field. To some extent the rendering on hardware or on displays etc. is already considered. It still lacks comprehensive guidelines concerning the adaptation for use by Persons with disabilities and people from other cultures.

In the field of public symbols and information individual creativity of designers should not prevail over international standards and conventions. In any case this is a field usually largely underestimated by TSP – especially when it comes to different languages and accessibility aspects. As for instance Schiphol Airport in Amsterdam is particularly appreciated by visitors because of its clear signage and information, this fact has indirectly positive effects such as on visitors preferring stopovers and spending money there – not to mention invaluable mouth-to-mouth promotion.

3.3 How to manage human communication and the respective content in public transport?

As already mentioned, human communication in all its guises and the management of the respective content is a largely underestimated field. For many reasons, including attractivity of a city, feeling at home and welcome, enjoy visiting places and restaurants, favorite destination for events, etc. the communication and information aspect is very important. It is also a highly complex field which makes a systematic approach strongly recommendable. Under probably any subtopic of this field there exist standards or informal guidelines. Some aspects might necessitate regional – or even national or European-wide – coordination, especially if accessibility issues are involved.

The strategic-political aspects (top-down), and if necessary, operational aspects (bottom-up) must be clearly differentiated.

3.3.1 Development of a systematic accessibility strategy for urban public transport

The development of a top-down systematic approach including accessibility aspects with the aim to formulate a comprehensive accessibility strategy for urban public transport could consist of the following phases:

1. looking for and studying existing best practices
2. consulting experienced experts
3. consulting national standards bodies or other standards related organizations or experts

The objective could be a clear communication and content management strategy harmonized within the urban public transport system, if necessary, coordinated with private partners and localised to regional and national conditions.

Phase 1: Learning from peers could encompass:

- looking for and study existing best practices especially with respect to approaches of other cities
- considering visitors from foreign countries, their languages and cultural conventions (as necessary)
- collecting information on the reasons why a good practice was successful in one city, but not in another
- investigate existing local content resources and practices concerning messages, announcements, emergency strategies, etc.
- investigate existing local technologies used for communication and information purposes, and
- using a scenario approach involving the users in the development of the strategy

The clearer the ideas become during this phase, the better the experts of Phase 2 can be briefed and prepared.

Phase 2: Consulting experienced experts could encompass:

- looking for most appropriate experts, e.g.by launching a call for experts
- briefing experts from different fields on their tasks with information on best practices and the objectives of the systematic approach, and
- jointly drafting a strategy/policy and plans for its practical implementation (if necessary, with competing options).

The more detailed the results of Phases 1 and 2 are, the more it facilitates to work in phase 3 – especially for avoiding overlook important aspects (or gaps) in existing standards.

Phase 3: Consulting standardization bodies or experts could encompass:

- looking for the most appropriate national standards body, experts or organization active in standardization,
- providing the identified experts or organizations/institutions with the results of phase 1 and 2,
- asking them to evaluate these results from the point of view of (legislation and) standards to be observed, and
- identify pertinent standards and other formal or informal guidelines/regulations

It is a possibility that in this phase standards could be identified, which nobody unfamiliar with the field of standardization would find. Most likely also gaps about accessibility will be identified in existing standards – which nevertheless could lead to liability cases.

The clearer the strategy or policy for accessible urban transport is formulated, the more efficient standardization experts or organizations can come up with the most relevant standards to be followed (duly observing also legal provisions to be followed).

3.3.2 Coping with producing and receiving accessible microcontent

FIGURE 2: Sources of relevance to the strategic level and to the operational level mapped the 12 identified technological domains to standardization fields at a strategic and at an

operational level. Figure 9 maps the identified 11 application areas to ICT devices and tools through user interfaces and accessible content. The left side of the Figure is taken (and adapted) from the tag tree of a project concerning accessible user interfaces to consumer products[43]. Most of the boxes of the left side also apply to user interfaces somewhere in the urban public transport system. Others need to be added according to local situations and needs.

Key takeaway:
Without an appropriate combination of accessibility devices/tools and accessible content, applications to support accessible urban public transport will most likely function only for limited categories of persons with disabilities (extended towards other persons having communication problems) and probably function only sub-optimally.

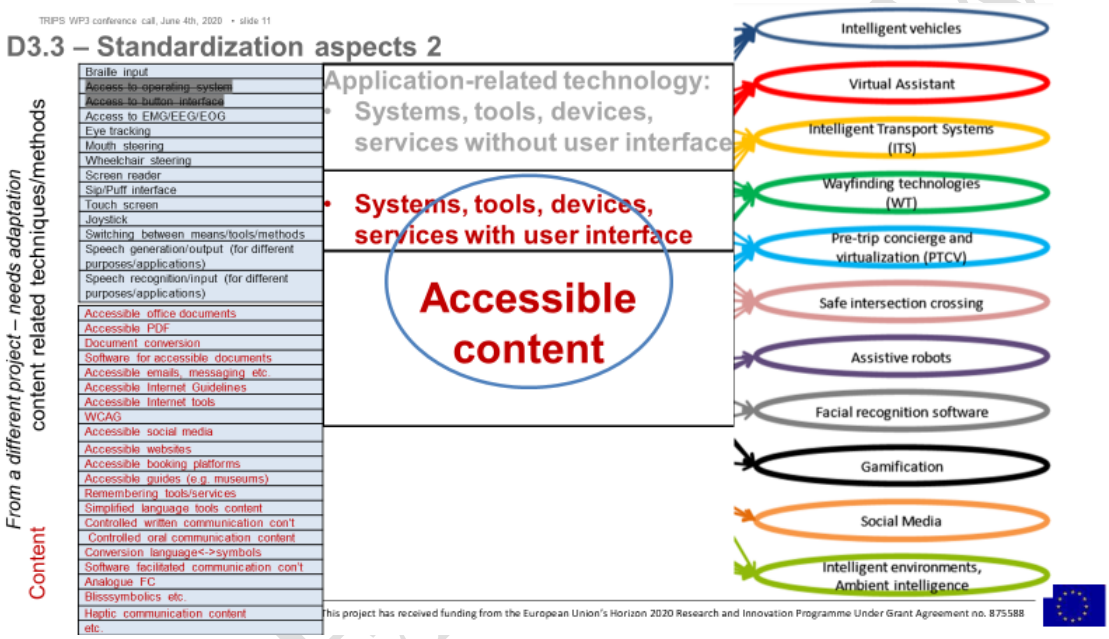


Figure 11: Devices/tools and content supporting accessibility for application areas

As has already been mentioned, state-of-the-art content management systems for microcontent can cope with large volumes of invariable and variable content entities which fall under microcontent. Most of them may have to be adapted to make them fit for receiving and producing "accessible content" in alternative means of communication (other communication modalities). While content entities should be "*represented*" in a harmonized form for each individual language (and individual sign language), they should be "*presented*" as much as possible in the formats and forms of the potential users including persons with disabilities.

As we know from terminology databases, the content entities *representing the same meaning in different languages* (including different individual sign languages) should be stored and processed in the same record (or records fixedly linked to each other). Such content can – depending on the needs – be translated into a few languages by permanent or temporary staff of the TSP familiar with the respective languages. Or the translation is outsourced to an external language service provider (LSP). The same applies to the *presentation* of content in

[43] tag tree https://wbt-vienna.github.io/accessibility-info-tree/#/tree

alternative means of communication where it probably needs to contract the respective experts.

Content entities can be produced "naturally" by a user or through a device of the user. In the first case, somebody from the TSP or a device/tools must understand the content. In the second case, a device of the TSP has to receive the content and (depending on the content) take the expected action automatically or transfer it to somebody of the TSP for reacting appropriately. "*Producing*" content by the TSP might be approached differently for different situations/micro-scenarios:

- Messages or announcements from the TSP (or its personnel or transport means etc.)
  - could be presented in one or a few languages to all users – but certainly not in many languages to everybody.
  - could be presented to the device of the user in the user's language or alternative means of communication.
- "Utterances" or messages from the user can be received directly by somebody of the TSP or by a device/tool foreseen for this purpose.

The more harmonized the content from the TSP's side is (by means of harmonized metadata and data models and with the "controlled communication" approach), the faster the user can familiarize with the way of communicating offered.

As already mentioned, the content of more or less "regular" written or oral messages, announcements and similar considered here as *static microcontent* can be distinguished into:

- short word strings that are unchangeable
  - in any situation just as individual messages or announcements (e.g. "doors are closing").
  - even in a (fixed or adaptable) sequence/combination of other messages or announcements (e.g. "doors are closing" + "please step back").
- short word strings which have one or more 'variable' elements referring to time indication, street indication, transfer to other line, etc.)
- longer word strings of the above nature.

A large number of sort of 'regular' (in the meaning of always occurring/needed) messages/announcements – even to some extent 'irregular/unexpected' ones (e.g. warning of pick- pockets in station so-and-so, short interruption of trip due to a person fainted in a wagon/bus/station…) can be covered by this approach. This applies also to these messages/announcements in different languages (and individual sign languages).

Contrary to the above-mentioned cases there may be very unexpected (incl. highly unlikely) situations when it may need the cooperation of or coordination among services, such as:

- emergencies with respect to public security, health, major disasters, etc.
- non-rational behaviour of an individual, for instance if under stress
- external communication services for the communication with transport users in cases of very unexpected, even highly unlikely situations

For the first case, it is advisable to include the content management strategy with respective emergency plans/strategies of the city. If the situation in the second case gets out of control, the TSP might need external assistance. In cases of very unexpected, even highly unlikely situations "*controlled communication*" can reach limits and may require unstructured content in foreign languages or alternative means of communication. Because of the very nature of such situations, fast action – including more or less immediate ***and*** reliable communication to

all users stuck in the situation – is required. Since a couple of years, online interpreting platforms emerged which offer interpreting services for an array of applications online. However, they are usually focused only on a limited number of languages – even less on providing services in alternative means of communication. As such more or less unpredictable situations mostly occur infrequently, but with massive consequences, if they occur, it might be useful to think of establishing one or more online interpreting platforms for emergency purposes working 7/24 – including services for persons with disabilities – at national or European level. The question remains whether this can be done on a commercial basis.

Key takeaway:
The kinds of more or less static content and the situations/micro-scenarios mentioned above can largely be managed by the TSP of an urban public transport system. If the transport system is part of a network with suburban or regional or national TSPs, the representation and presentation of content may need to be coordinated and harmonized – especially with regard to persons with disabilities (in a broad sense as mentioned above). This is of great benefit for foreign visitors, too – in fact for everybody using the transport means.

More or less unpredictable situations occur infrequently, but with massive consequences. They often need coordination with other emergency or health systems. If humans are affected, it also needs swift and reliable communication support. Therefore, it might be useful to think of establishing one or more online interpreting platforms for emergency purposes working any time of the day and any day of the year at national or European level.

The W3C standard WCAG 2.1 is of fundamental importance in this connection, but it may necessitate adaptation for some purposes or technical devices/tools in connection with the communication needs in the emerging accessible urban public transport systems. Just to mention the plethora of formats for presenting content in different technical modalities and more or less all communication modalities.

As smart homes, smart cities, smart transport, IoT etc. are getting more and more intertwined the demand for an online interpreting platform (with tele-interpreting systems) also providing communication services in alternative means of communication will grow. In ISO/TC 37/SC 5 standard ISO 24019[44] on interpreting delivery platforms (tele-interpreting) is under development. It would be a good moment to introduce accessibility aspects into this standard's development.

Section 3.3 outlines a systematic approach for TSPs to develop a comprehensive accessibility strategy duly including the aspect of human communication and the respective content necessary in various scenarios. It points out, which aspects are best dealt with internally by the TSP and which may need cooperation with other public or private services – also indicating pertinent standards under development.

[44] ISO 24019, Simultaneous interpreting delivery platforms — Requirements and recommendations

4. Discussion of TRIPS recommendations concerning standards

In the TRIPS project, we have discussed extensively the main reasons, why it may remain difficult to identify individual standards for the 12 technology domains and 11 major application areas identified by TRIPS. (See: Figure 1, p. 16) The main reasons for this difficulty are among others:

- Nearly all technology domains impact more than 1 major application area, and each application area is connected to more than 2 technology domains. This can be mapped to 6 or more policy areas and chapters of the EU RPIS 2020. In each of these policy areas and chapters tens of major standardization activities are underway – not including possibly tens of standardization activities taking place in various industry consortia.
- Although policies impact legislation (and vice versa) and legal regulations have an impact on the development of standards, the nature of standardization and the way it is structured are very different from policy and legislation. Nevertheless, they are all intertwined to some degree depending on the field.
- Some of the technical domains and application areas identified by TRIPS are directly or indirectly connected to important RPIS 2020 areas/chapters such as "5G", "Broadband infrastructure", "Cloud computing", "eHealth, healthy living and ageing", "Blockchain and distributed digital ledger technologies", "Smart cities and communities/ technologies and services for smart and efficient energy use" which might turn out to be of relevance to implementers of TRIPS results.
- To some extent, the need for specific standards may be different depending on the city's topography and climate, cultural background and homogeneity of inhabitants, historical emergence of transport systems, etc.

Key takeaway:
In any case, pertinent standards should be investigated before a city embarks on the implementation of a strategy for accessible urban transport. For this, starting top-down from pertinent policies and legislation is a good first step. In this connection the latest EU Rolling Plan for ICT Standardization and related EU documents should be consulted.

In parallel the results of pertinent EU projects and experiences in other cities could be evaluated. There are several award schemes for "accessible cities" under different points of view: tourism, cyclists, etc. One of the examples is the Access City Award 2019[45]. Awarded cities could be contacted for information on their policies, implementation strategies and the standards observed or developed in this connection.

4.1 Relationship between policies, legislation and standardization

In Europe, there is an intricate relationship between policies, legislation and standardization. They all have international, regional and national (and often also provincial) levels. This applies particularly to the field of accessibility:

[45] https://ec.europa.eu/social/main.jsp?langId=en&catId=88&eventsId=1375

- At international level there are international treaties or conventions or other kind of agreements of different nature. Some – as the CRPD – oblige signatories states to incorporate them into their legal system. In the case of the CRPD, the EU in addition to all EU Member States signed the convention and has implemented it in European law. Laws can foresee sanctions against their infringement.
- Technical standards normally are identifying the state-of-the-art of scientific, technical or scientific-technical methodology development. They can refer to all aspects of technology, industry, society and economy, their scope of a standard can be as broad as that of a law, but usually a standard does not foresee sanctions.
- The ideal of standardization is to include all major stakeholders of society: industry, academia, consumers and administration in any given standard development activity. However, persons with disabilities and their Organisations as well as AT experts so far are not sufficiently involved the standardisation processes for various reasons. This can become a political issue – as happened in the EU and several EU Member States.
- Seen from a top-down viewpoint "accessibility" is well represented in strategic policy at various levels – though still much needs to be done. The EU has been very successful in fostering this development among others by financing many R&D projects and activities – often in international cooperation.
- Official standards are complementary to law, in most cases secondary to law and in some cases part of the law, if referred to in law; for experts it should be a *must* to be sufficiently familiar with standards. For decision makers in industry and services, too, a certain familiarity with standards can be useful or even necessary.
- The importance of standards can also be recognized from the fact that the total body of standards texts in many countries and at EU level can equal the volume of legal regulations.
- Standards considering accessibility principles can be useful means in support of pertinent law.

Key takeaway:
The role and importance of standards and standardization is largely underestimated in the general public. The TRIPS consortium should take standards into account and aim at contributing to the further development of eAccessibility and eInclusion standards. There are several standardisation activities ongoing or just started, where TRIPS could positively contribute. Figure 8 provides a basic sketch for conceiving such an ecosystem.

4.2 Difficulties to access information on accessibility-related standards and standardization activities

There are many misconceptions around – not to mention a general lack of information and knowledge – concerning "*technical standards*":

- They can refer to all aspects of technology, industry, society and economy. The scope of a horizontal standard can be as broad and general as that of a law. Industry standards (also called de facto standards) specify individual models or services – formal standards (also called de jure standards) usually do not.
- As is the case with law, people (including most experts) learn, from media about a major standard, but would rarely read the text of the standard – most standards are developed and published unaware even by many experts.

- There are barriers to find information on standards and standardization activities – even for experts, if they are not engaged in standardizing activities; while governments and public administration is obliged to make the texts of laws and other legal regulations accessible, most standards documents are not freely accessible.
- Topics related to accessibility and AT have become scattered over many standardization activities falling also under keywords like "sustainability", "smart …", etc. The reason for this is that more and more standardizing committees include accessibility aspects in their standards – with the result that only a minority of such standards can be searched and found under "accessibility" or "AT". Besides, as disabilities and impairments in the past were largely seen as defects or shortcomings, many AT developments take place in the framework of health and eHealth.
- Another reason behind the increase of accessibility and AT-related standardization activities in many fields – which has been accelerating over the last years – lies in the fact that more and more industry quarters are recognizing a business case for accessibility. Standards considering accessibility can contribute to the design of better products and the saving of financial resources by integrating accessibility features into new products (and services) from the start so as to avoid significantly higher costs for retrofitting products in later stages of their life cycle.

It lacks an ecosystem of AT-related standardization similar to that of the standards related to the Internet and the Web, or the world-wide cooperation in the field of radiotechnology. The TRIPS Consortium should highlight this during public events and push the AT community towards an active role in standardisation processes.

4.3 Highly harmonized fields of standardization at international level

Concerning accessibility and AT, there are some areas of standardization which have to be considered by experts and decision makers alike as "default" (similar to existing laws):

- The standards and specifications of the Internet Protocol Suite (See Table 1, Annex B) must be taken as "default", because any deviance may cause interoperability issues when using networks. If additional programs/tools are integrated, they should be based on the latest versions of the standards and specifications of the IP Suite.
- It is somehow the same with the standards, guidelines and software of the W3C concerning the WWW. Here the situation is more complicated, as some W3C standards have development versions or constitute families of versions or releases; some are competing with each other or with industry standards. Again, if additional programs/tools are integrated, they should as much as possible be based on the latest versions of the standards, guidelines and software of the W3C. (See Table 2, Annex B)
- Common to the IP Suite and W3C standards and guidelines is, that any insufficiency or deficiency detected in the course of a system development (such as in the fields of accessible transport which would necessitate a modification) would need major efforts to influence the respective committees or working groups to adapt their standards.
- Some of the above-mentioned standards or guidelines were adopted by formal standards bodies. But there exist hundreds of other SDOs in the ICT field which also more and more embark on standardization activities related to one or the other accessibility aspect. Some of them have to be taken as de facto default (e.g. Bluetooth, if one of the Bluetooth versions is applied). Some standards in the field of eHealth belong to this category. Others are inseparably connected with proprietary software

systems. Here system developers and managers must be careful with their choices, as they will have to comply with other regulations which are highly topical from a societal and user protection point of view, such as privacy protection, data security, etc. machine safety (re. Directive 2006/42/EC) that can have an impact on the liability of transport service providers in case of accidents or user claims.

- As increasingly different systems, tools and services geared to and used by Persons with disabilities are connected or even managed through Internet-based platforms, this may cause non-trivial problems of how to integrate those systems/tools and services that were developed not fully in compliance with standards that have to be taken as "default".

Key takeaway:
In the field of accessibility and AT-related developments there are several broad areas of standardization which must be taken as "default" by the TRIPS consortium because of their highly harmonized nature.

4.4 ICTs, accessibility and human communication

Communication by language and other means of human communication is increasingly supported – sometimes even replaced in confined applications – by ICTs. Great efforts are undertaken to further develop the support of human communication through natural language processing (NLP) and natural interfaces and the like. (See D14, chapter 4) The necessity for human communication is deeply rooted in the human nature. The full complexity of human communication – from the syntax of individual languages to semantics – is researched from many angles, research results are gradually entering standardization activities including accessibility applications:

- Advances in the field of NLP and computational linguistics led to highly user-friendly use of more or less any language and its script in office automation, speech recognition and synthesis, speaker identification, automatic translation between languages based on several approaches, advances in automatic interpreting between languages, tele-interpreting platforms, etc.
- For Human-Machine communication the design of user interfaces is of high importance and taken care of by different technical committees in standardization. Natural user interfaces (NUI) help users to acquire knowledge and skills, they are supposed to be effectively invisible, and remain invisible as the user continuously learns increasingly complex interactions. (see D14, section 4.4)
- The field of content management evolved tremendously leading to huge volumes of content of all sorts which can be further exploited by new technologies, such as Big Data, etc.
- In many technological developments the aspect of accessibility is underrepresented – as is the content aspect of human communication. The content of human communication can have many guises from unstructured to highly structured, from verbal to non-verbal modalities. In this connection competing standards on formats about audio-visual objects might pose a problem.
- Content needs "representation", in order to become processable by computers. It also needs suitable "presentation", in order to become well understandable by humans. The W3C standard WCAG 2.1 is of fundamental importance in this connection, but it

needs further standardization activities to integrate various technologies and methodologies.

- Several standardization activities concerning human communication and content applications take place in ISO/TC 37 *Language and terminology*. (See section 3.3) Standards' topics include sign languages (identification and representation), a systematic approach to language varieties (including communication modalities other than spoken and written), controlled communication, etc.
- Tools for eye-tracking, speaker recognition (incl. clues to the person's thinking and mood), lipreading, image recognition, etc. will be provided with an improved theoretical and methodological to become more efficient in accessibility applications. In the course of this development AI could play a crucial role. (See D14, section 3.6)

The role of "content" – especially microcontent in the form of messages, announcements and the like – in urban public transport has been neglected. Content management for such content resources needs to be extended towards interoperability of content (incl. accessible content). The use of appropriate content management systems (CMS) including the integration of AT devices/tools for the most suitable presentation of the content to the users as they need it would close a whole array of gaps in this field of application. It would not only help to avoid risks for TSP, but also be a quantum leap in terms of long-term content maintenance and sustainability of the whole application domain.

4.5 The future role of the ATs

Accessibility aspects and AT-related standardization activities today are scattered over many technical committees in many SDOs. This definitely calls for initiatives to coordinate such activities. Some aspects – such as the complex nature of human communication (presented as content to the users) in different languages – are not sufficiently taken into account: AT experts would be well advised:

- to engage in standards coordination and cooperation among standardizing activities,
- to get involved in the integration of theories and methods concerning the different ways and means of human communication, in order to improve the theoretical-methodological basis of R&D in the field of the ATs,
- to take advantage of the need for system and content integration in fields like smart transport, smart homes, smart cities, etc. – not least also in accessible urban public transport, and
- to recognize that any application in the above-mentioned fields would function only for limited categories of Persons with disabilities (extended towards other persons having communication problems) and probably function only sub-optimally without the appropriate combination of accessibility devices/tools and accessible content under a holistic approach.

Key takeaway:
In view of the forecast societal and technological development, ATs will become more and more important. Holistic approaches to R&D in the field of the ATs as well as a stronger engagement in standards coordination would benefit standardization as a whole and society and industry at large. This calls for establishing an ecosystem for AT-related standardisation activities.

4.6 Limiting the number of kinds of disabilities and their degrees

A TSP will have to investigate which kinds of disabilities (and other kinds of functioning constraints) to which degree of disability are causing a barrier to those persons with disabilities who are or could become mobile in urban public transport, if those barriers could be overcome. Such an investigation could be carried out by considering among others:

- scenarios for barriers faced by users with disabilities, such as the Australian Government's (2017) "The Whole Journey"
- the TRIPS user-centred approach including the co-design method and taking the WHO's ICF as a guide
- a prioritisation of possible measures to be taken under given conditions and circumstances for overcoming which kind of barriers
- existing and potential AT solutions and solutions including AT devices and services
- the experience of other cities known as best practice with respect to accessible urban public transport.

Key takeaway:
The results of the TRIPS project certainly are a valuable guidance to TSPs to prioritize the measures for overcoming barriers to persons with disabilities duly considering legal and technical regulations, as well as duly considering aspects of societal need, technical and economic feasibility and sustainability of the envisaged solutions.

5. Conclusions and main recommendations

The TRIPS project is committed to a user-centred approach, relying of collaboration and co-design. The project is focussed on supporting disabled people to take control of the process to overcome barriers with respect to mobility for, if possible, all transport users. As this to a large degree can be supported by ICT and in particular by AT solutions and AT-related services, it is important to take forecasted ICT trends into account. In this connection it is necessary to investigate existing and emerging legal and technical regulations, as well as to identify existing or possibly upcoming gaps as early as possible.

This deliverable showed that "accessibility" should be regarded in a broader sense, i.e. including any kind of permanent or temporary disabilities beyond those usually considered an impairment. The co-design approach of TRIPS is an important methodological element to improve the active participation of users in the conception of accessibility designs in the field of urban public transport systems. This should be extended towards user-involvement in standards development. D13 identified several ongoing or emerging standardisation activities, where AT communities could largely contribute to improve the quality of standards from the outset. As pointed out in the deliverable, the organisation of an AT ecosystem for standardisation would greatly facilitate such an active involvement of AT communities.

Accessible urban public transport – in line with smart transport, smart homes, smart cities, etc. – is a fast-evolving topic and broad field of applications. This needs efforts under a comprehensive interoperability perspective towards the integration of methodologies and technical approaches, which in fact also necessitates to intensify existing and initiate new standardization efforts in this direction. Beyond existing laws and standards, it is advisable to

"learn from peers", i.e. from the experience of several cities and regions worldwide which have invested great efforts in realizing accessible transport. Beside the technology standards, other regulations which are highly topical from a societal and user protection point of view, such as privacy protection, data security, machine safety (with respect to liability) should not be neglected.

In connection with the related policies, legislation and standardization activities, the EU Rolling Plan for ICT Standardization (RPIS 2020 and forerunners) and related EU documents as well as the results of past projects are a good starting point for the investigation of pertinent standards and standardization activities. The differences between policies, laws and legislation on the one hand, and standards and standardization on the other hand should be recognized – as well as their intertwined nature.

D13 identifies gaps in standardization activities, pointing out the complexity and fragmentation of standardization efforts in the fields of the ATs increasingly including aspects of content interoperability and user interfaces. Such AT-related topics are taken up by an increasing number of technical committees. D13 investigation concentrates on international standards and those standards that can be considered as horizontal and largely generic. This is meant as a guide to achieve a better safety of investment into the respective ICT infrastructure especially by TSP and SMEs. It also serves as a guidance to improve sustainability.

In this connection, urban public TSPs can be recommended

- to systematically screen local/regional regulations, guidelines, best practice cases, success stories, etc. world-wide for evaluating the respective experiences
- to coordinate with suburban and regional transport systems
- to collaborate with emergency systems, health institutions, language and communication service providers, etc. where appropriate
- to tie up with private industry initiatives and pertinent R&D activities.

What could the field of the ATs do from a bottom-up perspective?

(1) The field of the ATs is recommended to engage in standardization activities for many reasons, among others to overcome the fragmentation of AT standards development in many fields. To this end efforts to organize an ecosystem of AT standardization would certainly be helpful.

(2) the original mandate of ISO/SAG Accessibility could be reviewed concerning better searchability of accessibility-related standards to foster their application by
   - re-opening the question of the 'check-box' on accessibility in Form 4 (of ISO and IEC)
   - investigating the possibility to create new ICS[46] codes to categorize standards with accessibility focus or including elements of accessibility to facilitate the discoverability of pertinent standards by experts and standard users

   and by
   - introducing new "semantic search functions/tools" in connection with standards in machine readable and accessible format to allow new user groups (incl. those related to accessibility) a better access to standards' content

[46] International Classification of Standards

Standardisation is a complex field of many stakeholders and many purposes. Contrary to common belief,

> ***"Standards are all around us, they affect all our lives even if we are often unaware of them. Standards set requirements for specific items, materials, components, systems and services, or describe a method or procedure. They facilitate international trade by ensuring compatibility and the interoperability of components, products and services. Although they are voluntary and market driven, when used they have shown to reduce costs for business and consumers, enhance performance, and improve safety.***

Standards are key for innovation and progress in the Single Market, and are essential to supporting European competitiveness, jobs and growth. They also allow Europe to maintain its leadership in technical development and global trade as the European hub for global standardisation." (European Commission 2016)

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Annexes

A ICT Standardisation policy foci of the EU
B Overview of standards related to Internet and WWW technologies
C Extract of standards identified by ISO/SAG "Strategic Advisory Group (SAG) on Accessibility"
D IEC/ISO/ITU Policy on Standardization and accessibility
E Recommendation 2016 concerning standards on eAccessibility and eInclusion
F Recommendation on software and content development principles 2010

2020-07-09

ANNEX A: ICT Standardisation policy foci of the EU

A ICT Standardisation policy foci of the EU

acc. to the EU Rolling Plan for ICT Standardisation 2020 (RPIS 2020)

A.1 Introduction

The Rolling Plan for ICT Standardisation (RPIS) 2020 provides a unique bridge between EU policies and standardisation activities in the field of information and communication technologies (ICT). This allows for increased convergence of standardisation makers' efforts towards achieving EU policy goals. The Rolling Plan attempts to list all known areas where ICT standardisation could support EU policy objectives. It also details the requirements for ICT standardisation, translates them into actions and provides a follow-up mechanism for the actions.

European Mandates – especially those referring to ICT standardization – are closely coordinated with the RPIS. European Mandates, also called standardization requests, are the mechanism by which the European Commission (EC) and the EFTA Secretariat request the European Standards Organizations (ESOs) to develop and adopt European standards in support of European policies and legislation.

Standardization policies:
https://joinup.ec.europa.eu/collection/rolling-plan-ict-standardisation/rolling-plan-2020
https://joinup.ec.europa.eu/collection/rolling-plan-ict-standardisation/rolling-plan-2019
European mandates:
https://www.cenelec.eu/aboutcenelec/whatwestandfor/supportlegislation/europeanmandates.html
https://ec.europa.eu/growth/tools-databases/mandates/index.cfm?fuseaction=txtSearch.search#

A.2 RPIS 2020 sections dealing with these technology domains/trends

The RPIS covers 4 Rolling Plan Policy Areas:

- Key enablers and security
- Societal challenges
- Innovation for Digital Single Market
- Sustainable growth

Each policy area is subdivided into chapters

TRIPS D3.2 identified 12 ICT trends for inclusive urban mobility:

13 Internet of Things (IoT)
14 Virtual Reality (VR)
15 Augmented Reality (AR) and Mixed Reality (MR)
16 AI – Rule-based systems
17 AI – Automated Speech Recognition (ASR) and Natural Language Processing (NLP)
18 AI – Machine Learning (ML)
19 Big Data analytics
20 Robotics and automation
21 Web technologies – Infotainment
22 Machine Vision
23 Advanced human-machine interaction techniques
24 Geolocation

In line with section 2.3 Annex A provides summaries of the RPIS 2020 sections dealing with the following technology domains/trends:

- A.2.1 **Internet of Things** (IoT) under "Key enablers and security"
- A.2.2 **Accessibility of ICT products and services** under "Key enablers and security"
- A.2.3 **Artificial Intelligence** (AI) under "Key enablers and security"
- A.2.4 **Public sector information, open data and big data** under "Key enablers and security"
- A.2.5 **Robotics and autonomous systems** under "Sustainable Growth"
- A.2.6 **Intelligent Transport Systems - Cooperative, Connected and Automated Mobility (ITS-CCAM) and Electromobility** under "Sustainable Growth"

As the overview of the above topics does not comprise further topics of potential relevance to TRIPS, the following RPIS topics are dealt with under:

- A.3.1 **Intelligent transport systems – Key enabler and security**
- A.3.2 **5G – Policy and legislation – Key enablers and security**
- A.3.3 **Cloud computing – Key enablers and security**
- **A.3.4** **Blockchain – Policy and legislation**
- A.3.5 **Smart cities & transport – Policy and legislation**

A.2.1 Internet of Things (IoT) – key enabler and security

https://joinup.ec.europa.eu/collection/rolling-plan-ict-standardisation/internet-things

Policy objectives

The Internet of Things (IoT) is a key priority area of the digital single market. The IoT is an emerging technology that connects more objects to the internet — including industrial processing machines and the items industrially processed (cyber-physical systems), household equipment, wearable electronics, vehicles, and sensors. The number of such connected devices is expected to exceed 20 billion by 2020. Besides the innovation potential in many industrial sectors, the IoT also has the potential to help address many societal challenges including climate change, resource and energy efficiency and ageing.

A large number of proprietary or semi-closed solutions to address specific problems have emerged, leading to non-interoperable concepts, based on different architectures and protocols. Consequently, the deployment of truly IoT applications, i.e. where information of connectable "things" can be flexibly aggregated and scaled, has been limited to a set of "intranets of things — or goods".

In the emerging IoT economy, voluntary global standards can accelerate adoption, drive competition, and enable cost -effective introduction of new technologies. ***Standardisation facilitates the interoperability, compatibility, reliability, security and efficiency of operations on a global scale among different technical solutions, stimulating industry innovation and providing greater clarity to technology evolution.*** Interoperability between IoT networks operated by different companies along the value chain opens up opportunities to address EU policy objectives, e.g. greater resource efficiency for a more circular economy, sustainable and responsible supply chains through transparency and traceability, among others.

Industry is in the best position to develop the technological standards and solutions to address global IoT ecosystem opportunities and challenges. There is a need for a secure solution that is interoperable and scales across a global IoT ecosystem. In this context, the European large-scale pilots, which were the subject of a call for proposals in 2016, are supporting the deployment of IoT solutions, by enhancing and testing their acceptability and adoption by users and the public, and by fostering new market opportunities for suppliers to the EU.

Related standardisation activities

- CEN – Horizontal standardisation

- CEN/TC 224 'Personal identification and related personal devices' addresses Protection Profiles (e.g.EN 419221-5:2018 on 'Protection Profiles for TSP Cryptographic Modules - Part 5: Cryptographic Module for Trust Services') and IoT privacy-related standardisation solutions (e.g. EN 419212-4:2018 on 'Application Interface for Secure Elements for Electronic Identification, Authentication and Trusted Service')
- CEN/TC 225 'AIDC technologies' works in the field of automatic identification and data capture techniques such as 1D and 2D optical data carriers, RFID and RTLS. These technologies are widely used as end points, allowing today the connection of billions of objects. CEN/TC 225 draws its expertise and legitimacy in IoT cutting-edge technologies and privacy from mandate M/436 (Privacy and public awareness of RFID applications). Under the spotlight of GDPR, a dedicated ad hoc group will be set up in order to discuss the revision of EN 16570 (public awareness) and EN 16571 (Privacy Impact Assessment).

- CEN – Vertical standardisation: activities with relevance to IoT ongoing in verticals in the following TCs: 251, 278, 294, 442.
- CENELEC
  - CLC/TC 57 'Power systems management and associated information exchange': European Standards for data models in power systems (EN IEC 61850-x), Application Program interfaces (EN IEC 61970-x) and Data and Communication security (EN IEC 62351-x).
  - CLC/TC 205 'Home and Building Electronic Systems (HBES)': is developing a European Standard on IoT Semantic Ontology Model Description (prEN 50090-6-2), which will explain the HBES IoT Model structures, semantically expressing the current HBES Open System solutions.
- ECMA TC 53 ECMAScript modules for embedded systems is standardising software APIs for embedded systems defining standard APIs for areas that include input/output, sensors, networking, communication, energy management, and display
- ETSI: one of the founding partners in oneM2M, the global standards initiative for the IoT and publishes all oneM2M specifications
  - SAREF standard ETSI TS 103 264, a reference ontology for smart appliances, which is mapped onto the oneM2M Base Ontology.
  - ISG on cross-cutting Context Information Management (ISG CIM): Group Specifications (GSs) for applications to publish, discover, update and access context information, with a particular focus is enabling exchange of linked data and context information, using a simple API, NGSI-LD (ETSI GS CIM 009 V1.2.1) based on JSON-LD, and a high-level data model (ETSI GS 006 V1.1.1) referencing existing (or new) taxonomies and ontologies.
  - MSG TFES has developed Harmonized Standards for LTE-M and NB-IoT equipment (Base Stations and devices) to facilitate and accelerate Machine Type Communication deployments in E-UTRA and NR bands.
  - Smart Body Area Networks developed in TC SmartBAN, and standards for ultra-narrowband radio technology in the TC ERM LTN (Low Throughput Networking) working group.
  - TC CYBER: TS on Cyber Security for Consumer Internet of Things, Draft ETSI EN 303 645
  - SC USER has developed a set of documents “User-Centric approach in digital ecosystem”, focusing of the roles, expectations and potential solutions for users.
- IEC: projects underway on IoT
  - IEC/IEEE 60802 TSN Profile for Industrial Automation, a joint project between IEC SC 65C and IEEE 802
  - IEC 62872-2 “Internet of Things (IoT) – Application framework for industrial facility demand response energy management”, a project in IEC TC 65/JWG 17, a joint working group between TC 65 and ISO/IEC JTC 1/SC 41 to foster the adoption of the international Reference Architecture for IoT developed in ISO/IEC JTC 1 SC41
- IEEE has a number of existing standards (current and under development), activities, and events that are directly related to creating the environment needed for a vibrant IoT

- IEEE P2413 standard for the architectural framework for the IoT, which includes descriptions of various IoT domains, definitions of IoT domain abstractions, and identification of commonalities between different IoT domains.
- IEEE P1931.1, standard focusing on real-time onsite operations facilitation (ROOF)
- IEEE 1451-99 is focused on developing a standard for harmonization of Internet of Things (IoT) devices and systems
- IEEE 2700 proposes a common framework for sensor performance specification terminology, units, conditions and limits is provided
- IEEE P2510 defines quality measures, controls, parameters and definitions for sensor data related to Internet of Things (IoT) implementations

- IETF
  - IPv6 Over Low Power WPAN (6LOWPAN) Working Group
  - IPv6 over Networks of Resource-constrained Nodes (6LO) Working Group
  - IPv6 Over Low Power Wide-Area Networks (lpwan) WG
  - Light-Weight Implementation Guidance (LWIG) Working Group
  - Routing over Low Power and Lossy Networks (ROLL) Working Group
  - Constrained RESTful Environments (CORE) Working Group
  - Trusted Execution Environment Provisioning (TEEP) WG
  - Software Updates for Internet of Things (SUIT) WG
  - Authentication and Authorisation for Constrained Environments (ACE) WG
  - DTLS In Constrained Environments (DICE) WG
  - IRTF Thing-to-Thing Research Group (T2TRG)
- ISO/IEC-JTC 1/SC 41 (Internet of Things and related technologies) has developed ISO/IEC 30141 (IOT reference architecture) and ISO/IEC 20924 (IOT vocabulary), and ongoing work includes the following:
  - Support for interoperability of IoT systems (ISO/IEC 21823-1)
  - IoT trustworthiness framework (ISO/IEC 30149)
  - Methodology for trustworthiness of IOT system/device (ISO/IEC 30147)
  - Data exchange platform requirements for IOT services (ISO/IEC 30161)
  - Compatibility requirements and model for devices within industrial IOT systems (ISO/IEC 30162)
  - Diverse use-cases covered by IoT
  - Monitoring the ongoing regulatory, market, business and technology IoT requirements
  - IoT standards that build on the foundational standards in relevant JTC 1 subgroups
  - The list of SC 41 projects can be found here: https://www.iec.ch/dyn/www/f?p=103:23:3095716894820::::FSP_ORG_ID,FSP_LANG_ID:20486,25
- ITU-T SG 20 "Internet of things (IoT) and smart cities & communities" is responsible for studies relating to Internet of things (IoT) and its applications, and smart cities and communities (SC&C). This includes studies relating to big data aspects of IoT and SC&C, e services and smart services for SC&C. It is also the lead study group for Internet of things identification. Definition of IoT can be found in Recommendation ITU-T Y.4000/Y.2060 "Overview of the IoT" http://itu.int/itu-t/Y.4000
    - The complete list of Recommendations developed by ITU-T SG20 is available at: https://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=20.
    - The work items under study is available at: https://www.itu.int/ITU-T/workprog/wp_search.aspx?sg=20.
    - More info: http://itu.int/go/tsg20 ITU-T SG20 also closely collaborates with oneM2M.
- OASIS runs a TC on message queuing telemetry transport (MQTT) and produced the Advanced Message Queuing Protocol (AMQP)

- 3GPP offers three new Low Power Wide Area Network (LPWAN) radio access technologies for long-range, power efficient, massive machine-type communications: Extended Coverage GSM Internet of Things (EC-GSM-IoT), LTE for Machine-Type Communications (LTE-M) and Narrowband Internet of Things (NB-IoT).
- OneM2M: global initiative to ensure the most efficient deployment of Machine-to-Machine (M2M) communications systems and the Internet of Things (IoT)
- OIC
- UNECE: developed UN/CEFACT Core Component Library in trade-related applications of Internet of Things, standards and clear guidance related to Smart Containers as well as Trade Facilitation applications of Internet of Thing
- W3C: Web of Things Interest Group and Web of Things Working Group
- OCG, the Open Geospatial Consortium, defines and maintains standards for location-based, spatio-temporal data and services
- AIOTI, the Alliance for Internet of Things Innovation (AIOTI)
- EC Several projects funded by the European Commission, integrated in the Internet of Things Research in Europe Cluster (IERC), deal with aspects of standardisation in IoT: CALIPSO, GAMBAS, IOT.EST, OPENIOT, UIOT6, SPRINT and PROBE-IT.

A.2.2 Accessibility of ICT products and services – Key enablers and security

https://joinup.ec.europa.eu/collection/rolling-plan-ict-standardisation/accessibility-ict-products-and-services

Policy objectives

Accessibility of ICT products and services includes telecommunications, audio-visual media services, the web and new emerging technologies. ICT accessibility is complemented by assistive technology. Interoperability of the two is required to ensure access by persons with disability to ICT and ICT based services on equal basis with others.

This area is related to EU implementation of the UN Convention on the Rights of Persons with Disabilities to which the EU and Member States are a party. It is important to note that under the Convention state parties are obliged to remove accessibility barriers and to adopt and promote design for all approach in the development of standards and guidelines.

The Commission adopted the European disability strategy 2010-2020 with the aim of supporting the implementation of the Convention in the EU.

References (extract):

- General comment No. 2 (2014) Article 9: Accessibility (https://documents-dds-ny.un.org/doc/UNDOC/GEN/G14/033/13/PDF/G1403313.pdf?OpenElement)
- Directive (EU) 2016/2102 of the European Parliament and of the Council of 26 October 2016 on the accessibility of the websites and mobile applications of public sector bodies (http://data.europa.eu/eli/dir/2016/2102/oj)
- The Tallinn Declaration on eGovernment, which mentions universal design and accessibility: https://ec.europa.eu/digital-single-market/en/news/ministerial-declaration-egovernment-tallinn-declaration
- The Commission's eGovernment Action Plan 2016 - 2020, which also refers to accessibility: https://ec.europa.eu/digital-single-market/en/news/communication-eu-egovernment-action-plan-2016-2020-accelerating-digital-transformation
- Directive 2014/24/EU of the European Parliament and of the Council of 26 February 2014 on public procurement (esp. Articles 42 and 62) https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32014L0024
- The Disability Strategy 2010-2020: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0636:FIN:EN:PDF

Related standardisation activities

- CEN-CENELEC-ETSI: revision of EN 301549
- BSI: BS 8878:2010 about a framework for web accessibility when designing or commissioning web products
- ISO/IEC-JTC 1/SC 35:
  - ISO/IEC 24571-1 Information Technology – Individualised adaptability and accessibility in e-learning, education and training – Part 1: Framework and reference model
  - ISO/IEC DIS 24752-8 Information technology -- User interfaces -- Universal remote console -- Part 8: User interface resource framework
- CEN: http://www.cencenelec.eu/standards/Sectors/Accessibility/Pages/default.aspx
- ETSI: programme to develop methods for objective assessment of Listening Effort, in particular with speech in the presence of background noise
- IEC: IEC TC 100/TA 16 develops standards addressing aspects of active assisted living (AAL), including issues related to accessibility, usability and specific user interfaces related to audio, video and multimedia systems and equipment within the scope of TC 100. http://www.iec.ch/dyn/www/f?p=103:7:0:::FSP_ORG_ID,FSP_LANG_ID:11009,25
- IETF: among others RFC 3551 identifies the requirements for SIP to support the hearing impaired and RFC4103 defines the RTP payload for text conversation
- ISO: ISO/IEC Guide 71:2014 Guidelines for standards developers to address the needs of older persons and persons with disabilities was adopted by CEN and CENELEC as CEN/ CENELEC Guide 6:2014. ITU also adopted it as H-Series Supplement 17. Many standards of JTC 1/SC 35 User interfaces
- ITU: Broad range of activities to be found in the ITU Accessibility Portal https://itu.int/en/ITU-T/accessibility
- W3C: standards concerning web content accessibility and related activities, such as
  - WAI ACT: A cooperation framework for guidance on advanced technologies, evaluation methodologies, and research agenda setting to support eAccessibility http://www.w3.org/WAI/ACT/ - furthermore:
  - WAI ACT: A cooperation framework for guidance on advanced technologies, evaluation methodologies, and research agenda setting to support eAccessibility http://www.w3.org/WAI/ACT/
  - WAI-Tools: Develops W3C Accessibility Conformance Testing (ACT) Rules to facilitate harmonized accessibility testing across EU Member States and internationally, and develops demonstrator monitoring in Portugal and Norway as examples for other EU Member States https://www.w3.org/WAI/about/projects/wai-tools/
  - WAI-Guide: Develops open curricula on web accessibility to help organizations across EU Member States and internationally to develop their own courses, promotes accessibility of authoring tools with focus on specific industries, and develops accessibility use cases for emerging technologies https://www.w3.org/WAI/about/projects/wai-guide/
- eAccess+: Hub providing resources notably on standards and guidelines for web accessibility (CIP ICT PSP) http://hub.eaccessplus.eu/wiki/Category:Standards
- Easy Reading: Researches user needs for cognitive and learning disabilities and develops tooling using personalization techniques in close cooperation with end-users, and exchanges research findings with W3C standardisation on cognitive accessibility and personalization
- EIII: European Inclusion Internet Initiative: partners among others including Dutch, Danish, Italian and Iceland governments. The initiative was completed in December 2015
- Prosperity4All: Develops the infrastructure and ecosystem that will allow for a ubiquitous auto-personalisation of interfaces and materials, based on user needs and preferences, to grow; it builds on the infrastructure provided by Cloud4All in order to create more parts of the GPII http://www.prosperity4all.eu; http://www.cloud4all.info/; http://gpii.net/

- Raising the Floor Consortium: Mission is to make the web and mobile technologies accessible to everyone with disability, literacy and ageing-related barriers, regardless of their economic status http://raisingthefloor.org
- SMART 2014 /0061: Monitoring methodologies for web accessibility in the European Union. The objective of the study is to collect information on the monitoring methodologies for verification of compliance with web accessibility requirements in the different Member States www.monitor-wa.eu
- EDF's "Plug and Pray": A disability perspective on artificial intelligence, automated decision-making and emerging technologies" report looks at the impact of emerging technologies on the lives of persons with disabilities. It also provides recommendations to industry, policy makers, organisations of persons with disabilities and academia on how to best ensure that the gains of emerging technologies are equally distributed and potential risks avoided/minimised. http://www.edf-feph.org/newsroom/news/edf-launches-report-plug-and-pray
- We4Authors Project: Web accessibility for web authoring tools producers and communities is a European Pilot Project led by Funka.

A.2.3 Artificial Intelligence (AI) – key enabler and security

https://joinup.ec.europa.eu/collection/rolling-plan-ict-standardisation/artificial-intelligence

Policy objectives

Although there is universally agreed definition of Artificial intelligence (AI), the most accepted definitions refer to systems that display intelligent behaviour by analysing their environment and taking actions – with some degree of autonomy – to achieve specific goals.

AI-based systems can be purely software-based, acting in the virtual world (e.g. voice assistants, image analysis software, search engines, speech and face recognition systems) or AI can be embedded in hardware devices (e.g. advanced robots, autonomous cars, drones or Internet of Things applications) or a combination of both.

We are using AI on a daily basis, e.g. to translate languages, generate subtitles in videos or to block email spam. Beyond making our lives easier, AI is helping us to solve some of the world's biggest challenges: from treating chronic diseases or reducing fatality rates in traffic accidents1 to fighting climate change or anticipating cybersecurity threats.

The new EU strategy on AI was published on 25th April 2018, in the Commission Communication on Artificial Intelligence for Europe. One of the main elements of the strategy is an ambitious proposal to achieve a major boost in investment in AI-related research and innovation and in facilitating and accelerating the adoption of AI across the economy.

References

- **COM(2020) 65 final:** White Paper On Artificial Intelligence - A European approach to excellence and trust
- **COM(2018) 237:** Artificial Intelligence for Europe <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2018%3A237%3AFIN>
- **EC** High-Level Expert Group on Artificial Intelligence **(AI HLEG):** Ethics Guidelines for Trustworthy Artificial Intelligence (AI) https://ec.europa.eu/futurium/en/ai-alliance-consultation/guidelines/1

Related standardisation activities

- CEN/CLC: https://www.cencenelec.eu/standards/Topics/ArtificialIntelligence/Pages/default.aspx
- ETSI
- IEC https://www.iec.ch/dyn/www/f?p=103:186:0::::FSP_ORG_ID,FSP_LANG_ID:22827,25

- ISO
- ISO/IEC-JTC 1/SC 42
  - SC 42/WG 1 – Foundational AI standards. Current projects include:
    - ISO/IEC 22989: Artificial Intelligence Concepts and Terminology
    - ISO/IEC 23053: Framework for Artificial Intelligence Systems Using Machine Learning
  - SC 42/WG 2 – Big data ecosystem. Current projects include:
    - ISO/IEC 20547-1: Information technology -- Big Data reference architecture -- Part 1: Framework and application process
    - ISO/IEC 20547-3: Information technology -- Big Data reference architecture -- Part 3: Reference architecture
    - ISO/IEC 24688: Information technology -- Artificial Intelligence -- Process management framework for Big data analytics
  - SC 42/WG 3 – AI Trustworthiness. Current projects include:
    - ISO/IEC 24027: Information technology -- Artificial Intelligence (AI) -- Bias in AI systems and AI aided decision making
    - ISO/IEC 24028: Information technology -- Artificial Intelligence (AI) -- Overview of trustworthiness in Artificial Intelligence
    - ISO/IEC 24029: Information technology -- Artificial Intelligence (AI) -- Assessment of the robustness of neural networks
    - ISO/IEC 23894 -- Information technology -- Artificial intelligence -- Risk management
    - ISO/IEC 24368: Information technology -- Artificial Intelligence (AI) -- Overview of Ethical and Societal Concerns
  - SC 42/WG 4 – AI Use cases and applications. Current projects include:
    - ISO/IEC 24030: Information technology -- Artificial Intelligence (AI) -- Use cases
  - SC 42/WG 5 – Computational approaches and computational characteristics of AI systems. Current projects include:
    - ISO/IEC 24372: Information technology -- Artificial Intelligence (AI) -- Overview of computational approaches for AI systems
  - SC 42/JWG 1 – Governance implications of AI
    - ISO/IEC 38507 -- Information technology -- Governance of IT -- Governance implications of the use of artificial intelligence by organizations
    - ISO/IEC JTC 1/SC 40 IT Service Management and IT Governance
  - SC 40/WG 1 has commenced work on ISO/IEC 38508 Governance of data — Guidelines for data classification
- IEEE https://standards.ieee.org/industry-connections/ec/autonomous-systems.html
    - IEEE P2807, Framework of Knowledge Graphs
    - IEEE P2807.1, Standard for Technical Requirements and Evaluating Knowledge Graphs
    - IEEE P2830, Standard for Technical Framework and Requirements of Shared Machine Learning
    - IEEE P2841, Framework and Process for Deep Learning Evaluation
    - IEEE P3652.1, Guide for Architectural Framework and Application of Federated Machine Learning More information is available at https://ieeesa.io/rp-ais
- IETF https://trac.ietf.org/trac/iab/wiki/Multi-Stake-Holder-Platform#AI
- ITU-T https://aiforgood.itu.int
    - https://www.itu.int/en/ITU-T/focusgroups/ml5g/Pages
    - https://www.itu.int/md/T17-SG13-190628-TD-WP2-0428
    - https://itu.int/go/tsg13
    - https://www.itu.int/en/ITU-T/focusgroups/ai4h/Pages
    - SG 5, 9, 20
    - United for Smart Sustainable Cities initiative is developing guiding principles for AI in cities. More info: https://www.itu.int/en/ITU-T/ssc/united

- The European AI Alliance
- High-Level Group on AI
- AI on Demand Platform
- CAHAI

A.2.4 Public sector information, open data and big data – Key enablers and security

https://joinup.ec.europa.eu/collection/rolling-plan-ict-standardisation/public-sector-information-open-data-and-big-data

Policy objectives

Standardisation at different levels (such as metadata schemata, data representation formats and licensing conditions of open data) is essential to enable broad data integration, data exchange and interoperability with the overall goal of fostering innovation based on data. This refers to all types of (multilingual) data, including both structured and unstructured data, and data from different domains as diverse as geospatial data, statistical data, weather data, public sector information (PSI) and research data (see also the rolling plan contribution on 'eInfrastructures for data and computing-intensive science'), to name just a few.

Overall, the application of standard and shared formats and protocols for gathering and processing data from different sources in a coherent and interoperable manner across sectors and vertical markets should be encouraged. Studies conducted for the European Commission showed that businesses and citizens were facing difficulties in finding and re-using public sector information. The *Communication on Open data*[47] states that "*the availability of the information in a machine-readable format and a* ***thin layer of commonly agreed metadata*** *could facilitate data cross-reference and interoperability and therefore considerably enhance its value for reuse".*

The PSI Directive encourages the use of standard licences which must be available in digital format and be processed electronically (Article 8(2)). Furthermore, the Directive encourages the use of open licences available online, which should eventually become common practice across the EU (Recital 26). In addition, to help Member States transpose the revised provisions, the Commission adopted guidelines[48] which recommend the use of such standard open licences for the reuse of PSI.

References

- **COM(2014) 442 Towards a thriving data-driven economy**
- **COM(2016) 176 ICT Standardisation Priorities for the Digital Single Market**
- **COM(2017) 9 final Building a European Data Economy:** A Communication on Building a European Data Economy was adopted on 10 January 2017. This Communication explores the following issues: free flow of data; access and transfer in relation to machine generated data; liability and safety in the context of emerging technologies; and portability of non-personal data, interoperability and standards. Together with the Communication the Commission has launched a public consultation.
- **The PSI Directive (2013/37/EU)** on the re-use of public sector information (Public Sector Information Directive) was published in the Official Journal on 27 June 2013. The Directive requests to make available for reuse PSI by default, preferably in machine-readable formats. All Member States have transposed it into national legislation.
- **COM(2011) 882** on Open data
- **COM(2015)192** "A Digital single market strategy for Europe"
- **COM(2018)234** "Proposal for a Directive on the re-use of public sector information (recast)
- **C(2018) 2375 final** "Recommendation on access to and preservation of scientific information"
- **COM(2018) 232 final** "Communication Towards a common European data space"
- **COM(2020) 66 final** "A European strategy for data"

[47] https://ec.europa.eu/digital-single-market/en/european-legislation-reuse-public-sector-information
[48] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.C_.2014.240.01.0001.01.ENG

Related standardisation activities

- ETSI:
  - oneM2M Partnership Project has specified the oneM2M Base Ontology (oneM2M TS-0012, ETSI TS 118 112) to enable syntactic and semantic interoperability for IoT data
  - ETSI TC SmartM2M is developing a set of reference ontologies
  - ISG for cross-cutting Context Information Management (CIM) has developed the NGSI-LD API (GS CIM 004 and GS CIM 009) which builds upon the work done by OMA SpecWorks and FIWARE
  - ISG MEC is developing a set of standardized Application Programming Interfaces (APIs) for Multi-Access Edge Computing (MEC)
  - TC ATTM committee has specified a set of KPIs for energy management for data centres (ETSI ES 205 200-2-1)
- ITU-T:
  - ITU-T SG 13[49], Recommendation ITU-T Y.3600 was approved in 2015; roadmap for big data standardisation in ITU-T under the name of Y.3600-series Supplement 40 "Big Data Standardisation Roadmap" published;
  - SG20 "Internet of things (IoT) and smart cities & communities (SC&C)" is studying big data aspects of IoT and SC
  - Focus Group on Data Processing and Management (FG-DPM) to support IoT and Smart Cities & Communities was set up in 2017
  - SG 17 has approved several standards on big data and open data including "Security requirements and framework for big data analytics in mobile internet services" (Recommendation ITU-T X.1147); "Security-related misbehaviour detection mechanism based on big data analysis for connected vehicles" (X.mdcv)
- W3C:
  - DCAT vocabulary (done in the linked government data W3C working group)
  - Dataset Exchange Working Group (https://www.w3.org/2017/dxwg) to revise DCAT
- OASIS: OpenDocument Format (ODF); XML Localisation Interchange File Format (XLIFF)
- ISO/IEC JTC1
  - SC 42/WG 2 Big Data
  - ISO/IEC 20546:2019 Information technology -- Big Data -- Overview and Vocabulary
  - ISO/IEC TR 20547-2:2018 Information technology -- Big data reference architecture -- Part 2: Use cases and derived requirements
  - ISO/IEC TR 20547-5:2018 Information technology -- Big data reference architecture -- Part 5: Standards roadmap
  - SO/IEC 20547-1: Information technology -- Big Data reference architecture -- Part 1: Framework and application process
  - ISO/IEC 20547-3: Information technology -- Big Data reference architecture -- Part 3: Reference architecture
  - ISO/IEC 24688: Information technology -- Artificial Intelligence -- Process management framework for Big data analytics
- IEEE: series of standards projects related to Big Data (mobile health, energy efficient processing, personal agency and privacy)
- CEN CENELEC
  - CEN/WS ISAEN "Unique Identifier for Personal Data Usage Control in Big Data"
  - CEN and CENELEC cooperating with BDVA (Big Data Value Association)
- OCG: Open Geospatial Consortium (OGC) defines and maintains standards for location-based, spatio-temporal data and services
- ISA and ISA2 programme of the European Commission
- CEF: framework of the Connecting Europe Facility programme

[49] http://itu.int/ITU-T/workprog/wp_item.aspx?isn=9853

- Automat: The project is to establish a novel and open ecosystem in the form of a cross-border Vehicle Big Data Marketplace
- BodyPass: aims to break barriers between health sector and consumer goods
- Future Internet Public Private Partnership programme

A.2.5 Robotics and autonomous systems – Sustainable Growth

https://joinup.ec.europa.eu/collection/rolling-plan-ict-standardisation/robotics-and-autonomous-systems

Policy objectives

The importance of robotics and autonomous systems (RAS) lies in its strong economic contribution as an industrial and commercial activity in its own right and its broad and disruptive socioeconomic impact across diverse market sectors worldwide. Advanced robotics and autonomous (or near-autonomous) vehicles will have a potential annual economic impact by 2025 on a par with e.g. mobile internet, advanced materials or energy markets.

Industrial robotics has already become a cornerstone in several of Europe's high-value manufacturing industries, such as the automotive industry, keeping these industries in Europe. This trend must be maintained, strengthened and extended to all main industries in Europe. Robotics technology also has an impact on a broad range of end-user markets and applications. The robotics professional and consumer service sectors are expected to achieve double-digit growth in the next decade and SMEs will play a key role e.g. in opening new markets. In addition to manufacturing, important future application domains for robots, with a high impact on everyday life, will include healthcare, agriculture, civil, commercial or consumer sectors, logistics and transport.

The EU's strategic vision is to build Europe's global position in the robotics market to account for one-third of industrial robotics, two-thirds of professional services and one-fifth of the domestic services market by 2020.

References:

- European Machinery Directive 2006/42/EC http://ec.europa.eu/growth/single-market/european-standards/harmonised-standards/machinery/index_en.htm
- Directive 2001/95/EC of the European Parliament and of the Council of 3 December 2001 on general product safety https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex:32001L0095
- Robotics PPP — EU Robotics: Strategic Research Agenda http://roboproject.h2214467.stratoserver.net/cms/upload/PPP/SRA2020_SPARC.pdf
- Robotics PPP — EU Robotics: Multiannual Roadmap (rolling document) https://eu-robotics.net/sparc/about/roadmap/index.html

Related standardisation activities

- ISO/TC299: Robotics – most active committee with 6 working groups:
  - WG 1 – Vocabulary and Characteristics
  - WG 2 – Personal Care Robot Safety
  - WG 3 – Industrial Safety
  - WG 4 – Service Robots
  - JWG 5 – Medical Robot Safety
  - WG 6 – Modularity for Service Robots
- CEN:
  - TC 310 'Advanced automation technologies and their applications'
    - EN ISO 13482:2014 'Robots and robotic devices - Safety requirements for personal care robots
    - Together with ISO, CEN/TC 310 is revising prEN ISO 10218-1 'Robots and robotic devices - Safety requirements for industrial robots - Part 1: Robots'; and prEN ISO 10218-2 'Robots and robotic devices - Safety requirements for industrial robots - Part 2: Robot systems and integration'.

- CEN/TC 114 'Safety of Machinery' develops standards of general principles for safety of machinery incorporating terminology and methodology.
- CENELEC
  - CLC/TC 44X 'Safety of machinery: electrotechnical aspects'
  - CLC/TC 63 'Electrical equipment in medical practice' is responsible for the EN IEC 80601 series, notably EN IEC 80601-2-77 'Particular requirements for the basic safety and essential performance of robotically assisted surgical equipment' and EN IEC 80601-2-78 'Particular requirements for basic safety and essential performance of medical robots for rehabilitation, assessment, compensation or alleviation'
- IEC: Advisory Committee on Applications of Robot Technology (ACART) coordinates common aspects of robotic technology such as vocabulary and symbols
- ISO/IEC JTC 1/SC 42 Artificial Intelligence: also has an impact on Robotics
- IEEE: has standardisation and pre-standardisation activities in the field of robotics and automation, including navigation, applications for medicine, transportation, intelligent manufacturing and ethical considerations for the design of autonomous systems – including
  - IEEE P2751 3D Map Data Representation for Robotics and Automation
  - IEEE 1872-2015 Standard Ontologies for Robotics and Automation
  - IEEE P1872.1 Draft Standard for Robot Task Representation
  - IEEE P1872.2 Draft Standard for Autonomous Robotics (AuR) Ontology
  - IEEE P7007 Draft Ontological Standard for Ethically Driven Robotics and Automation Systems
  - IEEE P7008 Draft Standard for Ethically Driven Nudging for Robotic, Intelligent and Autonomous Systems
- ITU-T: active on a number of work items on Artificial Intelligence which have relevance to Robotics
- OCEANIS: The Open Community for Ethics in Autonomous and Intelligent Systems (OCEANIS)
- SPARC: PPP for the collaboration between European robotic industry, academia and the European Commission to facilitate the growth and empowerment of the robotics industry and value chain – Includes a working group on standardisation.
- H2020: R&D&I projects funded within topics ICT 24, ICT 25, ICT 26 and ICT 27 from Work Programme 2016-17 that may produce relevant input for standardisation.
- International Federation of Robotics: Standardisation http://www.ifr.org/standardisation/
- US Occupational Safety and Health Administration: Robotics https://www.osha.gov/SLTC/robotics/index.html

A.2.6 Intelligent Transport Systems – Cooperative, Connected and Automated Mobility (ITS-CCAM) and Electromobility – Sustainable Growth

https://joinup.ec.europa.eu/collection/rolling-plan-ict-standardisation/rolling-plan-2020

Policy objectives

Intelligent transport systems apply ICT to the mobility sector. ITS services and applications can create clear benefits in terms of transport efficiency, sustainability, accessibility, safety and security, whilst contributing to the EU's single market and competitiveness objectives and to the Green Deal.

To take full advantage of the benefits that ICT-based systems and applications can bring to the mobility sector it is necessary to ensure interoperability and continuity of the services among the different systems throughout Europe. The existence of common European standards and technical specifications is paramount to ensure the interoperability of ITS services and applications and to accelerate their introduction and impact. International cooperation aiming at global harmonisation should be pursued.

References

- **Directive 2010/40/EU** of the European Parliament and of the Council on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport
- **COM(2019) 464 final** Report to the European Parliament and the Council on the implementation of Directive 2010/40/EU.
- **COM(2018)283 final:** On the road to automated mobility: An EU strategy for mobility of the future
- **COM (2016) 766** A European strategy on Cooperative Intelligent Transport Systems, a milestone towards cooperative, connected and automated mobility.
- **Commission Delegated Regulation (EU) N° 885/2013** supplementing ITS Directive 2010/40/EU of the European Parliament and of the Council with regard to the provision of information services for safe and secure parking places for trucks and commercial vehicles
- **Commission Delegated Regulation (EU) No 886/2013** supplementing Directive 2010/40/EU of the European Parliament and of the Council with regard to data and procedures for the provision, where possible, of road safety-related minimum universal traffic information free of charge to users
- **Commission Delegated Regulation (EU) No 962/2015** supplementing Directive 2010/40/EU of the European Parliament and of the Council with regard to the provision of EU-wide real-time traffic information services
- **Commission Delegated Regulation (EU) No 2017/1926** supplementing Directive 2010/40/EU of the European Parliament and of the Council with regard to the provision of EU-wide multimodal travel information services
- **Commission Decision 2008/8455/EC** final on the conclusion of an Implementing Arrangement between the European Commission and the Department of Transportation of the United States of America in the field of research on Intelligent Transport Systems and Information and Communication Technologies applications to road transport
- **COM(2008)886 final**: Commission Communication *Action Plan for the deployment of intelligent transport systems in Europe*
- **Commission Decision 2008/671/EC** on the harmonised use of radio spectrum in the 5875-5905 MHz frequency band for safety-related applications of Intelligent Transport Systems (ITS)
- **Recommendation C/2006/7125**: Safe and efficient in-vehicle information and communication systems: update of the European statement of principles on human machine interface (EsoP).
- **COM(2016)787 final:** Reporting on the monitoring and assessment of advanced vehicle safety features, their cost effectiveness and feasibility for the review of the regulations on general vehicle safety and on the protection of pedestrians and other vulnerable road users
- **RSCOM17-26 rev.3 (Final)**: Standardisation Request to CEPT to study the extension of the Intelligent Transport Systems (ITS) safety-related band at 5.9 GHz
- **Standardisation Request M/546:** Commission Implementing Decision of 12.2.2016 on a standardisation request to the European standardisation organisations as regards Intelligent Transport Systems (ITS) in urban areas in support of Directive 2010/40/EU of the European Parliament and of the Council of 7 July 2010 on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport.

Related standardisation activities

- CEN, ISO, ETSI:
  - CEN/TC 278 with ISO/TC 204 and ETSI/TC ITS. Cooperation through the ITS Standardisation Coordination Group (ITS-CG)
  - ETSI/TC ITS technical report TR 101 067 with the Release 1 standards and the development of ISO TR 17465-3 with the CEN/ISO Release 1 list

- 3GPP and LTE V2X progress: noting the impending completion of Release 14
- ETSI cooperation and liaison agreements with relevant SDOs such as IEEE, SAE, ISO, IETF, and standardisation supporting industry groups like TISA. Additionally, liaisons and contacts with regional and NSOs such as ARIB (Japan), CCSA (China) and TTA (Korea) and the Asian Pacific Telecommunication organisation (APT)

- ISO:
  - ISO/TC 22 & ISO/TC 204 (CEN/TC 278/WG 16 & TC 301), SAE: In-vehicle Platform; developed ISO/TS 15638-19:2013 ITS — Framework for collaborative telematics applications for regulated commercial freight vehicles (TARV Part 19)
  - HLC & JWG between TC 204 and TC 22 discussing how to continue activities.
  - SAE looks at electrical connections related activities.
  - ETSI, CEN, ISO, SAE, IEEE: Evaluation of the application of existing standards ongoing.
  - Harmonisation task groups (HTGs): looking into harmonisation needs between the standards developed by the different organisations.
- CEN, ETSI
  - CEN and ETSI: working, in consultation with main stakeholders (such as ASECAP and C2C CC), to find an appropriate solution to ensure non-detrimental interference from ITS-G5 systems
  - CEN/TR 16690 on Electronic fee collection — Guidelines for EFC applications based on in-vehicle ITS stations
- CEN: CEN/TC 278 develop standards in the field of telematics to be applied to road traffic and transport, including those elements that need technical harmonization for intermodal operation in the case of other means of transport. CEN/TC 278 WG17 has been created specifically to address standardisation requirements for Urban ITS; CEN/TC 278/WG 8: DATEX data exchange standards. DATEX II is a standardised e-language for traffic and travel data exchange between traffic control centres, traffic information centres and service providers
- ISO/IEC-JTC 1:
  - SC 37 Biometric: responsible for the standardisation of generic biometric technologies pertaining to human beings to support interoperability and data interchange among applications and systems.
  - ISO/IEC 19794-x: 2011/Amd. 2:2015 data format standards specifying XML encoding, extensible biometric data interchange formats; ISO/IEC 39794-x (e.g. generic extensible data interchange formats for the representation of data: a tagged binary data format based on an extensible specification in ASN.1 and a textual data format based on an XML schema definition (both capable of holding the same information); ISO/IEC 30107-x Biometric presentation attack detection multi-part standard
  - ISO/IEC 24779-x — Cross-Jurisdictional and societal aspects of implementation of biometric technologies — Pictograms, Icons and Symbols for use with Biometric Systems multi-part standard.
- ITU: various standardisation activities in the area of ITS communications.
  - ITU-R WP5A: studies in preparation of WRC-19 on AI 1.12 “to consider possible global or regional harmonized frequency bands”
  - Recommendations including “Harmonization of frequency bands for Intelligent Transport Systems in the mobile service” (ITU-R M.2121); “Radio interface standards of V2V and V2I communications for ITS applications” (ITU-R M.2084); “Systems characteristics of automotive radars operating in the frequency band 76-81 GHz for ITS applications”(ITU-R M.2057); “ITS - Guidelines and objectives” (ITU-R M.1890); “ITS - Dedicated short range communications at 5.8 GHz”(ITU-R M.1453); “Millimetre wave vehicular collision avoidance radars and radiocommunication systems for ITS applications” (ITU-R M.1452)
  - Reports including “Advanced ITS Radiocommunications” (M.2228), “Intelligent transport systems (ITS) usage” (Rep. ITU-R M.2445-0) and “Examples of arrangements for ITS deployments under the mobile service”(ITU-R M.2444).

- ITU-T SG16 Recommendations ITU-T F.749.2 “Service requirements for vehicle gateway platforms”, ITU-T H.550 “Architecture and functional entities of Vehicle Gateway Platforms” and ITU-T H.560 “Communications interface between external applications and a Vehicle Gateway Platform”
- ITU-T Studies on use cases and requirements for multimedia communication enabled vehicle systems using artificial intelligence (F.VS-AIMC), taxonomy of automated driving (F.AUTO-TAX), and gap analysis of vehicle gateways (HSTP-VG-Gap).
- ITU-T SG13 Recommendation ITU-T Y.2281 “Framework of networked vehicle services and applications using NGN”.
- ITU-T SG12 methods for speech and audio evaluation in vehicles. Available: Recommendations on hands-free communication in motor vehicles for narrowband (ITU-T P.1100) and wideband (ITU-T P.1110)
- ITU-T SG17 has dedicated group (Question 13/17 on ITS security) on “Security guidelines for V2X communication systems” (X.itssec-2), “Security requirements for vehicle accessible external devices” (X.itssec-3), “Methodologies for intrusion detection system on in-vehicle systems” (X.itssec-4) and “Security guidelines for vehicular edge computing” (X.itssec-5)
- SG17 finalized Recommendation ITU-T X.1373 “Secure software update capability for ITS communication devices”: https://itu.int/itu-t/recommendations/rec.aspx?rec=13197
- ITU-T SG20 is responsible for IoT and works on “Framework of Cooperative Intelligent Transport Systems based on the Internet of Things (Y.IoT-ITS-framework)
- Runs the platform “Collaboration on ITS Communication Standards (CITS)” as a globally recognized forum to review standardisation activities in various SDOs aiming at an int’lly accepted, globally harmonized set of ITS communication standards: http://itu.int/en/ITU-T/extcoop/cits
- CITS online database for ITS Communication Standards: http://itu.int/go/its-standards
- ITU-T Focus Group on Vehicular Multimedia (FG-VM) https://itu.int/en/ITU-T/focusgroups/vm
- ITU SG16 is working on the use of Artificial Intelligence (AI) on roads

- IEEE: activities in support of the transformation through electrification and automation, including:
  - Intra-vehicle communication: IEEE 802.3 (Ethernet) standards to support high bitrates and Time Sensitive Networking (TSN) in a vehicle.
  - : IEEE 802.11 (WLAN) V2X-wireless communication standards have been optimized
  - The IEEE WAVE standard (Wireless Access in Vehicular Environments) adds a whole protocol stack on top of IEEE 802.11p; IEEE 1609.2 standardises a security architecture and security functions for V2X; together with ETSI ITS-G5 coordinates to harmonize V2X security features
  - IEEE 1901 provides broadband over powerline communications to be used in charging electric vehicles (EVs); IEEE 2030.1.1 on DC quick charging.
  - IEEE P2020 standardises a suite of objective and subjective test methods for measuring automotive camera image quality attributes, and tools and test methods
  - A Formal Model of Safe Automated Vehicle Decision Making will be standardized in P2846
  - P2851 defines a data format with which results of safety analyses (such as FMEA, FMEDA, FMECA, FTA) and related safety verification activities - such as fault injection - executed for IPs, SoCs and mixed signal ICs can be exchanged and made available to system integrators.
  - P2418.4 provides a common framework for distributed ledger technology (DLT) usage, implementation, and interaction in connected and autonomous vehicles (CAVs).
  - The IEEE P7000 standards family addresses ethical considerations in a broad range of artificial intelligence/autonomous system uses, including vehicular contexts.
- IETF
  - WG on Emergency Context Resolution with Internet Technologies (ECRIT) developed a general architecture for enabling IP applications to discover and connect to emergency services.
  - WG Geographic Location/Privacy (GEOPRIV) has developed protocols that allow IP networks to inform end devices about their geolocation, a critical prerequisite for emergency calling.
  - Application-specific WGs, for example the Session Initiation Protocol Core (SIPCORE) Working Group developed extensions to support emergency calling as required.

- WG IP Wireless Access in Vehicular Environments (ipwave) works on Vehicle-2-Vehicle (V2V) and Vehicle-2-Internet (V2I) use-cases where IP is well-suited as a networking technology – characterized by dynamically changing network topologies and connectivity. This group's primary deliverable (and the only Standards track item) will be a document that will specify the mechanisms for transmission of IPv6 datagrams over IEEE 802.11-OCB mode.
- OASIS: OASIS hosts the Open Mobility Foundation (OMF), an open source project launched in 2019
- oneM2M: Basic Ontology specification, which enables semantic and syntactic interoperability across the IoT. This will become increasingly important as greater quantities of data are generated and shared across the IoT.
- W3C: several ongoing activities related to automotive/ITS:
  - WG Automation develops open web platform specifications for HTML5/JavaScript application developers enabling web connectivity through in-vehicle infotainment systems and vehicle data access protocols
  - WG Automotive and web platform business group influences the open web platform on the unique needs of the automotive industry, …. The initial scope of this business group will be to determine what vehicle data should be exposed through a web API(s).

Other activities related to standardisation

- C-ITS Platform (2014-2017): Commission expert group (E03188) brought together representatives of all C-ITS stakeholders to cooperate on legal, organisational, administrative and governing aspects, but also on more technical issues such as standardisation, or security and certification of the system.
- CCAM Platform (2019-now): Commission expert group (E03657) provides advice and support to the Commission in the field of testing and pre-deployment activities for Cooperative, Connected, Automated and Autonomous Mobility (CCAM).
- Car-2-Car Communication Consortium (C2C-CC): industry organisation representing car manufacturers and actively participates and chairs ETSI TC ITS. It also contributes to CEN working groups.
- C-ROADS: Platform resulting from a joint initiative of 16 EU Member States, 7 associated states and road operators for testing and implementing C-ITS services in light of cross-border harmonisation and interoperability. https://www.c-roads.eu/platform.html
- 5G Automotive Association (5GAA): Association to connect the telecom industry and vehicle manufacturers to develop end-to-end solutions for future mobility and transportation services. http://www.5gaa.org.org
- ERTICO — ITS Europe, GSM-A: Stakeholder organisations providing input to ETSI and CEN
- "Amsterdam Group" (AG): umbrella organisation bringing together the C2C-CC, ASECAP, CEDR and POLIS for smooth alignment of deployment of Cooperative-ITS functionalities and technologies European wide
- UN/ECE WP29: intergovernmental body World Forum for Harmonization of Vehicle Regulations (WP.29). The World Forum has set one of its priorities related to the establishment of a global applicable regulatory framework for automated/autonomous and connected vehicles.
- GENIVI®: non-profit industry alliance committed to driving the broad adoption of specified, open source, in-vehicle infotainment (IVI) software. The alliance develops an open standard for aligning automotive and consumer infotainment cycles. http://www.genivi.org/
- MirrorLink initiative: turns the car into a terminal; it has little computing power itself and relies instead on the phone as its processor. http://www.mirrorlink.com/
- EU and national funded RTD projects and pilots: among others, DriveC2X, FOTSIS, PRESERVE, ITSSv6, ComeSafety2, COMPASS4D, iMobilitySupport, SIM-TD, SCORE@F, eCoMove, EasyWay, SPITS
- WCO Datamodel (world customs organisation data model): important standard for providing alignment for announcements to and from government about transport and trade making communication throughout Europe between governmental parties and between government and commercial parties easier and cheaper.

- TN-ITS (Transport Network ITS Spatial Data Deployment Platform): as ROSATTE project (FP7) outcome the TN-ITS association promotes the integration of accurate (public) road data in navigation-oriented maps, and their timely updating, including possible alignment with the technical framework for the INSPIRE project, including the identification of standardisation needs.
- Smart Ticketing Alliance (STA): platform for cooperation and a coordinated approach for establishing ticketing interoperability for the Public Transport sector. www.smart-ticketing.org
- The ITxPT (Information Technology for Public Transport) Initiative aims to further implement standards for plug-and-play IT-systems applied to public transport. www.itxpt.org

A.3 RPIS 2020 sections dealing with further technology domains/trends of potential relevance to TRIPS

A.3.1 Intelligent transport systems – Key enabler and security

Intelligent Transport Systems - Cooperative, Connected and Automated Mobility (ITS-CCAM) and Electromobility

Policy objectives

Intelligent transport systems apply ICT to the mobility sector. ITS services and applications can create clear benefits in terms of transport efficiency, sustainability, accessibility, safety and security, whilst contributing to the EU's single market and competitiveness objectives and to the Green Deal.

References

- **Directive 2010/40/EU** of the European Parliament and of the Council on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport.
- **COM(2019) 464 final** Report to the European Parliament and the Council on the implementation of Directive 2010/40/EU.
- Commission Staff Working Document on the analysis of the Member States reports.
- **COM(2018)283 final:** On the road to automated mobility: An EU strategy for mobility of the future.
- **COM (2016) 766** A European strategy on Cooperative Intelligent Transport Systems, a milestone towards cooperative, connected and automated mobility.
- **Commission Delegated Regulation (EU) No 305/2013** supplementing Directive 2010/40/EU of the European Parliament and of the Council with regard to the harmonised provision for an interoperable EU-wide eCall.
- **Commission Delegated Regulation (EU) N° 885/2013** supplementing ITS Directive 2010/40/EU of the European Parliament and of the Council with regard to the provision of information services for safe and secure parking places for trucks and commercial vehicles
- **Commission Delegated Regulation (EU) No 886/2013** supplementing Directive 2010/40/EU of the European Parliament and of the Council with regard to data and procedures for the provision, where possible, of road safety-related minimum universal traffic information free of charge to users.
- **Commission Delegated Regulation (EU) No 962/2015** supplementing Directive 2010/40/EU of the European Parliament and of the Council with regard to the provision of EU-wide real-time traffic information services.
- **Commission Delegated Regulation (EU) No 2017/1926** supplementing Directive 2010/40/EU of the European Parliament and of the Council with regard to the provision of EU-wide multimodal travel information services.
- **Commission Decision 2008/8455/EC** final on the conclusion of an Implementing Arrangement between the European Commission and the Department of Transportation of

the United States of America in the field of research on Intelligent Transport Systems and Information and Communication Technologies applications to road transport.

- **COM(2008)886 final**: Commission Communication *Action Plan for the deployment of intelligent transport systems in Europe.*
- **Commission Decision 2008/671/EC** on the harmonised use of radio spectrum in the 5875-5905 MHz frequency band for safety-related applications of Intelligent Transport Systems (ITS).
- **Recommendation C/2006/7125**: Safe and efficient in-vehicle information and communication systems: update of the European statement of principles on human machine interface (EsoP).
- **COM(2016)787 final:** Reporting on the monitoring and assessment of advanced vehicle safety features, their cost effectiveness and feasibility for the review of the regulations on general vehicle safety and on the protection of pedestrians and other vulnerable road users.
- **RSCOM17-26 rev.3 (Final)**: Standardisation Request to CEPT to study the extension of the Intelligent Transport Systems (ITS) safety-related band at 5.9 GHz.
- **Standardisation Request M/546:** Commission Implementing Decision of 12.2.2016 on a standardisation request to the European standardisation organisations as regards Intelligent Transport Systems (ITS) in urban areas in support of Directive 2010/40/EU of the European Parliament and of the Council of 7 July 2010 on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport.
- **Directive 2014/94/EU** of the European Parliament and Council on the deployment of alternative fuels infrastructure (AFI).

Requested actions:

- Cooperative, Connected and Automated Mobility (CCAM
- OPEN IN-VEHICLE PLATFORM ARCHITECTURE AND HMI
- ELECTRIC VEHICLES (EVS)
- DIGITAL MAPS & LOCATION FEATURES:
- Digital local dynamic maps:
- (URBAN) ITS - MULTIMODAL SERVICES
- DATA EXCHANGE AND REUSE
- SECURITY in the context of C-ITS

Standardization

- ESOs: CEN/TC 278 with ISO TC 204 and ETSI TC ITS.
- ISO: ISO TC22 & ISO TC204 (CEN/TC278 WG16 & TC 301), SAE: In-vehicle Platform.
- CEN, ETSI
- ISO/IEC-JTC 1/SC 37 generic biometric technologies
- ITU: ITU-R WP5A, ITU-T SG 16, SG 13, SG 12, SG 17, SG 20, SG 16
- IEEE
- IETF
- OASIS https://openmobilityfoundation.org
- OneM2M
- W3C

EU funded projects (Horizon 2020 WG 3.5 call): Projects supporting local dynamic maps standardisation (e.g. HIGHTS)

A.3.2 5G – Policy and legislation – Key enablers and security

https://joinup.ec.europa.eu/collection/rolling-plan-ict-standardisation/5g

Policy objectives

The 2015 digital single market (DSM) strategy and the communication "*Towards connectivity for a European gigabit society*" identify very high-capacity networks like 5G as a key asset for global competitiveness. The first phase of 5G standardisation has now been completed with the publication by ETSI of its 3GPP Release-15 set of specifications. 5G standardisation will continue in further 3GPP releases. The second phase, to be defined in 3GPP Release-16, is well under way, with an anticipated completion by March 2020. The Commission launched a 5G public-private-partnership (the 5G-PPP) to that end in 2013. In addition to fibre-like performance for mobile networks, the benefits of adopting 5G go beyond the telecom sector to enable a fully mobile and connected society and to empower socioeconomic transformations in a variety of ways (many of which are not possible at present). These transformations include higher productivity, sustainability, well-being and innovation opportunities for smaller actors and start-ups. 5G makes a new wave of convergence possible through digital business models reaching non-ICT-native industrial sectors. In that context, the EU sees 5G as a core infrastructure to support the DSM strategy's wider objectives for the digitisation of the industry.

Despite the many anticipated benefits of 5G networks, there are a number of challenges and concerns pertaining to the area of public and internal security. In the context of a Europe that protects, the European Commission identified 5G networks as a strategic asset therefore requiring high cybersecurity standards and preserving lawful investigation capabilities. To attain these objectives, the needs of the law enforcement and other relevant authorities in the area of public and internal security should be taken on board though a coordinated approach in view of the ongoing 5G standardisation activities.

Related standardisation activities

- 3GPP
- 5G-ACIA
- ETSI (DECT)
- ETSI
- GSMA
- IEEE
- ITU

EU projects: See https://5g-ppp.eu/

A.3.3 Cloud computing – Key enablers and security

https://joinup.ec.europa.eu/collection/rolling-plan-ict-standardisation/cloud-computing

Policy objectives

Establishing a coherent framework and conditions for cloud computing was one of the key priorities of the digital agenda for Europe. The digital single market strategy confirmed the importance of cloud computing, which is driving a paradigm shift in the delivery of digital technologies, enhancing innovation, digital single market and access to content.

The key role of cloud computing is established through the European Cloud Initiative and through the initiative on Building a European Data Economy. Cloud computing is developing fast. Estimates indicate that these developments could lead to the growth of the European cloud market from €9.5bn in 2013 to €44.8bn by 2020, i.e. almost five times the market size in 2013. The latest Eurostat data available (end of 2018) shows the current state of play in the European Union regarding the use of cloud computing by enterprises:

The development of the cloud computing market and the efficient delivery of cloud services particularly depend on the ability to build economies of scale. The establishment of a Digital Single Market will unlock the scale necessary for cloud computing to reach its full potential in Europe.

Related standardisation activities

- CEN/CLC
- ETSI
- ISO/IEC
  - ISO/IEC 27017 Code of practice for information security controls based on ISO/IEC 27002 for cloud services
  - ISO/IEC 27018 Code of practice for personally identifiable information (PII) protection in public cloud acting as PII processors
  - ISO/IEC 27036-4 Information security for supplier relationships — Part 4: Guidelines for security of cloud services
  - ISO/IEC 19086-1 Cloud computing — service level agreement (SLA) framework — Part 1: Overview and concepts
  - ISO/IEC 19086-2 Cloud computing — Service level agreement (SLA) framework — Part 2: Metric model
  - ISO/IEC 19086-3 Cloud computing — Service level agreement (SLA) framework — Part 3: Core conformance requirements
  - ISO/IEC 19086-4 Cloud computing — Service level agreement (SLA) framework — Part 4: Components of security and of protection of PII
  - ISO/IEC 19941 Cloud Computing — Interoperability and portability
  - ISO/IEC 19944 Cloud Computing — Cloud services and devices: data flow, data categories and data use
  - ISO/IEC TR 22678 Cloud Computing – Guidance for Policy Development
  - ISO/IEC TR 23186 Cloud computing – Framework of trust for processing of multi-sourced data
  - ISO/IEC NP TR 23187 Cloud computing — Interacting with cloud service partners (CSNs) (work in progress)
  - ISO/IEC PDTR 23613 Cloud service metering and billing elements (work in progress)
  - ISO/IEC AWI 23751 Cloud computing and distributed platforms — Data sharing agreement (DSA) framework (work in progress)
  - ISO/IEC TR 23951 Cloud computing — Best practices for cloud SLA metrics (work in progress)
  - ISO/IEC 22624 Cloud Computing – Taxonomy based data handling for cloud services (final stages of approval)
  - ISO/IEC CD 22123 Cloud Computing -- CONCEPTS AND TERMINOLOGY (work in progress)
  - ISO/IEC TS 23167 Cloud Computing – Common Technologies and Techniques (work in progress)
  - ISO/IEC TR 23188 Cloud computing – Edge computing landscape (work in progress)
- ITU-T SG13 https://www.itu.int/rec/T-REC-Y.Sup49/en
  - More info: https://www.itu.int/en/ITU-T/studygroups/2017-2020/13
  - This work is complemented by ITU-T SG11 for cloud computing conformance and interoperability testing and SG17 for cloud computing security. SG11 approved/agreed:
  - Supplement 65 on “Cloud computing interoperability activities”
  - Recommendation ITU-T Q.4040 on “The framework and overview of Cloud Computing interoperability testing”,
  - Recommendation ITU-T Q.4041.1 on “Cloud computing infrastructure capabilities interoperability testing - part 1: Interoperability testing between the CSC and CSP”,
  - Recommendation ITU-T Q.4042.1 “Cloud interoperability testing for web applications - part 1: Interoperability testing between the CSC and CSP”
  - Recommendation ITU-T Q.4043 “Interoperability testing requirements for virtual switches”) More info: https://itu.int/go/tsg13
- ITU-T SG17 on “Security” has approved one Recommendation on “Data security requirements for the monitoring service of cloud computing” (ITU-T X.1603) and is in the

process of approving Recommendation ITU-T X.1605 "Security requirements of public infrastructure as a service (IaaS) in cloud computing" and Recommendation ITU-T X.1604 on "Security requirements of network as a service (NaaS) in cloud computing". SG17 has also commenced work on "Security guidelines for container in cloud computing environment" (X.sgcc), "Security guidelines for distributed cloud" (X.sgdc), "Security guidelines for multi-cloud (X.sgmc), Security requirements of cloud-based platform under low latency and high reliability application scenarios" (X.sr-cphr) and "Requirements of network security situational awareness platform for cloud computing" (X.nssa-cc). More details here: https://www.itu.int/en/ITU-T/studygroups/2017-2020/17

Further related standardisation activities

- IEEE
- IETF
- OGF
- OMG
- OneM2M
- OASIS
- OFE
- BSI Cloud Computing Compliance Controls Catalogue (C5)
- C-SIGs
- GICTF
- OCC
- TM Forum
- SNIA

A.3.4 Blockchain – Policy and legislation

https://joinup.ec.europa.eu/collection/rolling-plan-ict-standardisation/blockchain-and-distributed-digital-ledger-technologies

Policy objectives

Blockchain has great potential in providing an infrastructure for trusted, decentralised and disintermediated services beyond the financial sector. The first Semester of 2018 has seen $6.3bn invested in ICOs and $885mn for VC.

Blockchain is a promising technology to share data and manage transactions in a controlled manner, with many possible applications to deliver social goods in the field of eHealth and eGovernment, health records, land registries or the security certification of links in an Internet of Things chain of devices, food safety, trust funding (e.g., for development or humanitarian programmes), manage intellectual property rights and eID. Provisions must be taken at all stages to comply with the GDPR.

It has also great potential for the private sector, in trading, contracting, supply chain management, traceability along industrial supply chains (e.g. on social & environmental conditions of work, on material composition or on the maintenance history of the item) and much more. It may also transform the governance of private organisations and of companies (concept of Decentralised Autonomous Organisation - DAO), and hence impact labour rights. Furthermore, from a regulatory and supervisory point of view, it can provide regulators with the same view into the data as the companies they're regulating, thereby reducing fraud and compliance costs and facilitating auditing.

However, this process is hindered by a lack of harmonisation and interoperability that constitute obstacles to cross border and cross sector transactions. The responsibility for public policymakers would be to support innovation within a safe and future-proof technological and regulatory

environment, ensuring appropriate interoperability, transparency, accessibility, monitoring and governance

References

- Mid-Term Review on the implementation of the Digital Single Market Strategy, COM(2017) 228 final https://ec.europa.eu/digital-single-market/en/news/digital-single-market-commission-calls-swift-adoption-key-proposals-and-maps-out-challenges
- EU Blockchain Observatory and Forum https://www.eublockchainforum.eu
- European Blockchain Partnership https://ec.europa.eu/digital-single-market/en/news/european-countries-join-blockchain-partnership

Standardization:

- **ISO**
  - ISO/TC 307: Blockchain and distributed ledger technologies: https://www.iso.org/committee/6266604/x/catalogue/
  - WG1: Foundations
    - ISO/DIS 22739 Terminology
    - ISO/WD TS 23258 Taxonomy and Ontology
    - ISO/CD 23257.2 Reference architecture
  - WG2: Security, privacy and identity
    - ISO/CD TR 23244 Privacy and personally identifiable information protection considerations
    - ISO/CD TR 23245 Security risks, threats and vulnerabilities
    - ISO/CD TR 23576 Security management of digital asset custodians
  - WG3: Smart contracts and their applications
    - ISO/AWI TS 23259 Legally binding smart contracts
  - JWG4: Joint ISO/TC 307 - ISO/IEC JTC 1/SC 27 WG; Blockchain and distributed ledger technologies and IT Security techniques
    - ISO/NP TR 23246 Overview of identity management using blockchain and distributed ledger technologies" - to be replaced with "Overview of existing DLT systems for identity management.
  - WG5: Governance
    - ISO/NP TS 23635 Guidelines for governance
  - WG6: Use cases
    - ISO/CD TR 3242 Blockchain and distributed ledger technologies – Use cases
  - SG7: Interoperability of blockchain and distributed ledger technology systems
- IEEE https://ieeesa.io/rp-blockchain
- ITU-T http://itu.int/en/ITU-T/focusgroups/dfs/Documents/201703/ITU_FGDFS_Report-on-DLT-and-Financial-Inclusion.pdf
- W3C
- IETF IRTF
- CEN/CLC https://www.cencenelec.eu/news/articles/Pages/AR-2018-04.aspx
- ETSI
- OASIS https://www.linkedin.com/pulse/bbiller-supply-chain-blockchain-presentation-slides-ken-holman
- UNECE: White Paper 1: https://www.unece.org/fileadmin/DAM/cefact/GuidanceMaterials/WhitePaperBlockchain.pdf; White Paper 2: https://www.unece.org/fileadmin/DAM/cefact/GuidanceMaterials/WhitePaperBlockchain_TechApplication.pdf
- INATBA https://inatba.org/

A.3.5 Smart cities & transport – Policy and legislation

Smart cities and communities/ technologies and services for smart and efficient energy use

Policy objectives

Smart urban technologies can make a significant contribution to the sustainable development of European cities. 75% of the EU population lives in urban areas, a proportion that is growing as the urbanisation trend continues, both in Europe and worldwide.

A smart city is an entity that uses ICT effectively, to integrate the requirements of its urban community, in terms of energy and other utilities (production, distribution and use), environmental protection, mobility and transport, services for citizens (healthcare, education, emergency services etc.) and with proper regard for security, both of individuals and their personal data, and use it as a driver for economic and social improvements. This would also increase the deployment of smart technologies and solutions in rural communities, contributing to the development of businesses and creating conditions for making smart communities attractive to the population.

In standards terms, there are some over-arching requirements, concerning standards for common terminologies, for citizens' interface with their local authority, etc. But mainly, smart city standards topics relate to the need to ensure commonalities —as far as these are appropriate and cost-effective— between the approaches taken by the different application areas, to enable the city to derive the best horizontal advantage from its overall approach and above all benefit from interoperability. The standards requirements as such for these application areas are specified in the Rolling Plan elsewhere at the appropriate points.

The core components in such a complex system are the frameworks that assist companies, cities and other actors to provide appropriate solutions that prioritise economic, social and environmental outcomes. Solutions should address the whole lifecycle, optimising environmental, social and economic outcomes through the seamless transfer of information.

References

- **Strategic Implementation Plan,** http://ec.europa.eu/eip/smartcities/files/sip_final_en.pdf
- **COM(2012) 4701**: *Smart Cities and Communities — European Innovation Partnership*
- **COM(2017) 228 final**: Mid-Term Review on the implementation of the Digital Single Market Strategy - A Connected Digital Single Market for All
- **COM(2016) 176:** ICT Standardisation Priorities for the Digital Single Market
- **COM(2015) 192**: A Digital Single Market Strategy for Europe
- **COM(2016) 176** ICT Standardisation Priorities for the Digital Single Market

The "United for smart sustainable cities" (U4SSC) initiative coordinated by ITU, UNECE and UN-Habitat and supported by 13 other UN agencies and programmes to advocate for public policy to emphasize the importance of ICT in enabling the transition to smart sustainable cities (see the ITU section below for more details).

Standardization:

- CEN/TC 465 'Sustainable and Smart Cities and Communities'
- ESOs: http://www.cencenelec.eu/standards/Sectors/SmartLiving/smartcities/Pages/SSCC-CG.aspx
- ETSI
- ISO TC 268 "Sustainable development in communities" https://www.iso.org/committee/656906.html

- ISO/DIS 37122 Sustainable cities and communities - Indicators for smart cities (under development)
- ISO/FDIS 37104 Sustainable cities and communities -Guidance for practical implementation in cities (under development)
- ISO/DIS 37105 Sustainable cities and communities - Descriptive framework for cities and communities (under development)

- ISO-IEC/JTC 1 WG11 "Smart cities"
  - ISO/IEC WD 30145-1 Smart City ICT Reference Framework- Part 1: Smart City Business Process Framework （under development）
  - ISO/IEC CD 30145-2 Smart City ICT Reference Framework- Part 2: Smart City Knowledge Management Framework（under development）
  - ISO/IEC DIS 30145-3 Smart City ICT Reference Framework- Part 3: Smart City Engineering Framework（under development）
  - ISO/IEC FDIS 30146 Smart City ICT Indicators（under development）
  - ISO/IEC DIS 21972 Information technology - An upper level ontology for smart city indicators（under development）
  - ISO/IEC NP 24039 Information Technology – Smart City Digital Platform（under development).
- IEEE https://ieeesa.io/rp-smartcities
- ITU-T SG 20
- IETF
- OASIS
- AENOR
- BSI
- DIN/DKE/VDE
- SEMANCO
- eeSemantics
- Adapt4EE/Ready4SmartCities
- Horizon 2020 call SCC-03-2015 Espresso
- Industry Memorandum of Understanding on Urban Platforms https://ec.europa.eu/digital-single-market/en/news/memorandum-understanding-towards-open-urban-platforms-smart-cities-and-communities
- Demand-side group (city-led) on Urban Platforms (within the European Innovation Partnership on Smart Cities and Communities) https://eu-smartcities.eu/content/urban-platforms
- Open & Agile Smart Cities (OASC) www.oascities.org
- SynchroniCity www.synchronicity-iot.eu
- Future Internet Public Private Partnership www.fiware.org/
- EUROCITIES and GREEN DIGITAL CHARTER (GDC) http://www.greendigitalcharter.eu
- H2020 CITYkeys http://www.citykeys-project.eu/
- H2020 Smart Cities 12 Lighthouse projects
- Fed4IoT https://fed4iot.org/
- Spanish national plan on smart cities http://www.agendadigital.gob.es/planes-actuaciones/Paginas/plan-nacional-ciudades-inteligentes.aspx
- ITU and UNECE "United for smart sustainable cities" (U4SSC) initiative to advocate for public policy to emphasize the importance of ICT in enabling the transition to smart sustainable cities.

2020-06-14

ANNEX B: Overview of standards related to Internet and WWW technologies

B Overview of standards related to Internet and WWW technologies

The big family of technical standards and specifications belonging to the TCP/IP Suite (Transmission Control Protocol – often incorrectly used as equivalent for Internet Protocol) – are a complex 'universe' of technical standards. They belong to 4 categories (layers): application layer, transport layer, Internet layer and link layer.

Internet protocol suite

Application layer

BGP - DHCP - DNS - FTP - HTTP - IMAP - LDAP - MGCP - NNTP - NTP - POP - ONC/RPC - RTP - RTSP - RIP - SIP - SMTP - SNMP - SSH - Telnet - TLS/SSL - XMPP - *more...*

Transport layer

TCP - UDP - DCCP - SCTP - RSVP - *more...*

Internet layer

IP (IPv4 - IPv6) - ICMP - ICMPv6 - ECN - IGMP - IPsec - *more...*

Link layer

ARP - NDP - OSPF - Tunnels (L2TP) - PPP - MAC (Ethernet) - DSL - ISDN - FDDI - *more...*

Taken from: https://en.wikipedia.org/wiki/Internet_protocol_suite

Table 1: Overview of standards and specifications of the IP Suite

Partners of previous projects indicated the use of many of the IP Suite standards – first of all referring to **communication protocol** standards (according to the AALIANCE[2] classification):

- RFC 1945 *Hypertext Transfer Protocol* (**HTTP**) – IP Suite
- RFC 3550, RFC 3551: *Real-Time Transport Protocol* (**RTP**) – IP Suite (developed by the Audio/Video Transport working group of the IETF standards organization)
- RFC 3711: *Secure Real-time Transport Protocol* (**SRTP**) – IP Suite (defines a profile of **RTP**, intended to provide encryption, message authentication and integrity)
- *Web Real-Time Transport Protocol* (**WebRTP**) – W3C, IETF (is SRTP for WebRTC)
- *Web Real-Time Communication* (**WebRTC**) – W3C, IETF (collection of communications protocols and application programming interfaces that enable real-time communication over peer-to-peer connections)
- ISO/IEC 40210:2011 *Information technology – W3C **SOAP** Version 1.2 Part 1: Messaging Framework* (Second Edition) – W3C
- RFC 768: *User Data Protocol* (**UDP**) – IP Suite
- *Secure Shell* (**SSH**) – IP Suite
- *Transport Layer Security* (**TLS**) – IP Suite

The Internet Protocol Suite guarantees the fundamental technical interoperability of the Internet.

Another complex of several families of standards constitute the technical basis of the World Wide Web (WWW) developed by the WWW Consortium (W3C). Various W3C Working Groups develop different kinds of standards called Recommendations, Notes, Guidelines and Initiatives. Even if some standards were deprecated, they are still maintained.

V - T - E	World Wide Web Consortium (W3C)	
Products and standards	Recommendations	ARIA - Canonical XML - CDF - CSS - DOM - Geolocation API - HTML (HTML5) - ITS - JSON-LD - MathML - OWL - P3P - PLS - RDF - RDF Schema - SISR - SKOS - SMIL - SOAP - SRGS - SRI - SSML - SVG - SCXML- SPARQL - Timed text - VoiceXML - Web storage - WSDL - XForms - XHTML - XHTML+RDFa - XInclude - XLink - XML - XML Base - XML Encryption - XML Events - XML Information Set - XML namespace - XML Schema - XML Signature - XOP - XPath - XPath 2.0 - XPointer - XProc - XQuery - XSL - XSL-FO - XSLT (elements)
	Notes	XAdES - XHTML+SMIL - XUP
	Working drafts	CCXML - CURIE - EME - InkML - MSE - RIF - SMIL Timesheets - sXBL - WICD - XFDL - XFrames - XBL - XMLHttpRequest
	Guidelines	Web Content Accessibility Guidelines
	Initiative	Multimodal Interaction Activity (MMI) - Markup Validation Service - Web Accessibility Initiative - WebPlatform
	Deprecated	C-HTML - HDML - JSSS - PGML - VML - XHTML+MathML+SVG
Organizations	**Advisory Committee (AC)** World Wide Web Foundation	
	Elected groups	**Advisory Board (AB) - Technical Architecture Group (TAG)**
	Working groups	CSS - HTML - **Geolocation** - **Social Web** - SVG - Web Hypertext Application Technology (WHATWG) - **Web Platform**
	Closed groups	Device Description (DDWG) - **WebOnt (Semantic Web Activity)**
Software	CERN httpd - Libwww	
	Browsers	Line Mode (1990–) - Arena (1993–98) - Agora (1994–97) - Argo (1994–97) - Amaya (browser/editor, 1996–2012)
Conferences	International World Wide Web Conference (IW3C) (Steering Committee (IW3C2) - First conference ("WWW1", 1994)	

Taken from: https://en.wikipedia.org/wiki/Template:W3C_standards

Table 2: W3C Standards overview

Some W3C standards have development versions or constitute families of versions or releases, some are competing with each other or with industry standards. Thus, different ICT vendors offer incompatible versions of HTML which causes inconsistencies in how web pages are displayed. Web services is a field of dynamically emerging standards which, according to W3C's Web Services Architecture Working Group, can be distinguished into two major classes:

- ***REST-compliant Web services***, in which the primary purpose of the service is to manipulate XML representations of Web resources using a uniform set of "stateless" operations; and
- ***arbitrary Web services***, in which the service may expose an arbitrary set of operations.

The more constrained architectural style for reliable Web applications known as *Representation State Transfer* (REST, which is based on HTTP and URI) has been proposed by Roy Fielding and has inspired many who see it as a model for how to build Web services. But even the REST Web is the subset of the WWW (based on HTTP) in which agents provide *uniform interface semantics* – essentially create, retrieve, update and delete – rather than arbitrary or application-specific interfaces, and manipulate resources only by the exchange of *representations*. Furthermore, the REST interactions are 'stateless' in the sense that the meaning of a message does not depend on the state of the conversation. Both classes of Web services use URIs to identify resources and use Web protocols (such as HTTP and SOAP 1.2) and XML data formats for messaging. (It should be noted that SOAP 1.2 *can* be used in a manner consistent with REST. However, SOAP 1.2 can also be used in a manner that is *not* consistent with REST)

The ***Resource Description Framework*** (RDF) is another family of dynamically emerging specifications released as recommendations. Originally designed as a metadata data model. It has come to be used as a general method for conceptual description or modeling of information that is implemented in web resources, using a variety of syntax notations and data serialization formats. It is also used in knowledge management applications. It is closely related to the ***Resource Description Framework Schema*** (RDFS), OWL and other W3C specifications and recommendations.

W3C is also the originator of document markup languages (such as HTML <also ISO/IEC 15445>, HTML.5, XHTML), certain XML (eXtensible Markup Language) developments, and many more documents, specifications, guidelines and standards. This also covers standards falling under ***document formats, file formats and persistent data structures***:

- RFC 7303 *eXtensible Markup Language* (**XML**) – W3C
- RFC 1866 *HyperText Markup Language* (**HTML**) – W3C
- **HTML5**: *Guidelines for Mobile Best Practices* – W3C
- **XML-RPC**: remote procedure call protocol encoded in XML – patented in April 2006 (similar to JSON-RPC)
- RFC 7159 *JavaScript Object Notation* (**JSON**) – json.org
- JSON encoded remote procedure call protocol (**JSON-RPC**) – jsonrpc.org (RPC built on JSON, as a replacement of XML-RPC or SOAP, see: http://www.jsonhttps://en.wikipedia.org/wiki/Birds_of_a_feather_(computing)rpc.org/specification)
- RFC 2318 *Cascading Style Sheets* (**CSS**) – W3C
- RFC 2396 (e.a.) *Uniform Resource Identifier* (**URI**) – IETF (with respect to URI schemes defined by RFC 7595, IANA, the Internet Assigned Numbers Authority, maintains a register)
- *Representational state transfer* (**REST** or **RESTful** Web services): W3C (REST is an architectural style, not a protocol standard in itself; but RESTful implementations make use of standards, such as HTTP, URI, JSON, and XML)
- ISO 32000-1:2008 *Document management – Portable document format – Part 1:* ***PDF*** *1.7*

The Web Ontology Language (OWL) is another 'universe' of dynamically emerging standards which is branching out into many pre-standard-like specifications which are tested by various developer communities. Some are more mature than others. It is difficult to judge at which point in time they can be considered as true 'standard'. Concerning ontologies, a distinction must be made between the methodology, or ICT-standards on ontologies, and standard ontologies in the meaning of the ontology content. Ontologies being collections of data (=content) formally described by an ontology, such as a domain ontology, will be dealt with further below.

- the W3C standard OWL today is a family of 'standards' for authoring ontologies in the meaning of knowledge representations. ***The resulting knowledge representations are not necessarily 'content interoperable'.***
- W3C OWL-S: Semantic Markup for Web Services is an ontology built on top of OWL for describing Semantic Web Services. OWL-S requires an additional description for a full specification of the grounding, the most commonly used being WSDL, the Web Services Description Language. Therefore, if OWL-S is included in a collection of information on standards, WSDL or similar also should be listed in such a collection.
- W3C's Semantic Sensor Networks Community Group (SSN-XG) continues work on the OWL-encoded SSN ontology which enables expressive representation of sensors, sensor observations, and knowledge of the environment.

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ANNEX C: Extract of standards identified by ISO/SAG "Strategic Advisory Group (SAG) on Accessibility"

C Extract of the standards identified by ISO/SAG Accessibility

Keywords "Transport", "Accessibility deliverables", "Guide to standards developers", "Consumer products (incl. information)" and "Other than ISO IEC"

The following is an eextract from ISO/SAG "Accessibility", created in September 2018 to explore how to bring together information on accessibility and how to best share it with the technical community. In 2019, the SAG has been working on mapping all existing accessibility deliverables. Close to 300 deliverables on accessibility were found and these have been categorized according to sector, accessibility relevance and type of deliverable (requirements, recommendations, MSS Guide for standard developers). The mapping will allow committees and working groups to find existing work on accessibility to avoid overlap and to use as references in their work.

Explanation from the collection of information of the SAG "Accessibility":

How to use this document

This excel-file contains accessibility related documents within ISO and ISO/IEC.
(It does not comprise information on CENCLC standards)
The documents are categorized according to sectors, accessibility relevance and type of deliverable.

Sectors

- Transport
- Built environment and facilities
- ICT
- Consumer products (incl. information)
- Workplace (incl. information)
- Operations

Accessibility relevance

- Accessibility deliverables
- Mainstream deliverables incl. Accessibility

Types of deliverables

- Requirements
- Recommendations
- Management system standards/process
- Guide for standard developers)

The sheet "Total list" contains all the documents that have been found and one sheet per sector including all other categories. There are two extra sheets with non-ISO/IEC documents and works under development.

Document	Document type	Title	Description	Technical body	Built environment and facilities	Transport	ICT	Workplace (incl. information)	Consumer products (incl. information)	Operations	Accessibility deliverables	Mainstream deliv. incl. Accessibility	Guide for standard developers	Management system /process	Guideline /recommendations	Requirements
ISO 11428: 1996	Standard	**Ergonomics - Visual danger signals - General requirements, design and testing**	Requirement that all persons (including, for example, color blind) must be able to see a warning signal within a certain area.	ISO/ TC 159/ SC 5	x							x				x
ISO 19147: 2015 (en)	Standard	**Geographic information — Transfer Nodes**	All over the world, the authorities are facing serious problems due to the steady rise in the traffic volume. This rise will sooner or later call for very dramatic measures; one first step might be to persuade or force car users to change modes partly or entirely. In order to help this process, the authorities will need a complete overview of where it is possible to change modes of transport. This International Standard specifies the data types and code lists associated with those types for the implementation of transfer nodes and their services in transport modelling and location based services. The standard defines a set of services and facilities that may be related to transfer nodes and a way to provide information on accessibility, deviations and restrictions related to these services and facilities.	ISO/ TC 211			x			x		x				x
ISO 37154:20 17(en)	Standard	**Smart community infrastructures — Best practice guidelines for transportation**	This document provides general guidance on the planning, design, development, organization, monitoring, maintenance and improvement process of smart transportation systems and infrastructures, which can help promote solutions for intra- and inter-city issues, i.e. for issues both within and outside the city that impact quality of life, the environment or any other areas of city performance. This document applies to transportation infrastructures used for the movement of people, freight or other goods, including items transported for delivery. Accessibility 1 of 14 community needs	ISO/ TC 268/ SC 1	x					x		x			x	
ISO/TS 18152:20 10	Technical specificatio	**Ergonomics of human-system interaction — Specification for the process assessment of human-system issues**	Model for assessing the process of evaluating human-system interactions regarding usability, among others	ISO/ TC 159/ SC 4			x	x		x		x		x		

ISO/TS 20282-2:2013	Technical report	**Usability of consumer products and products for public use -- Part 2: Summative test method**	specifies a user-based summative test method for the measurement of the usability and/or accessibility of consumer products and products. Sees accessibility as a special case of usability	ISO/ TC 159/ SC 4			x		x			x			x	
ISO/TS 20658:2017 (en)	Technical specificatio	**Medical laboratories — Requirements for collection, transport, receipt, and handling of samples**	his document specifies requirements and good practice recommendations for the collection, transport, receipt and handling of samples intended for medical laboratory examinations. Accessibility for mobility devices	ISO/ TC 212						x		x				x
ISO/TS 37151:2015 (en)	Technical specification	**Smart community infrastructures — Principles and requirements for performance metrics**	This Technical Specification gives principles and specifies requirements for the community infrastructure performance metrics, and gives recommendations for analysis of community infrastructures. Accessiblity needs of residents included. Community infrastructures include, but are not limited to, energy, water, transportation, waste, and ICT.	ISO/ TC 268/ SC 1	x		x					x			x	x
ISO 19028:2016	Standard	**Accessible design — Information contents, figuration and display methods of tactile guide maps**	Requirements for content and design of tactile orientation maps for, for example, public buildings and public transport.	ISO/ TC 173/ SC 7	x		x				x					x
ISO/IEC TS 24751-4:2019	Technical specification	**Information technology for learning, education and training — AccessForAll framework for individualized accessibility — Part 4: Registry server API**	ISO/IEC 24751 is intended to meet the needs of learners with disabilities and anyone in a disabling context. For individualized accessibility, the needs and preferences of individual users need to be described in a concise and machine-readable manner. User interfaces and their components can then read such personal "AfA preference statements" and accommodate them in their adaptations.	ISO/IEC JTC 1/ SC 36			x	x			x				x	
IEC 62944:2016	Standard	**Audio, video and multimedia systems and equipment - Digital television accessibility - Functional specifications**	sets out principles and requirements to make digital television products accessible for persons with disabilities and older people. Provides functional specifications focusing on blind and partially sighted people, deaf and hard of hearing people, people with mobility conditions and those with cognitive disabilities.	IEC/ TC 100/ SC 16			x		x		x					x
IEC 82079-1:2013	Standard	**Preparation of instructions for use - Structuring, content and presentation - Part 1: General principles and detailed requirements**	Principles and requirements for instructions for users of all types of products. Requirements to take into account, for example, age, disability and accessibility.	ISO/TC 10			x		x		x					x
IEC/TR 62 678	Technical report	**Audio, video and multimedia systems and equipment activities and considerations related to accessibility and usability**	Hardware-oriented / equipment-oriented standards focused on accessibility TR published 2010	IEC/ TC 100					x		x					x

Inventory of accessibility	Inventory	**Inventory of accessibility and accessibility-related information technology standards and specifications**	This inventory of accessibility and accessibility-related information technology standards and specifications identifies a collection of documents (which it refers to as standards even though they encompass more than traditional ISO and ISO/IEC standards) that provide guidance on meeting the needs of people with disabilities. While its primary audience is standards developers, it can also be helpful for developers of information technology products and services, policy makers, procurers and for accessibility advocates to consider.	ISO/IEC JTC 1, Special Working Group on Accessibility.			x				x		x			x
ISO /IEC TR 13066-6:2014	Technical report	**Information technology — Interoperability with Assistive Technology (AT) — Part 6: Java accessibility application programming interface (API)**	Overview of JAVA accessibility application programming interface.	ISO/IEC JTC 1/ SC 35			x				x				x	
ISO 11156:2011	Standard	**Packaging - Accessible design - General requirements**	Requirements for the design of packaging so that people with different abilities can handle them.	ISO/ TC 122					x		x					x
ISO 17049:2013	Standard	**Accessible design -- Application of braille on signage, equipment and appliances**	Requirements for braille on signs, equipment and devices.	ISO/ TC 173/ SC 7	x				x		x					x
ISO 17069:2014(en)	Standard	**Accessible design — Consideration and assistive products for accessible meeting**	There are various types of meetings, ranging from small gatherings in families, schools, workplaces, and towns, to bigger ones such as academic meetings, sessions in congresses, and international conferences. Participation in meetings is indispensable for full participation and inclusion in society as envisioned in the United Nations Convention on the Rights of Persons with Disabilities.	ISO/ TC 173/ SC 7	x		x	x			x				x	
ISO 19026:2015	Standard	**Accessible design -- Shape and colour of a flushing button and a call button, and their arrangement with a paper dispenser installed on the wall in public restroom**	Requirements for flushing button and call button on toilets in public restrooms.	ISO/ TC 173/ SC 7	x						x					x
ISO 19029:2016	Standard	**Accessible design -- Auditory guiding signals in public facilities**	Requirements for audible signals for persons with visual impairment for information on location and direction in public facilities	ISO/ TC 173/ SC 7	x						x					x
ISO 19809:2017(en)	Standard	**Packaging — Accessible design — Information and marking**	This document provides requirements and recommendations concerning accessible design of consumer packaging with regard to information and marking. This document specifies considerations and methods for designing and presenting information and marking to make consumer packages accessible to people with the widest range of capabilities by considering their sensory and cognitive abilities.	ISO/ TC 122					x		x				x	x

ISO 21542:2011	Standard	**Building construction — Accessibility and usability of the built environment**	Requirements and recommendations for the built environment regarding accessibility	ISO/ TC 59/ SC 16	x						x				x	x
ISO 22015:2019(en)	Standard	**Packaging — Accessible design — Handling and manipulation**	This document provides requirements and recommendations in designing consumer packages, independent of material, to increase accessibility with regard to handling and manipulation. The document considers packaging needs from a wide range of users with diverse human abilities and needs in diverse contexts of use.	ISO/ TC 122					x		x				x	x
ISO 23599:2019(en)	Standard	**Assistive products for blind and vision-impaired persons — Tactile walking surface indicators**	The purpose of this document is to create requirements for Tactile Walking Surface Indicators (TWSIs) for blind or vision-impaired persons. When blind or vision-impaired persons travel alone, they might encounter problems and hazards in various situations. In order to obtain information for wayfinding, these pedestrians use information available from the natural and built environment, including tactual, acoustic and visual information. However, environmental information is not always reliable and it is for this reason that TWSIs perceived through use of a long white cane, through the soles of shoes and through the use of residual vision have been developed.	ISO/ TC 173	x						x					x
ISO 24501:2010	Standard	**Ergonomics – Accessible design – Sound pressure levels of auditory signals for consumer products**	Method and requirements for determining the audio level of audio signals so that all (including older) users of consumer products, including information and telecommunications related products, can hear the signals.	ISO/ TC 159/ SC 5					x		x					x
ISO 24502:2010	Standard	**Ergonomics – Accessible design – Specification of age-related luminance contrast for coloured light**	Method and requirements for calculating age-related visual contrast in order to be able to adjust lighting exposure, visual signs and screens for the elderly.	ISO/ TC 159/ SC 5	x				x		x					x
ISO 24503:2011	Standard	**Ergonomics - Accessible design - Tactile dots and bars on consumer products**	Requirements for tactile symbols on consumer products and controls of consumer products.	ISO/ TC 159/ SC 5					x		x					x
ISO 24504:2014	Standard	**Ergonomics – Accessible design – Sound pressure levels of spoken announcements for products and public address systems**	Methods for determining the appropriate sound level for verbal messages for, consumer devices, ICT, train stations, for example. Sound level requirements in relation to younger and older.	ISO/ TC 159/ SC 5	x		x		x		x					x
ISO 24505:2016	Standard	**Ergonomics -- Accessible design -- Method for creating colour combinations taking account of age-related changes in human colour vision**	Requirements for color combination in signs and displays adapted for all ages. *Under revision to be replaced by revised standard*	ISO/ TC 159/ SC 5	x				x		x					x

ISO 24508:2019(en)	Standard	**Ergonomics — Accessible design — Guidelines for designing tactile symbols and characters**	The use of tactile information in a design requires proper consideration to best support human tactile senses so that the information is easily and correctly understandable. Guidelines for designing tactile symbols and characters based on ergonomic knowledge of human tactile abilities are therefore necessary for such design.	ISO/ TC 159/ SC 4	x				x		x				x	
ISO 24550:2019(en)	Standard	**Ergonomics — Accessible design — Indicator lights on consumer products**	This document specifies design requirements and recommendations for indicator lights, mainly LED sourced, on consumer products for use by older people and people with visual disabilities. It does not consider the needs of persons who are blind. Indicator lights include those that inform users visually about the conditions, changes in functional status and settings, and malfunction of products. They convey information by light on/off, time-modulated intensity, blinking, colour, luminance level, and layout. This document addresses household and home appliances	ISO/ TC 159/ SC 4					x		x					x
ISO 28803:2012	Standard	**Ergonomics of the physical environment - Application of international standards to people with special requirements**	Requirements and guidance on how ISO standards related to ergonomics in the physical environment can be applied to people with special needs.	ISO/ TC 159/ SC 5	x						x				x	x
ISO 8201:2017	Standard	**Acoustics - Audible emergency evacuation signal**	Audible emergency evacuation signals can be supplemented with visual / tactile signals for hearing impairment	ISO/ TC 21/ SC 3	x					x	x				x	
ISO 9241-20:2008	Standard	**Ergonomics of human-system interaction - Part 20: Accessibility guidelines for information/communication technology (ICT) equipment and services**	Guidance for accessibility intended for those who plan, design, develop, buy and evaluate ICT products and services intended for work, home environment and public environments and regardless of physical, cognitive or sensory ability.	ISO/ TC 159/ SC 4			x			x	x				x	
ISO 9241-220:2019 (en)	Standard	**Ergonomics of human-system interaction — Part 220: Processes for enabling, executing and assessing human-centred design within organizations**	This document describes processes that represent good practice for human-centred design within and across projects. Human-centred design is an approach to system design and development that aims to improve usability, accessibility and user experience and avoid harm from use, by focussing on the use of the system.	ISO/ TC 159/ SC 4						x	x				x	x
ISO 9241-391:2016	Standard	**Ergonomics of human-system interaction - Part 391: Requirements, analysis and compliance test methods for the reduction of photosensitive seizures**	Requirements and recommendations for visual protection of photosensitive to avoid attacks on human-system interactions.	ISO/ TC 159/ SC 4			x			x	x				x	x
ISO 9241-910:2011	Standard	**Ergonomics of human-system interaction — Part 910: Framework for tactile and haptic interaction**	Framework and guidance for interactive systems using tactile / haptic devices and interactions	ISO/ TC 159/ SC 4			x				x				x	

ISO 9921:2003	Standard	**Ergonomics - Assessment of speech communication**	Requirements for the function of speech communication to invoke danger and to draw attention related to hearing loss.	ISO/ TC 159/ SC 5						x	x					x
ISO 9999:2011	Standard	**Assistive products for persons with disability - Classification and terminology**	establishes a classification of assistive products, based on the terminology from the International Classification of Functioning, Disability and Health (ICF, WHO , 2001). The ICF classification covers health and health-related domains, classified from body, individual and societal perspectives by means of two lists: a list of body functions and structure and a list of domains of activity and participation. Since an individual's functioning and disability occurs in a context, ICF also includes a list of environmental factors.	ISO/ TC 173/ SC 2					x		x				x	
ISO 11429	Standard	**Ergonomics — System of auditory and visual danger and information signals**	IS published 1996 environment oriented standards enabling accessibility	ISO/ TC 159/ SC5	x				x		x				x	
ISO 1503	Standard	**Spatial orientation and direction of movement — Ergonomic requirements**	High level accessibility guidance IS published 2008	ISO/ TC159/ SC4	x						x					x
ISO 28802	Standard	**Ergonomics of the physical environment — Assessment of environments by means of an environmental survey involving physical measurements of the environment and subjective responses of people**	IS published 2012 environment oriented standards enabling accessibility	ISO/ TC 159/ SC5	x						x				x	
ISO 9241-1	Standard	**Ergonomic requirements for office work with visual display terminals (VDTs) — Part 1: General introduction**	High level accessibility guidance IS published 1997	ISO/ TC 159/ SC4			x	x			x					x
ISO 9241-2	Standard	**Ergonomic requirements for office work with visual display terminals (VDTs) — Part 2: Guidance on task requirements**	High level accessibility guidance IS published 1992	ISO/ TC 159/ SC4			x	x			x					x
ISO 9241-410:2008	Standard	**Ergonomics of human-system interaction — Part 410: Design criteria for physical input devices**	Guidance for designing input devices for interactive systems with regard to the capabilities and limitations of users.	ISO/ TC 159/ SC 4			x				x				x	

ISO 9241-5	Standard	**Ergonomic requirements for office work with visual display terminals (VDTs) — Part 5: Workstation layout and postural requirements**	IS published 1998 environment oriented standards enabling accessibility	ISO/ TC 159/ SC4			x	x			x					x
ISO 9241-6	Standard	**Ergonomic requirements for office work with visual display terminals (VDTs) — Part 6: Guidance on the work environment**	IS published 1999 environment oriented standards enabling accessibility	ISO/ TC 159/ SC4			x	x			x				x	
ISO/IEC 12905: 2011	Standard	**Integrated circuit cards -- Enhanced terminal accessibility using cardholder preference interface**	Requirements and recommendations for cards with data that adapt terminals to the user's needs.	ISO/IEC JTC 1/ SC 17			x				x				x	x
ISO/IEC 13066-1:2011	Standard	**Information technology -- Interoperability with assistive technology (AT) -- Part 1: Requirements and recommendations for interoperability**	Requirements and recommendations for the design and evaluation of interoperability between AT (Assistive technology) and IT.	ISO/IEC JTC 1/ SC 35			x		x		x				x	x
ISO/IEC 20071-23:2018	Standard	**Information technology — User interface component accessibility — Part 23: Visual presentation of audio information (including captions and subtitles)**	This document provides guidance for producers, exhibitors, and distributors on the visual presentation of alternatives to audio information in audiovisual content, such as captions/subtitles. This document acknowledges the various needs and preferences of viewers (end users) as well as the different approaches to visual presentation of audio information. It applies to all presentations of visual alternatives to audio information intended to be presented as captions/subtitles. This document provides requirements and recommendations that are intended to support users who are not able to use the audio information, prefer to use a visual representation of audio information, or prefer both audio and visual presentations.	ISO/IEC JTC 1/ SC 35			x		x		x				x	
ISO/IEC 23988:2007	Standard	**Information technology — A code of practice for the use of information technology (IT) in the delivery of assessments**	Recommendations for designing IT services with assessment of user response. Design for usability, such as the possibility of color blind settings.	ISO/IEC JTC 1/ SC 6			x				x				x	
ISO/IEC 24756:2009	Standard	**Information technology — Framework for specifying a common access profile (CAP) of needs and capabilities of users, systems, and their environments**	Defined framework for accessibility profile for users, computer systems and their environments, including support through AT.	ISO/IEC JTC 1/ SC 37			x				x				x	

ISO/IEC 24786:2009	Standard	**Information technology -- User interfaces -- Accessible user interface for accessibility settings**	UI requirements and recommendations to make accessibility settings available for personalization.	ISO/IEC JTC 1/ SC 35			x		x		x				x	x
ISO/IEC 29136:2012	Standard	**Information technology -- User interfaces -- Accessibility of personal computer hardware**	Requirements and recommendations for accessibility regarding personal computer hardware, such as keyboards and touch screens.	ISO/IEC JTC 1/ SC 35			x		x		x				x	x
ISO/IEC 29138-1:2018	Technical report	**Information technology -- User interface accessibility -- Part 1: User accessibility needs**	This document identifies a collection of user accessibility needs that diverse users have of ICT systems to make these systems accessible to them	ISO/IEC JTC 1/ SC 35			x				x		x			
ISO/IEC 30071-1:2019(en)	Standard	**Information technology — Development of user interface accessibility — Part 1: Code of practice for creating accessible ICT products and services**	This document provides guidance on developing and implementing an organizational accessibility policy for creating accessible ICT systems (including products and services). It can help organizations to ensure that their ICT systems are accessible to diverse users.	ISO/IEC JTC 1/ SC 35			x				x					x
ISO/IEC Guide 71:2014	Guide	**Guide for addressing accessibility in standards**	Guide for standard developers with requirements and recommendations for accessibility related to products, services and the built environment.	ISO/TMBG						x	x		x			
ISO/IEC TR 13066-2:2016	Technical report	**Information technology -- Interoperability with assistive technology (AT) -- Part 2: Windows accessibility application programming interface (API)**	Guidance for Windows operating system services to enable AT to interact with software.	ISO/IEC JTC 1/ SC 35			x		x		x				x	
ISO/IEC TR 13066-3:2012	Technical report	**Information technology -- Interoperability with assistive technology (AT) -- Part 3: IAccessible2 accessibility application programming interface (API)**	Overview of the IAccessible2 interface for increased accessibility by enabling IT-AT interoperability for Windows operating systems.	ISO/IEC JTC 1/ SC 35			x		x		x				x	
ISO/IEC TR 13066-4:2015	Technical report	**Information technology -- Interoperability with assistive technology (AT) -- Part 4: Linux/UNIX graphical environments accessibility API**	Overview of the Linux / UNIX interface for increased accessibility by enabling IT-AT interoperability.	ISO/IEC JTC 1/ SC 35			x		x		x				x	
ISO/IEC TR 19766:2007	Technical report	**Information technology -- Guidelines for the design of icons and symbols accessible to all users, including the elderly and persons with disabilities**	Guidance for designing icons for increased accessibility.	ISO/IEC JTC 1/ SC 35			x				x				x	

ISO/IEC TR 29138-3:2009	Technical report	**Information technology -- Accessibility considerations for people with disabilities -- Part 3: Guidance on user needs mapping**	Guide for standard developers for mapping of user needs related to accessibility and IT.	ISO/IEC JTC 1			x				x		x			
ISO/IEC TR 29194:2015	Technical report	**Information Technology -- Biometrics -- Guide on designing accessible and inclusive biometric systems**	Guidance for biometric systems for accessibility management and user needs.	ISO/IEC JTC 1/ SC 37			x				x				x	
ISO/IEC TS 20071-11:2012	Technical specificatio	**Information technology -- User interface component accessibility -- Part 11: Guidance for alternative text for images**	Guidance for increased accessibility by describing images with written text in electronic documents.	ISO/IEC JTC 1/ SC 35			x				x				x	
ISO/IEC TS 20071-21:2015	Technical specificati	**Information technology -- User interface component accessibility -- Part 21: Guidance on audio descriptions**	Guidance for describing audio in media such as video and television broadcasts, regardless of technology or language, and intended for the blind and people with visual impairment.	ISO/IEC JTC 1/ SC 35			x		x		x				x	
ISO/IEC TS 20071-25:2017	Technical specification	**Information technology -- User interface component accessibility -- Part 25: Guidance on the audio presentation of text in videos including captions, subtitles, and other onscreen text**	Guidance for describing text as audio in videos such as television broadcasts, regardless of technology or language. Refers to accessibility for users with different needs, for example with learning difficulties, reading difficulties, cognitive impairment or visual impairment.	ISO/IEC JTC 1/ SC 35			x		x		x				x	
ISO/IEC 10779:2008(en)	Standard	**Information technology — Office equipment accessibility guidelines for elderly persons and persons with disabilities**	This International Standard specifies accessibility guidelines to be considered when planning, developing and designing electrophotographic copying machines, page printers and multi-function devices. These guidelines are intended to improve accessibility required when primarily older persons, persons with disabilities and persons with temporary disabilities (hereafter referred to as older persons and persons with disabilities) use office equipment.	ISO/IEC JTC 1/ SC 28			x	x			x				x	
ISO/IEC 20016-1	Standard	**Information technology for learning, education and training — Language accessibility and human interface equivalencies (HIEs) in e-learning applications — Part 1: Framework and reference model for semantic interoperability**	2016 Content oriented to enable accessibility	ISO/IEC JTC 1/ SC 36			x	x			x					

ISO/IEC 24751-1:2008(en)	Standard	**Information technology — Individualized adaptability and accessibility in e-learning, education and training — Part 1: Framework and reference model**	ISO/IEC 24751 is intended to meet the needs of learners with disabilities and anyone in a disabling context. ISO/IEC 24751 is intended to facilitate the matching of individual user needs and preferences with educational digital resources that meet those needs and preferences. It is intended to address mismatches between personal needs and preferences caused by any number of circumstances, including requirements related to client devices, environments, language proficiency or abilities. The terms and definitions within ISO/IEC 24751 are not judgmental but functional; the purpose is not to point out flaws in educational digital resources with respect to accessibility and adaptability, but to facilitate the discovery and use of the most appropriate content components for each user.	ISO/IEC JTC 1/ SC 36			x	x			x					x
ISO/IEC 24751-3:2008(en)	Standard	**Information technology — Individualized adaptability and accessibility in e-learning, education and training — Part 3: "Access for all" digital resource description**	ISO/IEC 24751 is intended to meet the needs of learners with disabilities and anyone who is disabled by their context. This part of ISO/IEC 24751 provides a common language to describe digital learning resources to facilitate matching of those resources to learners' accessibility needs and preferences.	ISO/IEC JTC 1/ SC 36			x	x			x					x
ISO/IEC 7811-9:2015	Standard	**Identification cards — Recording technique — Part 9: Tactile identifier mark**	This part of ISO/IEC 7811 specifies the physical characteristics of a tactile identifier mark used by visually impaired card holders to distinguish their cards. It defines the area on the card for the TIM and the layout of Braille style embossed dots arranged in patterns to enable easy tactile recognition.	ISO/IEC JTC 1/ SC17			x		x		x					x
ISO/IEC TR 29138-2:2009(en)	Technical report	**Information technology — Accessibility considerations for people with disabilities — Part 2: Standards inventory**	This part of ISO/IEC TR 29138 identifies a collection of documents (which it refers to as standards even though they encompass more than traditional ISO and ISO/IEC standards) that provides guidance on meeting the needs of people with disabilities. While its primary audience is standards developers, it can also be helpful for developers of information technology products and services, policy makers, procurers and for accessibility advocates to consider.	ISO/IEC JTC 1			x		x		x		x		x	
ISO/TR 22411:2008	Technical report	**Ergonomics data and guidelines for the application of ISO/IEC Guide 71 to products and services to address the needs of older persons and persons with disabilities**	This Technical Report presents ergonomics data and guidelines for applying ISO/IEC Guide 71 in addressing the needs of older persons and persons with disabilities in standards development. It provides: – ergonomics data and knowledge about human abilities — sensory, physical, cognitive abilities — and allergies; – guidance on the accessible design of products, services and environments.	ISO/ TC 159						x	x		x			

ISO 24509:2019(en)	Standard	**Ergonomics — Accessible design — A method for estimating minimum legible font size for people at any age**	his document provides a method for estimating minimum legible font size for single characters, but not for words or sentences, in self-luminous or reflected mode, used in documents, products labels, signs, and displays for people at any age and in any viewing condition in which viewing distance, luminance and contrast are varied. This document applies designing and evaluating legibility of single characters for people at any age who have no pathological disorders in their eyes, but not for people with visual impairments such as low vision. The application is specifically directed to, but not limited to, the cases of printed materials where fixed font size is used. Applicability of the method to other languages is given in Annex F.	ISO/ TC 159/ SC 4					x		x					x
ISO 24550:2019(en)	Standard	**Ergonomics — Accessible design — Indicator lights on consumer products**	This document specifies design requirements and recommendations for indicator lights, mainly LED sourced, on consumer products for use by older people and people with visual disabilities. It does not consider the needs of persons who are blind. Indicator lights include those that inform users visually about the conditions, changes in functional status and settings, and malfunction of products. They convey information by light on/off, time-modulated intensity, blinking, colour, luminance level, and layout. This document addresses household and home appliances. It excludes electronic displays presenting characters and graphics, machinery, and appliances in special use for professional, technical, and industrial applications.	ISO/ TC 159/ SC 4					x		x					x

ISO 24551:2019(en)	Standard	**Ergonomics — Accessible design — Spoken instructions of consumer products**	This document specifies ergonomic requirements and recommendations for consumer product spoken instructions that are provided to guide users in the operation of a product and/or as a means of providing feedback to users about the status/state of a product. Such instructions can be used by persons with or without visual impairments, and are useful for users who have difficulty reading and/or cognitive impairments. The applicability of the requirements and recommendations described in this document does not depend on the language of the instructions or whether the instructions are provided via recorded human speech or synthesized speech from text. The requirements and recommendations in this document are applicable to conventional, stand-alone consumer products in general, whose function is limited by characteristics that prevent a user from attaching, installing or using assistive technology in order to use the product. They are not applicable to machines and equipment used for professional work. This document does not apply to products for which the instructional content and/or the means of presentation are specified in other standards (e.g. medical devices, fire alarms). It also does not provide recommendations or requirements for spoken instructions of Interactive Voice Response (IVR) systems or digital assistants on personal computers or similar devices. NOTE ISO 9241-154 provides recommendations or requirements for IVR systems. This document does not specify voice sounds of text-to-speech systems or narrative speech used in place of printed instruction manuals and independently from the product.	ISO/ TC 159/ SC 4					x		x					x
ISO Guide 76	Guide	**Development of service standards -- Recommendations for addressing consumer issues**	ISO/IEC Guide 76:2008 provides general guidance on the issues to be considered in standards for services. On the basis of this guidance, detailed standards can be prepared for any service. ISO/IEC Guide 76:2008 provides a checklist which can be used by consumer representatives and others participating in the process of standards development. Use of the checklist enables full consideration to be given to all matters of consumer interest, including the needs of children, older persons, persons with disabilities and those from different ethnic and cultural heritages.	ISO/ COPOLCO						x		x	x		x	
ISO/IEC Guide 37:2012(en)	Guide	**Instructions for use of products by consumers**	This Guide establishes principles and gives recommendations on the design and formulation of instructions for use of products by consumers.	ISO/ COPOLCO					x			x	x			

ISO/IEC/IEEE 26512:2018(en)	Standard	**Systems and software engineering — Requirements for acquirers and suppliers of information for users**	his document supports the interest of system users in having consistent, complete, accurate, and usable information. It addresses both available approaches to standardization: a) process standards, which specify the way that information products are to be acquired and supplied; and b) information product standards, which specify the characteristics and functional requirements of the information. As defined in ISO/IEC/IEEE 12207 and ISO/IEC/IEEE 15288:2015, the acquisition and supply activities make up the agreement processes of the software or system life cycle. Acquisition and supply of information for users and related services are specializations of those processes. Such services can be acquired and supplied for any part of the information management process.	ISO/IEC JTC 1/ SC 7			x					x	x			x
BS 18477:2010	Standard	**Inclusive service provision. Requirements for identifying and responding to consumer vulnerability"**	defines procedures for ensuring that services are available and made accessible to all consumers equally, including with respect to accessibility. Relevant to all services, but with specific focus on utilities, telecoms, financial services, retail, health, transport and housing.	BSI					x	x	x				x	
CEN/TR 15753:2008		**Packaging - Package leaflets for medicinal products - Braille and other formats for visually impaired people"**	addresses the provision of information for medicinal products in alternative formats suitable for blind and partially sighted people.	CEN/ TC 261					x		x				x	
CEN/TS 16635:2014	Technical specification	**Railway application - Design for PRM Use - Equipment and Components onboard Rolling Stock - Toilets (Gäller tills standarden EN 16585-1 med samma titel publiceras)**	Requirements for designing toilets on trains for persons with limited mobility. *Withdrawn and replaced by* **EVS-EN 16585-1:2017** **Railway applications - Design for PRM use - Equipment and components onboard rolling stock - Part 1: Toilets**	CEN/ TC 256		x					x					x
CENELEC Guide 28		**Accessibility in interfaces in low voltage electrical installations – a guide for standards writers":**	provides safety and accessibility guidance to writers of technical standards, addressing the needs of all users, irrespective of their abilities and preferences. Refers to people with disabilities	CENELEC					x		x		x		x	
DIN-Fachbericht 124:2002 (DIN Technical Report 124)	Technical report	**Products in Design for Al**	discusses "barrier-free" products, including in the context of people with disabilities. Gives overview of issues and recommendations around design and implementation. Seeks to inspire designers and developers to create solutions that can be used by as many people as possible.	DIN					x	x	x				x	
EN 12312-14:2006+A1:2009 –		**Aircraft ground support equipment. Specific requirement**	Disabled/incapacitated passenger boarding vehicles	CEN/ TC 274		x					x					x

EN 17161:2019		**Design for All — Accessibility following a Design for All approach in products, goods and services — Extending the range of users**	one of the deliverables from Mandate M/473, “Standardisation Mandate to CEN, CENELEC and ETSI to Include "Design for All" in relevant standardisation initiatives”. Process standard that specifies requirements that enable an organisation to design, develop and provide products, goods and services so that they can be accessed, understood and used by the widest range of users, including persons with disabilities. Uses the structure of Management Systems Standards and the “Plan-Do-Check-Act” model from those standards. This means that the process can easily be integrated in existing management systems such as ISO 9001.	CEN/CLC TC 12						x	x			x		x
EN 301549:2019		**Accessibility requirements suitable for public procurement of ICT products and services in Europe**	this standard was the main outcome of Mandate M/376, “Standardisation Mandate to CEN, CENELEC and ETSI in support of European Accessibility Requirements for Public Procurement of products and services in the ICT domain”. Gives detailed Functional Accessibility Requirements. Adopts Web Content Accessibility Guidelines (WCAG) 2.1 for ICT.	CEN/CLC/ETSI/ JWG eAcc			x		x		x					x
EN 62665:2016	Standard	**Multimedia systems and equipment - Multimedia e-publishing and e-book technologies - Texture map for auditory presentation of printed texts**	Texture map requirements to enable the exchange of e-books and e-publications between persons with and without visual impairment.	CEN					x		x					x
EN 62875:2015	Standard	**Multimedia systems and equipment - Multimedia e-publishing and e-book technologies - Printing specification of texture map for auditory presentation of printed texts**	Requirements for printing a texture map to enable the exchange of e-books and e-publications between persons with and without visual impairment.	CEN					x		x					x
EN 81-70:2018		**Safety rules for the construction and installation of lifts. Particular applications for passenger and goods passenger lift. Accessibility to lifts for persons including persons with disability**	provides minimum requirements for safe access. It applies to new lifts.	CEN/ TC 10	x						x					x
EN 81-82:2013		**Safety rules for the construction and installation of lifts - Existing lifts - Part 82: Rules for the improvement of the accessibility of existing lifts for persons including persons with disability**	Requirements for designing existing lifts to improve accessibility for persons incl. people with disabilities. equivalent of EN 81-70 but for upgrading existing lift.	CEN/ TC 10	x						x					x
ETSI EG 202 116 V1.2.2		**Human Factors (HF); Guidelines for ICT products and services; "Design for All"**	focuses on Design for All as a concept, why it is needed and where to focus attention. Includes in-depth design considerations and guidance. Establishes ICT as a core component of a very broad range of products and services, and therefore highly relevant to their accessibility and usability performance.	ETSI HF			x		x		x		x		x	

SS 30600:2015	Standard	**Grafiska symboler – Publika informationssymboler för ökad tillgänglighet utifrån konceptet Design för alla**	Requirements for information symbols according to design for all categories such as Accessibility and Public Institutions, Transport Institutions, Commercial Institutions, Public Behavior. Complement to ISO 7001.	SIS	x	x					x					x
IETF RFC5194		**Framework for Real-Time Text over IP Using the Session Initiation Protocol, (SIP)**	sets out how to implement Text-over-IP using the Session Initiation Protocol (SIP), with specific focus on meeting the needs of deaf, hard of hearing and speech-impaired people. Includes interoperability with legacy solutions such as analogue text telephony and text relay services.	Internet Engineering Task Force			x				x					x
IETF RFC3351		**User Requirements for the Session Initiation Protocol (SIP) in Support of Deaf, Hard of Hearing and Speech-impaired Individuals**	presents user requirements for deaf, hard of hearing and speech-impaired people in the context of IP based real-time communications.	Internet Engineering Task Force			x				x					x

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ANNEX D: IEC/ISO/ITU Policy on Standardization and accessibility

D IEC/ISO/ITU Policy on Standardization and accessibility

Retrieved from: https://www.iso.org/files/live/sites/isoorg/files/archive/pdf/en/iec_iso_itu_joint_policy_statement.pdf

October 2014

IEC/ISO/ITU Policy on Standardization and accessibility

Introduction

The importance of accessibility was recognized when United Nations member states adopted in 2006 the *United Nations Convention for the Rights of Persons with Disabilities* (UNCRPD). The UNCRPD takes the view that persons with disabilities are "subjects" with rights, capable of claiming those rights and making decisions for their lives based on their free and informed consent as well as being active members of society[1].

Older persons are making up an increasing percentage in the population worldwide. While not all older persons have disabilities, the prevalence and risk of disability is highest amongst this demographic group, although age-related disabilities can begin to take hold early and are often progressive in severity.

The World Report on Disability[2], jointly published by the World Health Organization and the World Bank in June 2011, estimates that around 15 percent of the world population or more than one billion people live with some form of disability, the majority of whom in lower-income countries or lower-income segments of their societies[3].

The increasing prevalence and complexity of technology in everyday life presents both opportunities and challenges. In order for older persons and persons with disabilities to participate in society on equal terms, it is necessary to improve the accessibility of products, services and environments. This applies in particular for access to buildings and the built environment, accessibility throughout the whole transport chain, to the design and usability of information and telecommunication systems, and to products and services used in everyday life.

Improved accessibility enhances the quality of life and can reduce discrimination. Products, services and environments that improve accessibility should be available to more persons, so economies of scale can be attained. This may generate an increase in trade, as products and services become easier to use for entire populations and, in turn, will benefit society as a whole.

Policy Statement

Standards contribute to accessibility

IEC, ISO and ITU encourage the development of standards that take account of the widest range of characteristics and abilities of persons, including in particular those of older persons, children and persons with disabilities.

There exists a continuum of human abilities. Standards should therefore aim to address needs throughout this continuum. It is also recognized that standards for everyday products and services cannot meet all needs, and that additional standardization for assistive products and assistive technologies may be necessary to meet certain requirements.

Considering the needs of persons with the widest range of characteristics and abilities at the outset can make it possible to design products, services and environments, which include virtual environments supported by information and communication technologies, that more people can use with little or no extra cost. For example, it is estimated that ensuring full compliance with accessibility standards in new public buildings adds generally very limited extra costs[4], which are much less than adapting existing buildings later on.

Standardization can impact the design of products, services and environments and can therefore play an important role. Older persons and persons with disabilities are important user and consumer groups. Their needs should be systematically addressed when standards are developed or revised.

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Standards that take into account the needs of such users will have broader impact and greater market relevance, helping to make products, services and environments more accessible and usable for everybody.

To ensure standards contribute to accessibility, IEC, ISO and ITU emphasize the importance of the following four points:

1 Apply the principles of Accessible or Universal Design

The core objective of Accessible or Universal Design is to ensure that products, systems, services, environments and facilities can be used by persons from a population with the widest range of characteristics and abilities.

Standardization should ensure that products, services and environments are available, accessible, usable and safe for all users, including older persons and persons with disabilities. By following Accessible or Universal Design from the outset to introduce accessibility features, the likelihood of a need for expensive retrofitting can be significantly reduced.

2 Engage older persons and persons with disabilities in standards development

The representation of interests of older persons and persons with disabilities in relevant standardization projects should be supported. Guidance and training should be provided to such representatives to be effectively involved in the standardization process.

3 Train standards developers on the importance of accessibility

Standards developers need to consider accessibility in their work, especially key documents such as ISO/IEC Guide 71 *Guide for addressing accessibility in standards,* adopted by ITU as ITU-T Supplement 17 for the H-series, to support the mainstreaming of accessibility features into standards. Coordination should be strengthened between standards committees dealing with everyday products, services and environments and those with responsibility for assistive products and technologies. Awareness raising, training and the development of tools may also be required for standards developers to increase their understanding of accessibility and to promote its application in their own scope of expertise. Exchange of information and cooperation between standards developers addressing accessibility issues in different subject areas should be facilitated in order to encourage consistent approaches.

4 Improve accessibility of standardization secretariat support

IEC, ISO and ITU will endeavour, within their budget and financial limitations, to improve accessibility in standardization, including in secretariat support, their working environment, working methods and processes as well as in their products and services, taking into account the widest range of characteristics and abilities of persons, including and in particular those of older persons and persons with disabilities.

(1) See: UN Enable - Convention on the Rights of Persons with Disabilities, at: http://www.un.org/disabilities/default.asp?id=150, with the full text of the Convention
(2) World Report on Disability 2011 published by the World Health Organization and The World Bank, and a Summary of the Report are available at: http://www.who.int/disabilities/world_report/2011/en/index.html
(3) World Report on Disability 2011, p. 29-31 and Summary of the report, p. 8.
(4) World Report on Disability 2011, p. 173

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ANNEX E: Recommendation 2016 concerning standards on eAccessibility and eInclusion

E Recommendation 2016 concerning standards on eAccessibility and eInclusion

Retrieved from: https://aaate.net/recommendation-2016-concerning-standards-on-eaccessibility-and-einclusion/

2017-03-07

Recommendation 2016 concerning standards on eAccessibility and eInclusion

(drafted at the IN LIFE Workshop "Strategic Standardization Issues Concerning eAccessibility & eInclusion" at the 15th International Conference on Computers Helping People with Special Needs – ICCHP 2016, in Linz, Austria, in July 2016)

Purpose:

Increasingly R&D projects and the software industry – especially for mobile technologies – consider the "Recommendation on software and content development principles 2010" whereby

"decision makers in public as well as private frameworks, software developers, the content industry and developers of pertinent standards /should be/ aware that multilinguality, multimodality, eInclusion and eAccessibility need to be considered from the outset in software and content development. These considerations are required in order to avoid the need for additional or remedial engineering or redesign at the time of adaptation, which tend to be very costly and often prove to be impossible".

Since 2010, hundreds of standards about eAccessibility and eInclusion were developed or revised by technical committees in standards organisations at international, European, or national level – not to mention many industry standards developed by other standards developing organisations (SDO). In addition, there are possibly thousands of standards that have a bearing on persons with disabilities (PwD). In particular, 'accessibility' in a broad sense rarely occurs in the title or in the body of these standards.

"Recommendation 2016" addresses critical issues identified in recent conferences, initiatives and projects dealing with eAccessibility and eInclusion and related topics concerning the difficulties faced by system developers, their customers, health care providers and end-users when trying to find and apply pertinent standards.

The organizations endorsing Recommendation 2016 call upon stakeholders of eAccessibility and eInclusion, in particular standards developing organizations (SDOs) to:

- develop a more refined classification or keywording approach to identify content in standards with a bearing on eAccessibility and eInclusion
- register the potential relevance for eAccessibility & eInclusion of an emerging standard right from the beginning of a standardization activity
- cross-reference standards having a bearing on eAccessibility and eInclusion
- encourage the formulation and use of consistent vocabulary / terminology
- implement search functionalities that ease the use of standards
- facilitate the active involvement of PwD as end-users in standardizing activities among others by providing standards documents in an 'accessible' format

Implementing the above measures would enhance interoperability of eAccessibility&eInclusion related products and services and thus benefit users of standards and standardization at large.

Recommendation:

Standards development processes and monitoring in conjunction with standards about eAccessibility and eInclusion and related aspects, should allow the coordination of standardizing activities across technical committees and SDOs, leading to content coherence among standards about similar themes. This would help industry and other organizations to comply with standards' requirements referring to corporate social responsibility and risk management, as well as with the latest legal regulations on accessibility in eProcurement and public websites.

Supportive measures may be worthwhile pursuing, to (a) promote certification schemes based on standards about eAccessibility and eInclusion, (b) encourage education and training activities regarding such standards, and (c) enhance the positive role that media (both institutional and social) and civil society can play here.

Online endorsement: aaate-endorsed-the-recommendation-2016-concerning-standards-on-eaccessibility-and-einclusion/

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2020-07-10

ANNEX F: Recommendation on software and content development principles 2010

F Recommendation on software and content development principles 2010

Retrieved from: https://aaate.net/recommendation-2016-concerning-standards-on-eaccessibility-and-einclusion/

MoU/MG/12 N 476 Rev.1
Status: FI
Date: 26 March 2012
Source: ISO/TC 37 Co-secretary

Recommendation on software and content development principles 2010

Formulated at the ICCHP 2010 and endorsed by ISO/TC 37 and other technical committees

Purpose

This recommendation addresses decision makers in public as well as private frameworks, software developers, the content industry and developers of pertinent standards. Its purpose is to make aware that multilinguality, multimodality, eInclusion and eAccessibility need to be considered from the outset in software and content development, in order to avoid the need for additional or remedial engineering or redesign at the time of adaptation, which tend to be very costly and often prove to be impossible.

Background

In software development, globalization[1], localization[2] and internationalization[3] have a particular meaning and application. In software localization they have been recognized as interdependent and of high importance from a strategic level down to the level of data modelling and content interoperability.

In 2005 the Management Group of the ITU-ISO-IEC-UN/ECE Memorandum of Understanding on eBusiness standardization adopted a statement (MoU/MG N0221), which defines as basic requirements for the development of fundamental methodology standards concerning semantic interoperability the fitness for

- multilinguality (covering also cultural diversity),
- multimodality and multimedia,
- eInclusion and eAccessibility,
- multi-channel presentations,

which have to be considered at the earliest stage of

- the software design process, and
- data modelling (including the definition of metadata),

and hereafter throughout all the iterative development cycles.

The above requirements are a prerequisite for global content integration and aggregation as well as content interoperability. Content interoperability is the capability of content to be combined with or embedded in other (types of) content items and to be extensively re-used as well as re-purposed for other kinds of eApplications. In order to achieve this capability, software must support these requirements from the outset. The same applies to the methods and tools of content management – including web content management.

Recommendation

Software should be developed and data models for content prepared in compliance with the above-mentioned requirements to facilitate the adaptation to different languages and cultures (localization) or new applications (re-purposing), the personalization for different individual preferences or needs, including those of persons with disabilities. These requirements should also be referenced in all pertinent standards.

[1] ***Globalization***) *refers to all of the business decisions and activities required to make an organization truly international in scope and outlook. G11N is the transformation of business, processes and products to support customers around the world, in whatever language, country, or culture they require.*
[2] ***Localization*** *is the process of modifying products or services to account for differences in distinct markets. Therefore, L10N is an integral part of G11N, and without it, other globalization efforts are likely to be ineffective. The interdependence of G11N and L10N has also been coined* ***glocalization****.*
[3] ***Internationalization*** *is the process of enabling a product at a technical level for localization. An internationalized product does not require remedial engineering or redesign at the time of localization. Instead, it has been designed and built from the outset to be easily adapted for a specific application after the engineering phase.*