

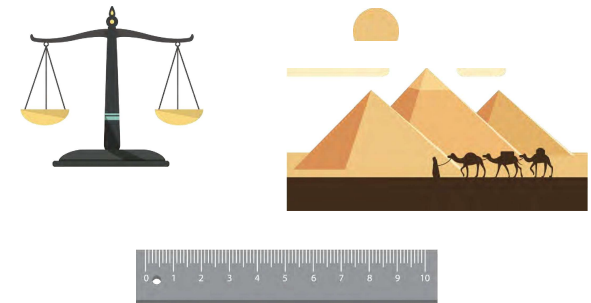
XR & Metaverse Standardization

Prof. Dr.-Ing. Dipl.-Kfm. Christoph Runde
Virtual Dimension Center (VDC) Fellbach
Auberlenstr. 13
D-70736 Fellbach
www.vdc-fellbach.de



Introduction

- standards support everyday life much more than people think
 - society recognized importance of standardized measurements thousands of years ago: e.g. weight, distance or length
 - development of a common reference system agreed upon people and institutions
-
- rapid technological progress -> need for standardization grows
 - especially in the area of Information and communications technologies (ICT)
 - standardization and standards boost progress and create basis upon which technology can evolve





What standards are (in a wide sense) and why they're needed

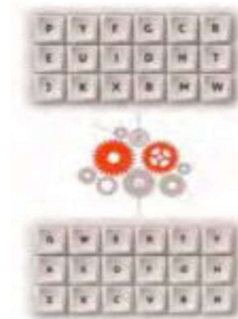
- The most general definition for a «Standard» may be «a widely agreed way of doing something »
- where, depending on the specific area of application, “*doing something*” may be replaced by, e.g., “*designing a product*”, “*building a process*”, “*implementing a procedure*” or “*delivering a service*”.
- «Standard» (i.e. agreed and common) ways of doing things bring lot of benefits; our technological world without «Standards» simply **would not work (or, at least, it would be harder to make it work)**



What standards are (in a wide sense) and why they're needed

For instance, what if

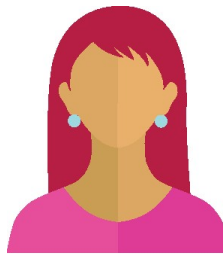
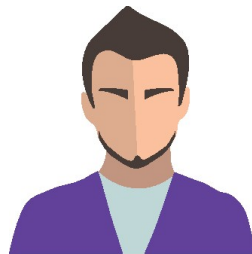
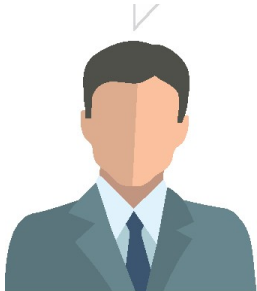
- each computer had its own type of keyboard
- each smartphone and PC had its own specific set of connectors and charger (though some have by choice „ . more on this in next slides)
- each device had its own protocol for interoperation



Two main different types of "*standards*"

- Different types of standards according to the development process (standardization)

De facto standards, or standards in actuality, are adopted widely by an industry and its customers. These standards arise when a critical mass simply likes them well enough to collectively use them.



SDO standards are produced by devoted organizations, called organizations whose purpose is to develop standards and Standards Development Organizations (SDOs). SDOs are that put in place formal well-defined procedures to guarantee a fair development process. De facto standards can become formal standards if they are approved by a SDO. Examples: HTML PDF



Standards in everyday life

Using a Smartphone for browsing
(some of possibly involved standards) :

- User equipment regarding hardware
- characteristics, also taking into account safety issues
- Connectivity among user devices and wireless network as well as the functionality of the same network
- Functionality of the Internet and the protocols to support web browsing

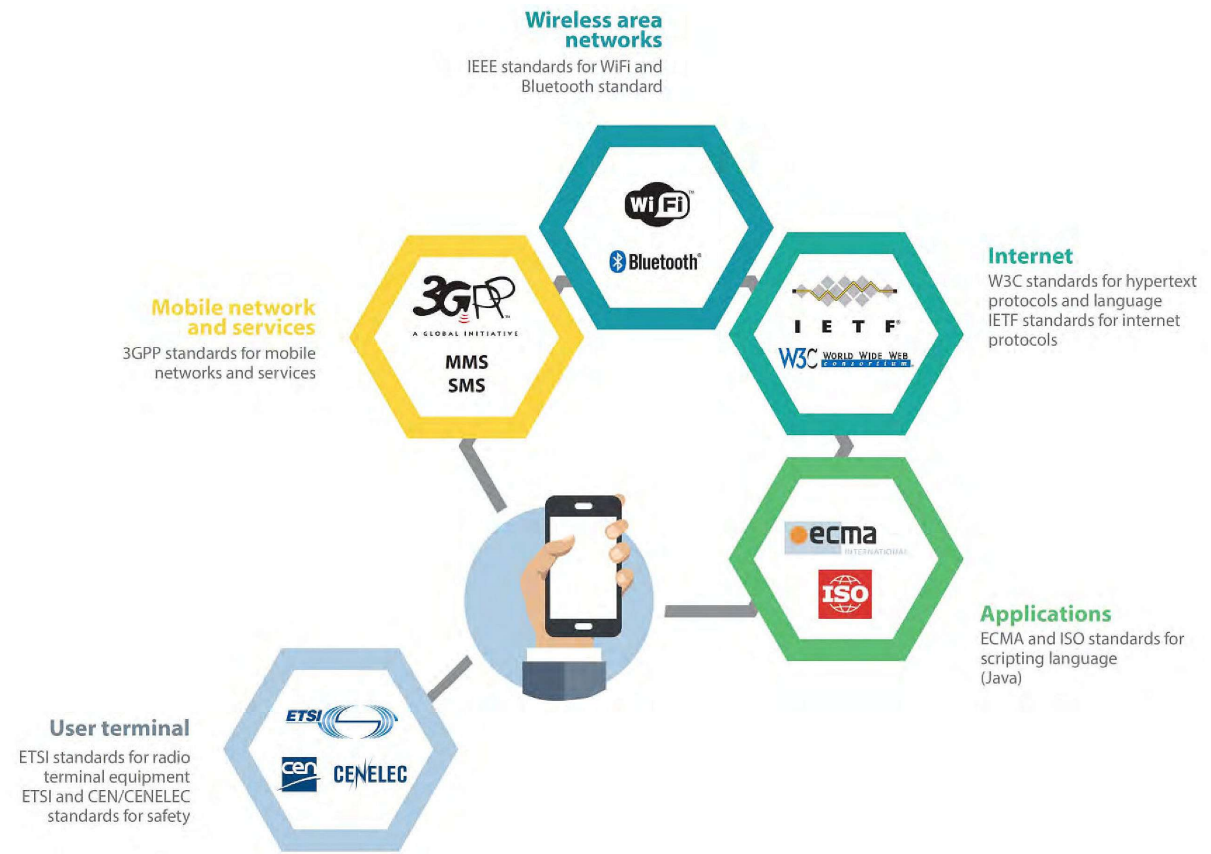


Fig.: ETSI 

Standards in everyday life

Using a Personal Computer
(some of possibly involved standards) :

- A 2010 paper (Biddle & al., 2010) identifies 251 technical interoperability standards implemented in a laptop computer, but total number estimated to be over 500
- out of the 251 identified standards, "202 (80%) were developed by SDOs and 49 (20%) by individual companies"

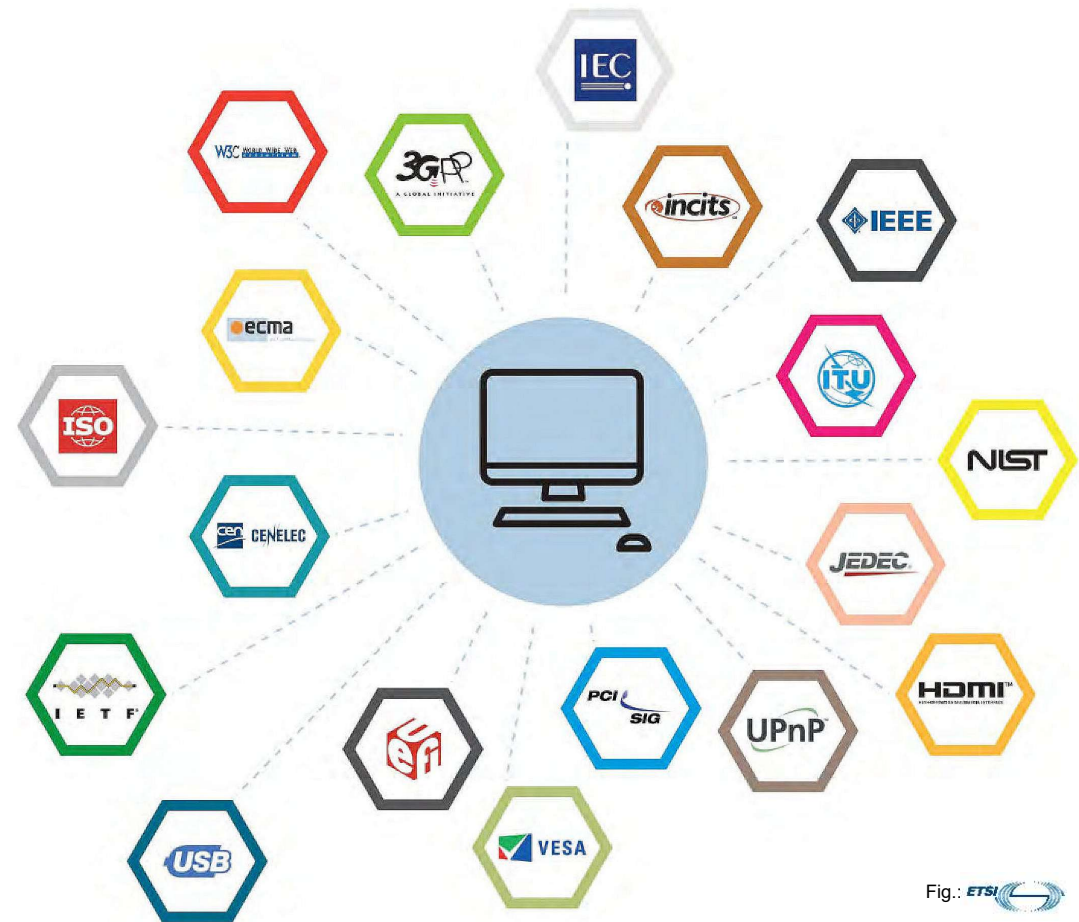
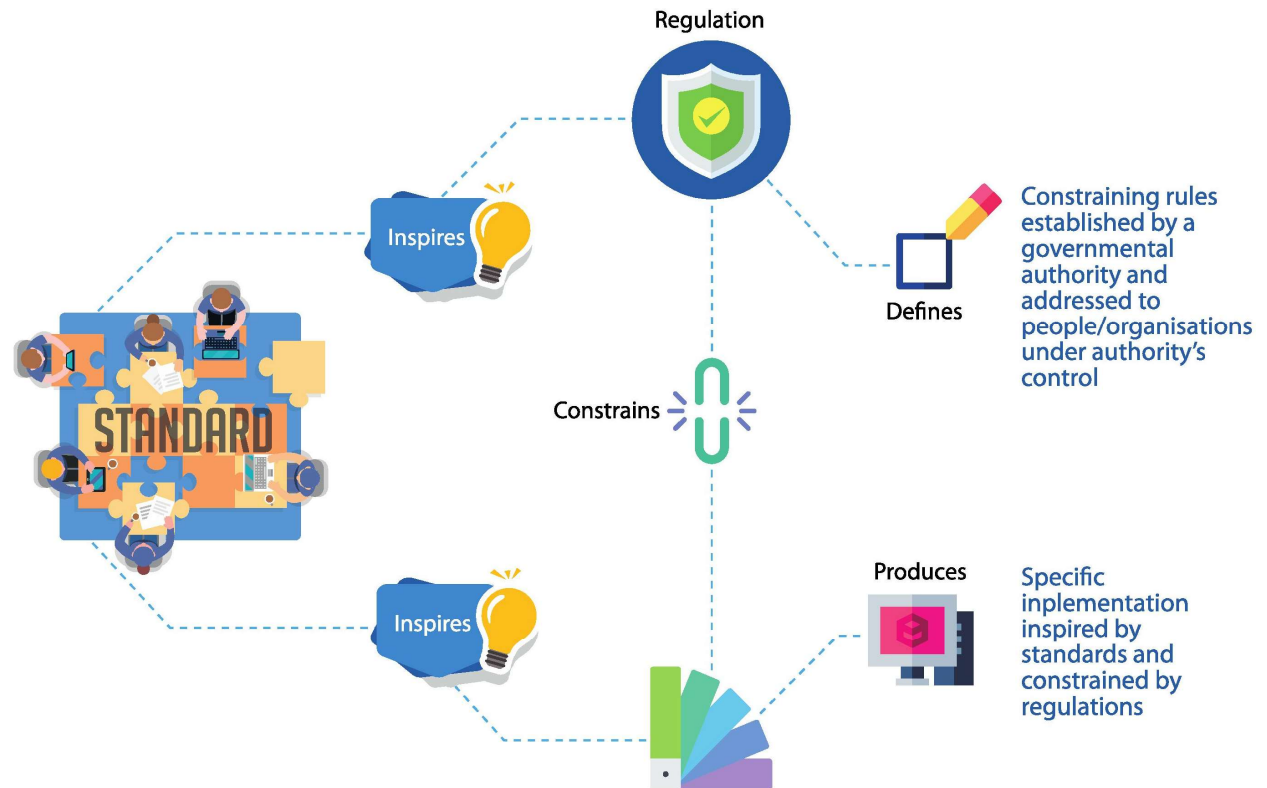


Fig.: ETSI 

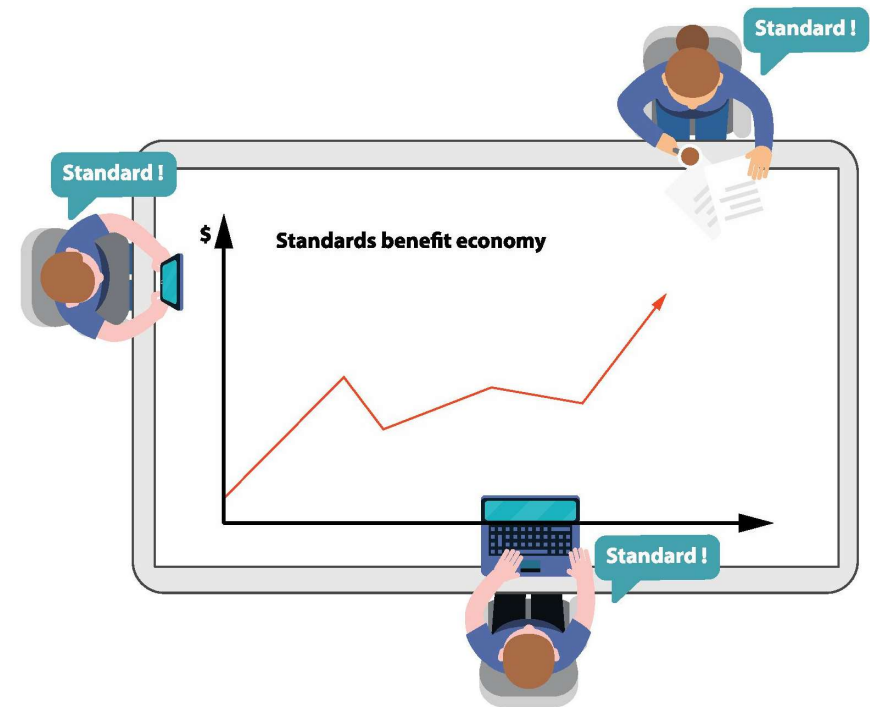
Formal standardization, SDO standards, and regulation

- Standards are NOT regulations.
- Standards are NOT a set of thorough design rules.
- Yet, they may inspire both
- Standards are voluntary NOT compulsory

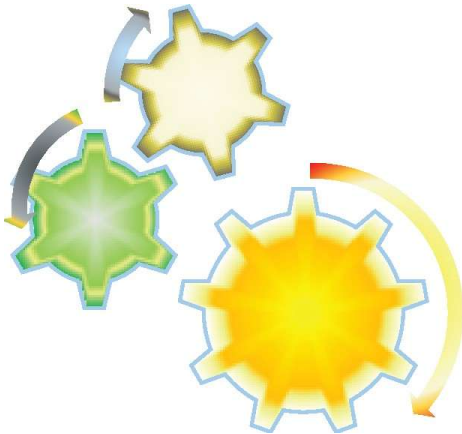


As a consensus-built set of rules for doing something, a Standard benefits the **economy** by

- incentivizing investments, as standards ensure the stability of the technology in a reasonable time frame
- enabling economy of scale
- facilitating trade thanks to common approaches among countries
- encouraging larger and fairer competition
- consolidation of new technologies and identifying evolution paths that are able to preserve past investments
- increasing collaboration opportunities among the companies, especially for small and innovative enterprises



As a consensus-built set of rules for doing something, a Standard benefits **innovation**, by



- reducing development time, costs and risks, by steering designers' activity, which facilitates the uptake of innovation in the marketplace



- improving quality
- decreasing time to market
- promoting the interoperability of products, services and processes
- attract customers

Standards benefit **economy**, (in particular newly established ones and SMEs)

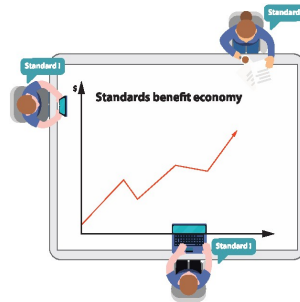
+ Innovation



— STANDARD —

- ease new developments
 - - risk,
 - - investment
 - + opportunities

+ trade and competition



- Enlarge potential market

+ safety and sustainability



STANDARD

- fairer competition and less risks of non-compliance (widespread and shared basic requirements)





Why standards?

- save (manufacturing, information, transaction, shipping, distribution, switching,...) costs
 - simplify work
 - increase market transparency
 - concentrate on innovative aspects
 - increase interoperability
 - increase exchangeability
 - intensify competition, price depression
 - reversal of the burden of proof
- by using standards

standards may jeopardize innovation, as:

- when established, standards may limit or delay the introduction of innovative (disruptive) solutions in the market
- introducing innovation into standards may take a long time

measures SDOs put in place to minimize risks:

- effectively managing the standardization processes by being open and responsive to the market innovation trends and to research impulses from the experts involved in the standardization activities
- establish open expert groups to explore innovation



standards may jeopardize fair competition among industries and Countries, as :

- SDOs may be politicized, or unduly influenced by special interests

measures SDOs put in place to minimize risks:

- enlarge contributor base
- right balance between effectiveness and fairness

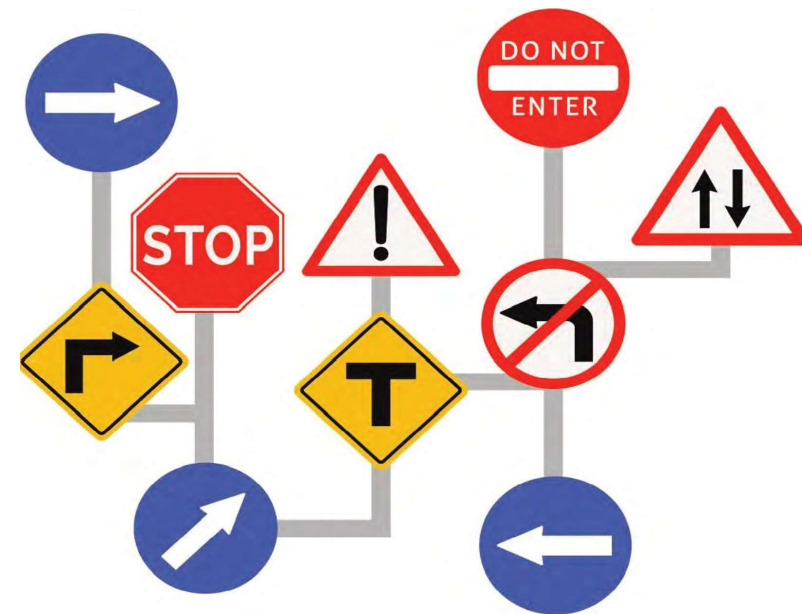


Varied standardization landscape may carry to inconsistencies, as:

- standards produced by different SDOs may be in competition or partially overlap; consequent production of inconsistent or, at least, redundant requirements may strongly jeopardize standardization benefits
- risk of unfairness as some SDO may be misused for local or specific interests

measures to put in place to minimize risks

- users and contributors to standards must select the most appropriate SDO
- SDOs need to promote liaisons and collaboration among themselves



Recognized SDOs:

- These are officially recognized by regulation systems or political bodies
- ITU, UN specialized agency for information and communication
- UE regulation 1025/2012 rules the standardization at an European level and lists a set of reference SDOs with either an international (ISO, IEC, and ITU) or European scope (CEN, CENELEC, and ETSI)



Not Recognized Organizations:

- These are not recognized by any political bodies
- IEEE is a primary SDO with a large number of active technical standards, ranging from wireless communications and digital health to cloud computing, power and energy, 3D video, electrical vehicle standards, and the Internet of Things. It was created by the Institute of Electrical and Electronics Engineers (IEEE), the American association of Electrical and Electronics Engineers and it brings together and organizes members from all over the world.

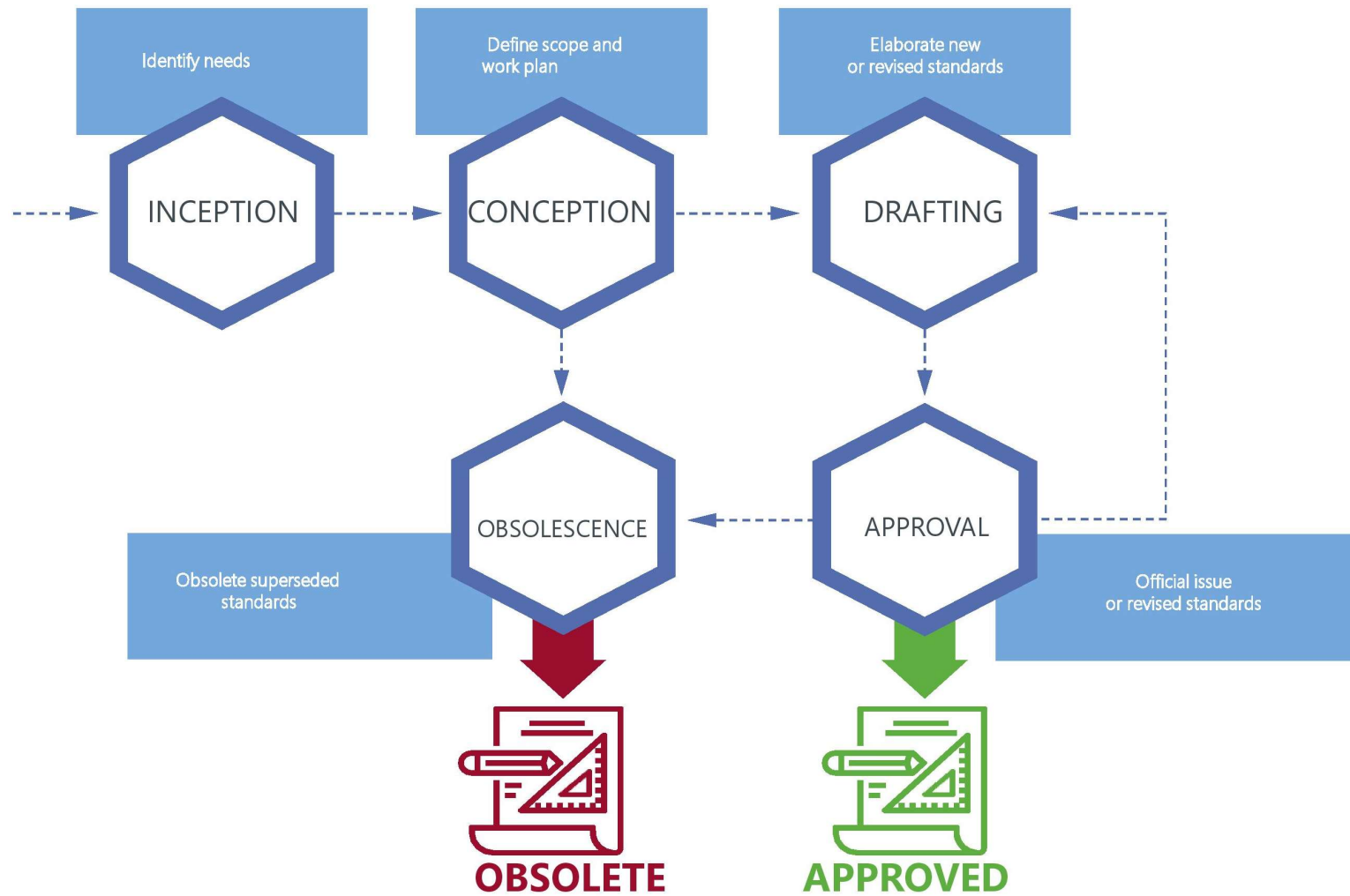


Structure of International Standardization

National SDOs organize so-called "mirror committees" to ISO and IEC committees. They represent national input and interests in ISO and IEC and feed information from ISO and IEC back to their homeland.



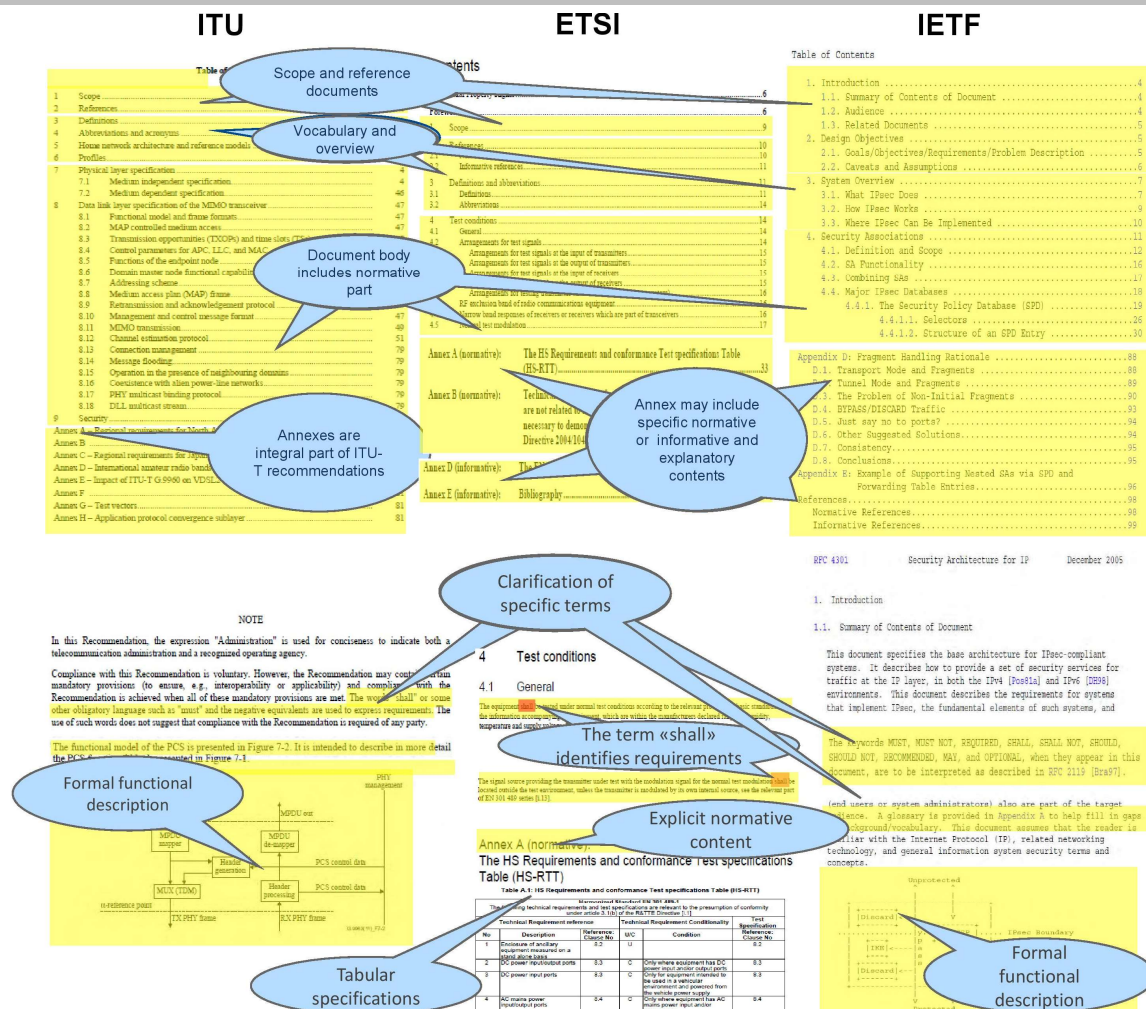
Standard development process



Using standards

How to find a standard and its contents

- select relevant SDOs by technical and geographical scope
- identify selected SDOs' relevant specification documents and their relevance
- all SDOs make their documents available online access may be restricted to authorized users -> check access
- clearly identify standard document's scope and objectives
- clearly identify standard document's objectives and area of application
- identify the list of other reference documentation
- discriminate document sections and between normative and informative parts



Standards development process: abbreviations

- PWI Preliminary work item
- NP New Work Item Proposal
- AWI Approved Work Item
- WD Working draft
- CD Committee Draft
- DIS Draft International Standard
- FDIS Final Draft International Standard
- international harmonized stage codes
(here on the right ->)

STAGE	SUBSTAGE						
				90 Decision			
	00 Registration	20 Start of main action	60 Completion of main action	92 Repeat an earlier phase	93 Repeat current phase	98 Abandon	99 Proceed
00 Preliminary stage	00.00 Proposal for new project received	00.20 Proposal for new project under review	00.60 Close of review			00.98 Proposal for new project abandoned	00.99 Approval to ballot proposal for new project
10 Proposal stage	10.00 Proposal for new project registered	10.20 New project ballot initiated	10.60 Close of voting	10.92 Proposal returned to submitter for further definition		10.98 New project rejected	10.99 Approval to New project approved
20 Preparatory stage	20.00 New project registered in TC/SC work programme	20.20 Working draft (WD) study initiated	20.60 Close of comment period			20.98 Project deleted	20.99 WD approved for registration as CD
30 Committee stage	30.00 Committee draft (CD) registered	30.20 CD study initiated	30.60 Close of comment period	30.92 CD referred back to Working Group		30.98 Project deleted	30.99 CD approved for registration as DIS
40 Enquiry stage	40.00 DIS registered	40.20 DIS ballot initiated: 12 weeks	40.60 Close of voting	40.92 Full report circulated: DIS referred back to TC or SC	40.93 Full report circulated: decision for new DIS ballot	40.98 Project deleted	40.99 Full report circulated: DIS approved for registration as FDIS
50 Approval stage	50.00 Final text received or FDIS registered for formal approval	50.20 Proof sent to secretariat or FDIS ballot initiated: 8 weeks	50.60 Close of voting. Proof returned by secretariat	50.92 FDIS or proof referred back to TC or SC		50.98 Project deleted	50.99 FDIS or proof approved for publication
60 Publication stage	60.00 International Standard under publication		60.60 International Standard published				
90 Review stage		90.20 International Standard under periodical review	90.60 Close of review	90.92 International Standard to be revised	90.93 International Standard confirmed		90.99 Withdrawal of International Standard proposed by TC or SC
95 Withdrawal stage		95.20 Withdrawal ballot initiated	95.60 Close of voting	95.92 Decision not to withdraw International Standard			95.99 Withdrawal of International Standard

Anything about XR in this topic?!

positioning ourselves in future topics

Europe finds ourselves only at the sideline of a fight for global XR ecosystems.

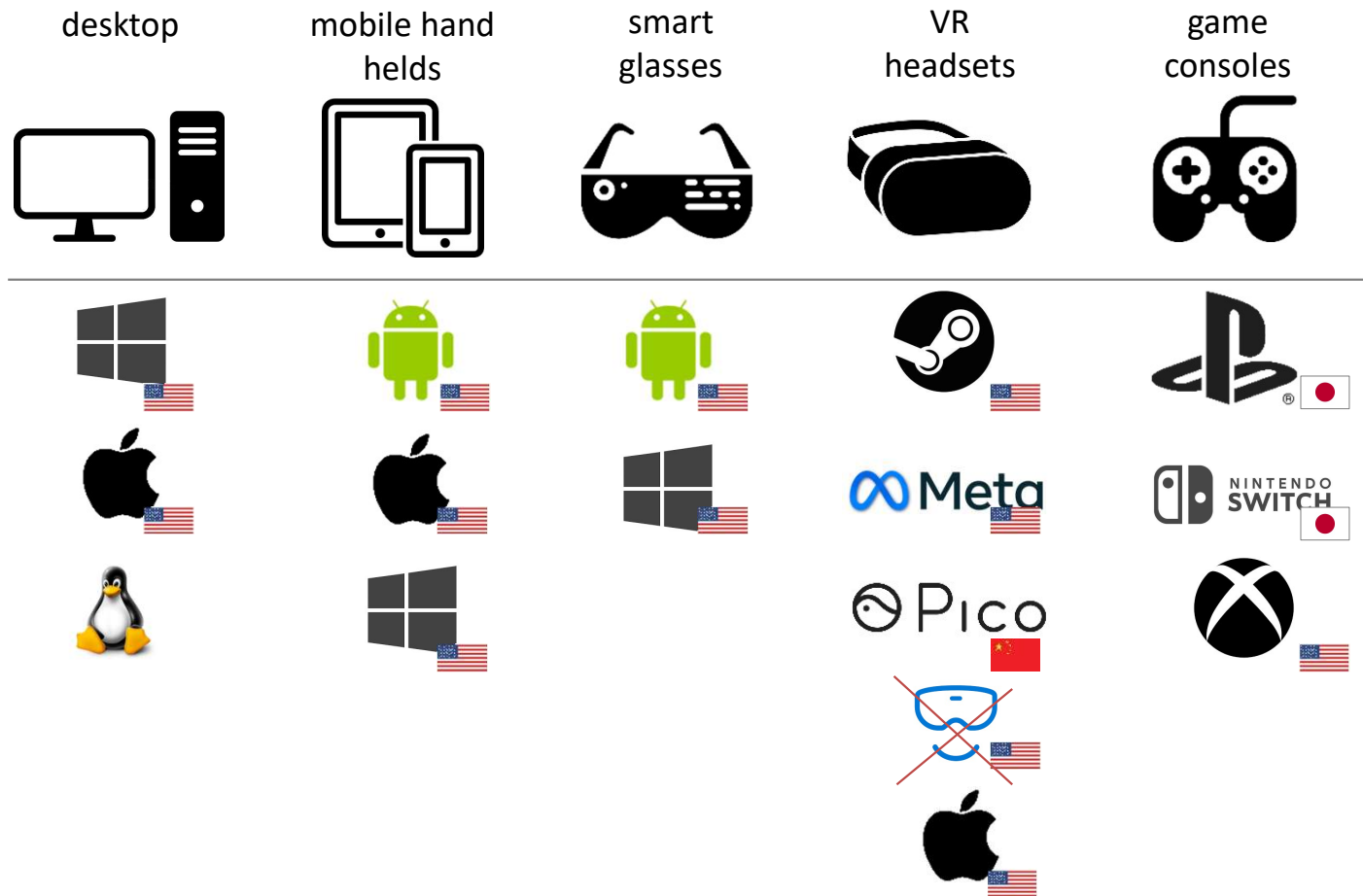
problem:

- Europe will probably not create a huge, global platform provider
- platform providers aim at vendor lock-in

questions:

- what options for action do we have?
- what can be our future role to create added value and employment?

=> **standardization!**





Chris Kremidas-Courtney, senior fellow at Brussels think tank „Friends of Europe“ and Lecturer for Institute for Security Governance (ISG) in Monterey, California.

He said that China plans to “*be the world leader in metaverse development,*” a technology that dovetails with its plan for a state-controlled digital renminbi. Standard-setting is the natural first step in that roadmap.

“If you want to seize the future,
you set the standards for it”

Chris said.

POLITICO

Enter keyword



EXPLORE ▾

NEWSLETTERS & PODCASTS ▾

POLITICO PRO

FROM POLITICO PRO

Beijing is coming for the metaverse

Proposals reviewed by POLITICO show China wants to assert state control over virtual environments.



Experts that reviewed the proposal at the request of POLITICO said it risks violating principles of privacy and freedom | Jade Gao/AFP via Getty Images

BY GIAN VOLPICELLI

AUGUST 20, 2023 | 4:00 PM CET | 5 MINUTES READ

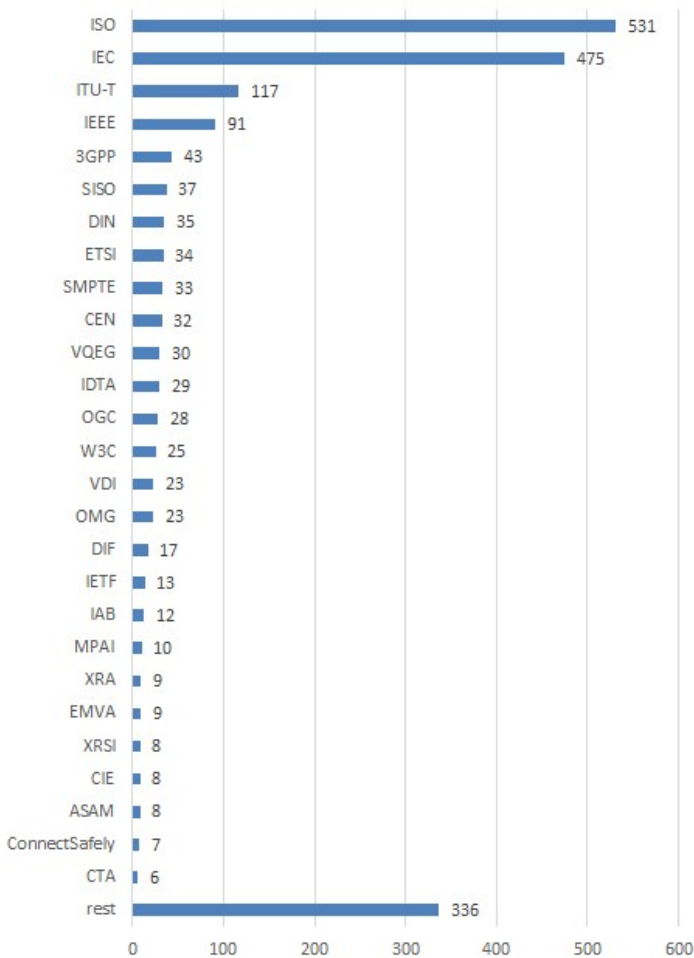
Getting engaged

We got involved in the
standardization eco system

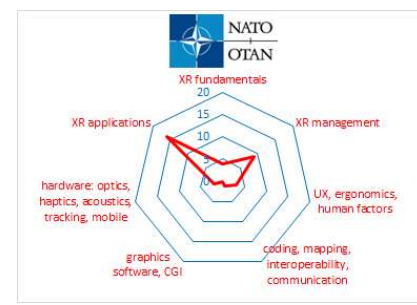
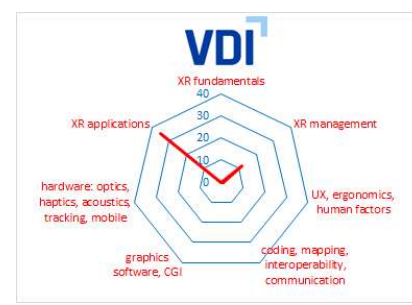
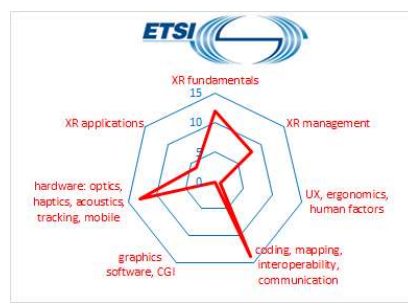
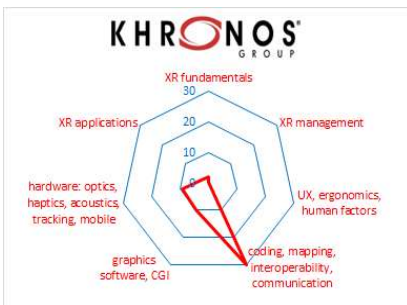
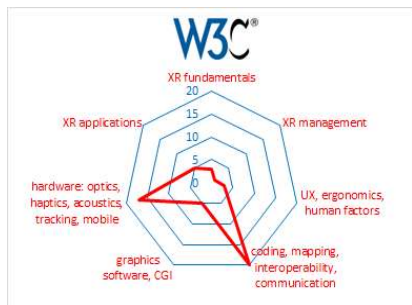
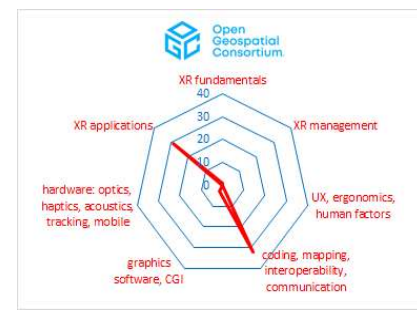
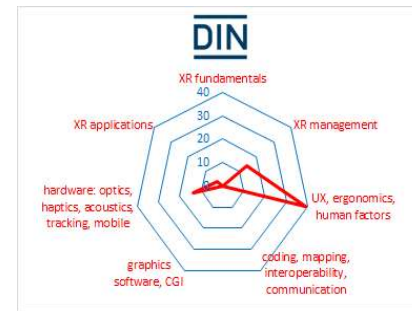
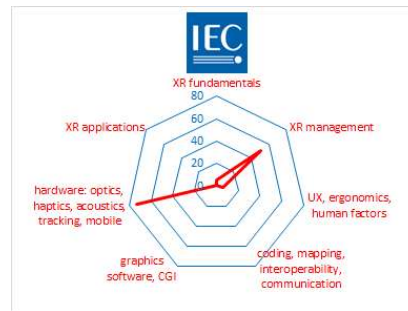
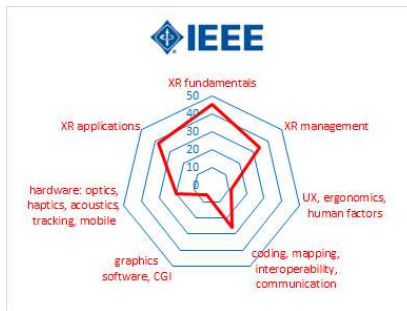
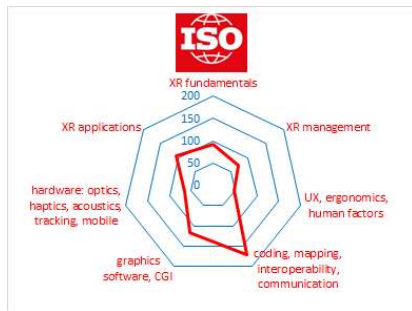


Organizations related to or fostering MV / VW standardization

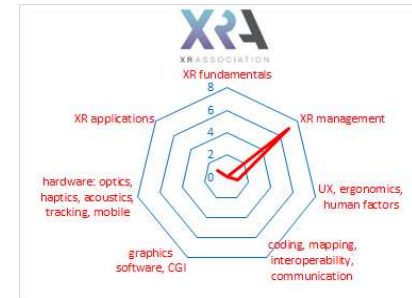
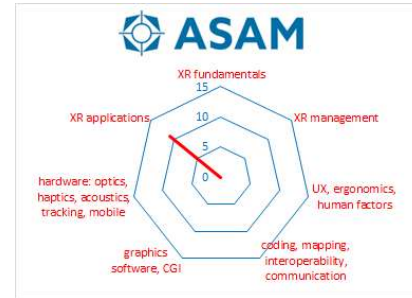
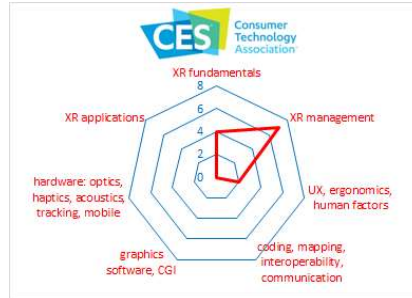
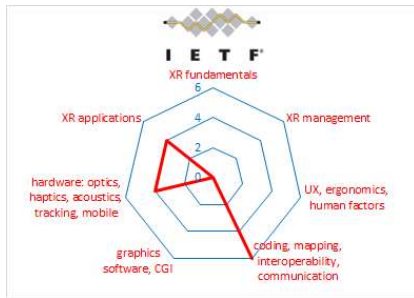
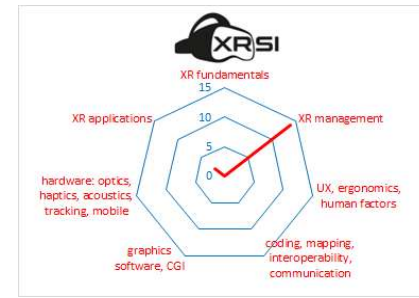
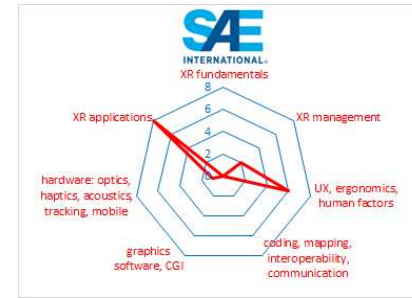
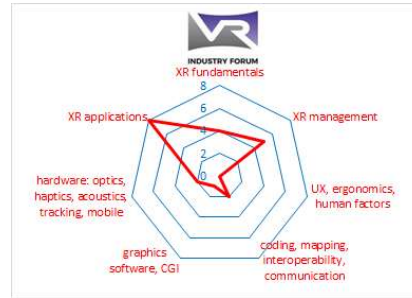
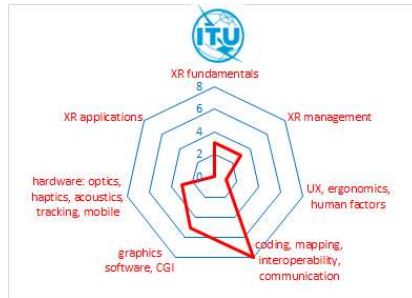
published standards, specs, recommendations



Focuses of XR standardization organizations varying



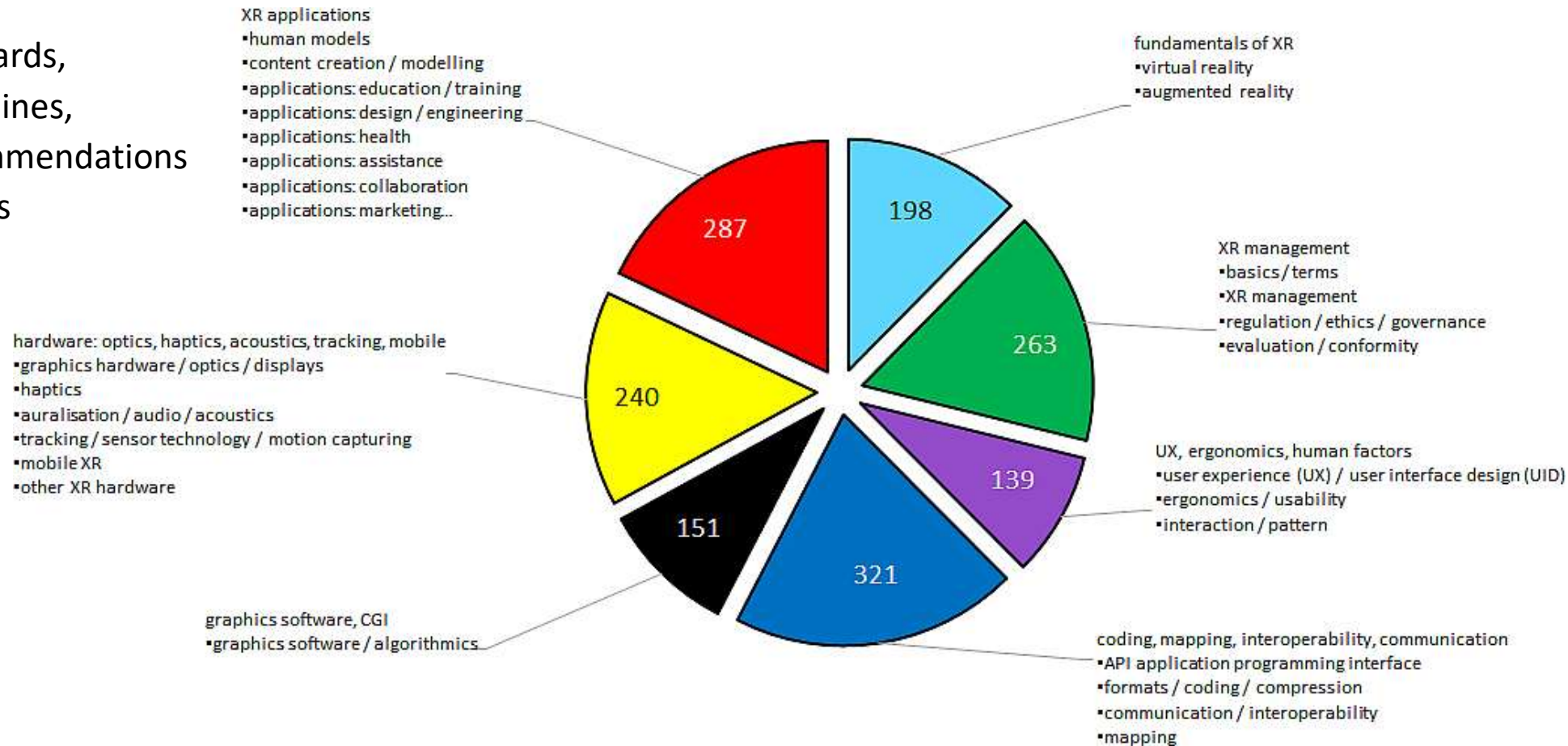
Focuses of XR standardization organizations varying



XR Standards clustering: focussing on 7 main topics

clustering

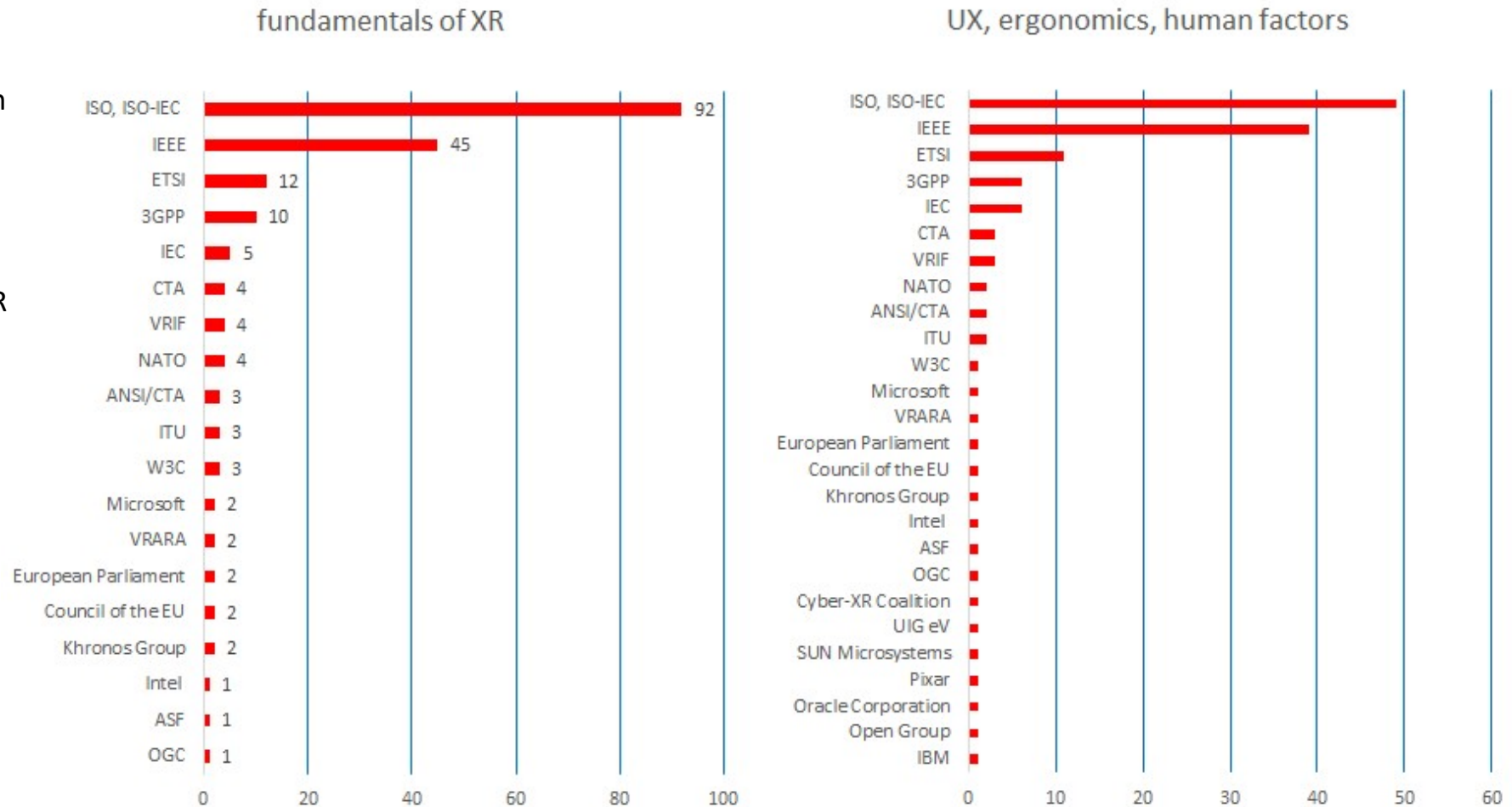
- XR standards,
 - XR guidelines,
 - XR recommendations
- into 7 topics



What XR SDOs work on which XR topics?

analysis on the right hand side shows XR SDOs contributing with own documents to certain XR fields.

It becomes further obvious that certain XR topics are treated by SDOs in different number at total.

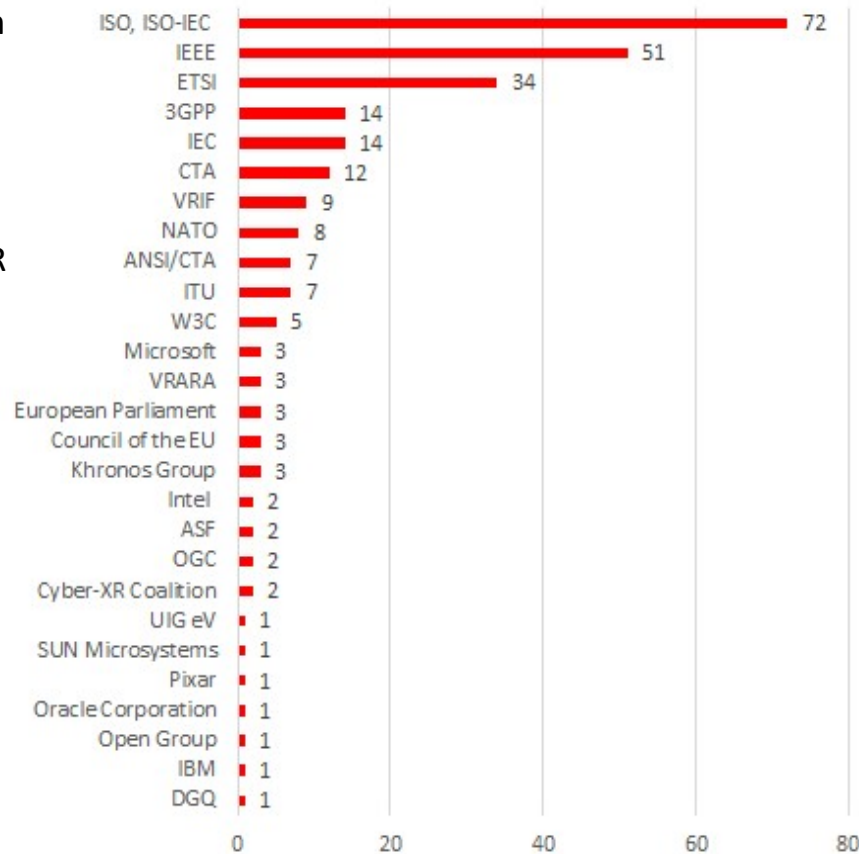


XR Standards clustering: focussing on 7 main topics

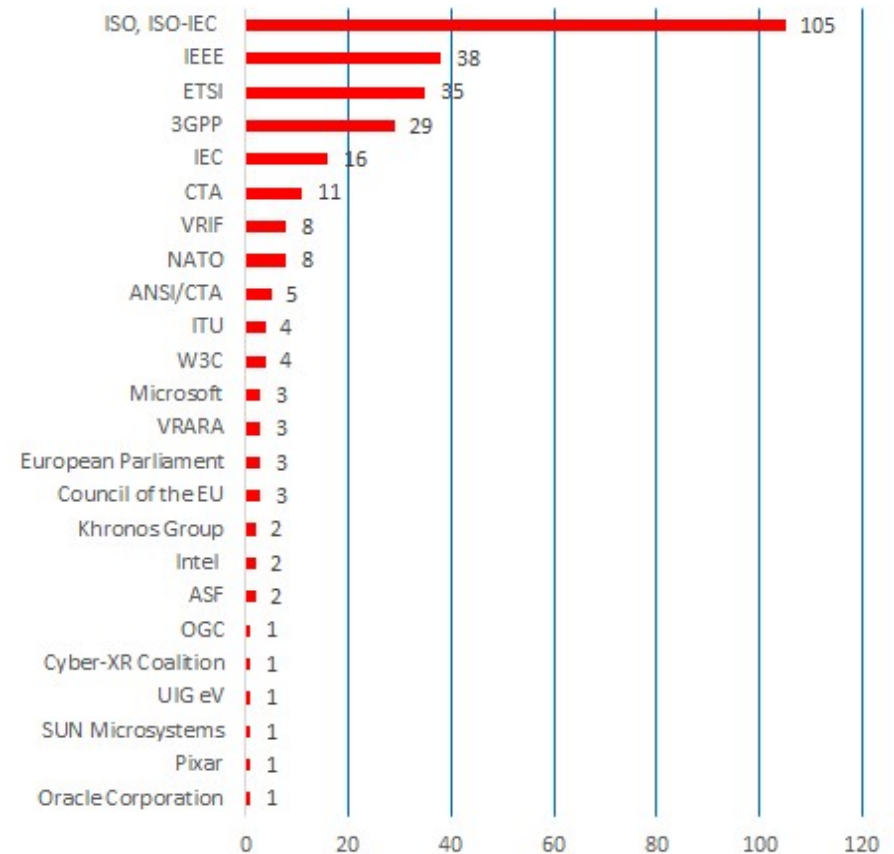
analysis on the right hand side shows XR SDOs contributing with own documents to certain XR fields.

It becomes further obvious that certain XR topics are treated by SDOs in different number at total.

XR management



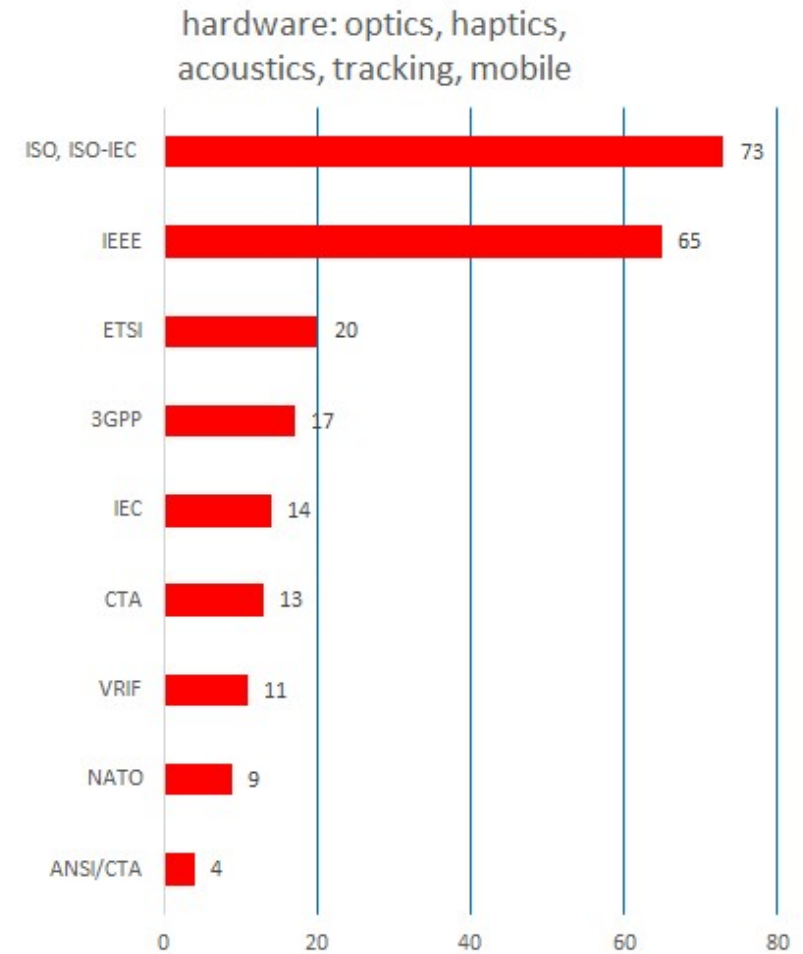
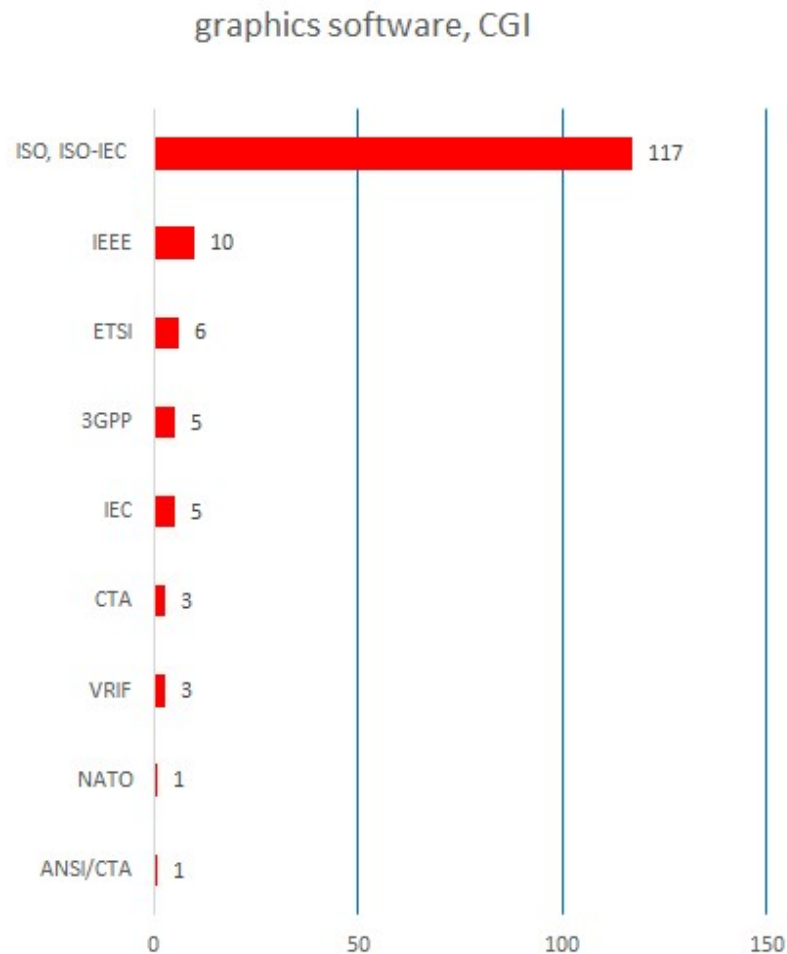
XR applications



XR Standards clustering: focussing on 7 main topics

analysis on the right hand side shows XR SDOs contributing with own documents to certain XR fields.

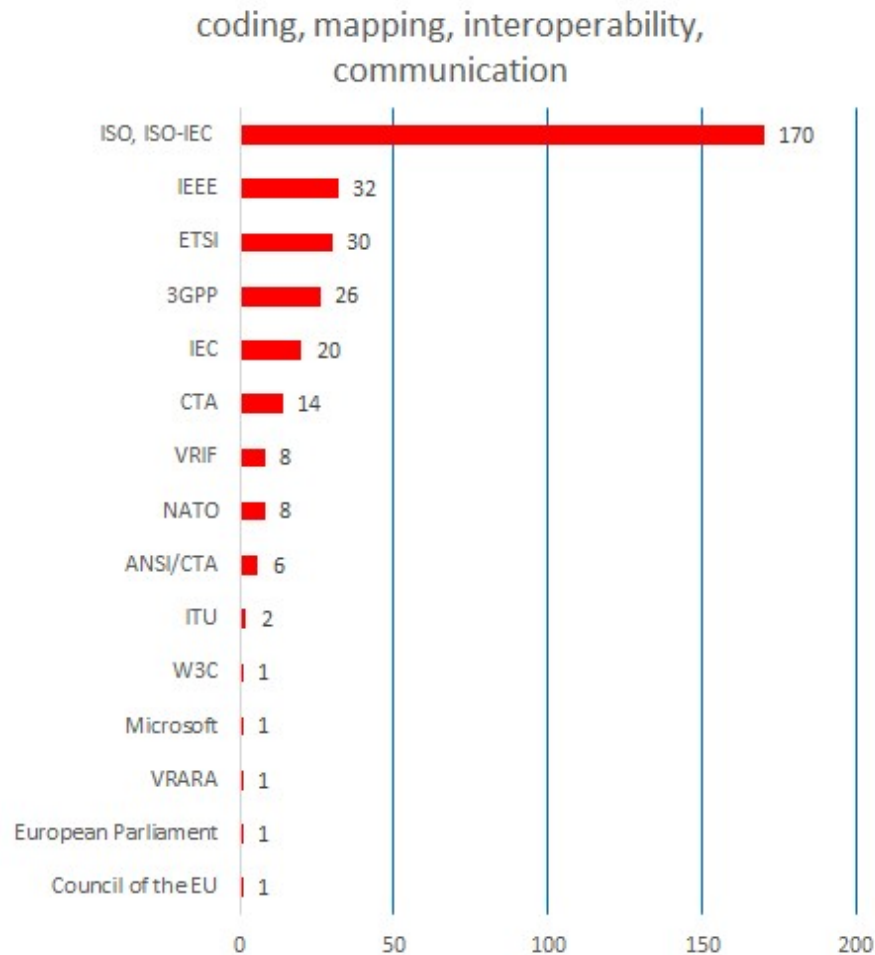
It becomes further obvious that certain XR topics are treated by SDOs in different number at total.



XR Standards clustering: focussing on 7 main topics

analysis on the right hand side shows XR SDOs contributing with own documents to certain XR fields.

It becomes further obvious that certain XR topics are treated by SDOs in different number at total.



Examples of XR standards: metrology

INTERNATIONAL
STANDARD

ISO
17901-1

First edition
2015-07-01

Optics and photonics — Holography —
Part 1:
Methods of measuring diffraction
efficiency and associated optical
characteristics of holograms

*Optique et photonique — Holographie —
Partie 1: Méthodes de mesurage de l'efficacité de diffraction et
caractéristiques optiques associées aux hologrammes*



Reference number
ISO 17901-1:2015(E)

© ISO 2015

ISO/IEC Standards Collection - Stand 2016-11

INTERNATIONAL
STANDARD

ISO/IEC
23090-6

First edition
2021-06

Information technology — Coded
representation of immersive media —
Part 6:
Immersive media metrics



Reference number
ISO/IEC 23090-6:2021(E)

© ISO/IEC 2021

ISO/IEC Standards Collection - Stand 2021-09



IEC 62908-13-10

Edition 1.0 2016-11

INTERNATIONAL
STANDARD



Touch and interactive displays –
Part 13-10: Reliability test methods of touch displays – Environmental durability
test methods

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 31.120

ISBN 978-2-8322-3795-3

Warning! Make sure that you obtained this publication from an authorized distributor.

© Registered trademark of the International Electrotechnical Commission

Examples of XR standards: metrology

DIN EN ISO 20685



ICS 13.180

Ersatz für
DIN EN ISO 20685:2006-02

3D-Scanverfahren für international kompatible anthropometrische Datenbanken (ISO 20685:2010);
Deutsche Fassung EN ISO 20685:2010

3-D scanning methodologies for internationally compatible anthropometric databases (ISO 20685:2010);
German version EN ISO 20685:2010

Méthodologies d'exploration tridimensionnelles pour les bases de données anthropométriques compatibles au plan international (ISO 20685:2010);
Version allemande EN ISO 20685:2010

Gesamtumfang 25 Seiten

Normenausschuss Ergonomie (NAErg) im DIN

© DIN Deutsches Institut für Normung e.V. - Jede Art der Vervielfältigung, auch auszugsweise, nur mit Genehmigung des DIN Deutsches Institut für Normung e.V., Berlin, gestattet.
Allenverkauf der Normen durch Beuth Verlag GmbH, 10772 Berlin

Preisgruppe 13
www.din.de
www.beuth.de



1711513

ETSI TR 126 929 V17.0.0 (2022-05)





TECHNICAL REPORT

5G;
QoE parameters and metrics relevant to the Virtual Reality (VR)
user experience
(3GPP TR 26.929 version 17.0.0 Release 17)





IEC 62629-62-11

Edition 1.0 2022-11

INTERNATIONAL
STANDARD



3D display devices –
Part 62-11: Measurement methods for virtual-image type – Optical

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 31.120; 31.260

ISBN 978-2-8322-6006-7

Warning! Make sure that you obtained this publication from an authorized distributor.

© Registered trademark of the International Electrotechnical Commission

Examples of XR standards

DRAFT INTERNATIONAL STANDARD

ISO/IEC DIS 3721-1

ISO/IEC JTC 1/SC 24

Secretariat: BSI

Voting begins on:
2021-09-01

Voting terminates on:
2021-11-24

Information technology — Computer graphics, image processing and environmental data representation — Information model for Mixed and Augmented Reality Contents —

Part 1:
Core Objects and Attributes

ICS: 35.140

THIS DOCUMENT IS A DRAFT CIRCULATED FOR COMMENT AND APPROVAL. IT IS THEREFORE SUBJECT TO CHANGE AND MAY NOT BE REFERRED TO AS AN INTERNATIONAL STANDARD UNTIL PUBLISHED AS SUCH.

IN ADDITION TO THEIR EVALUATION AS BEING ACCEPTABLE FOR INDUSTRIAL, TECHNOLOGICAL, COMMERCIAL AND USER PURPOSES, DRAFT INTERNATIONAL STANDARDS MAY ON OCCASION HAVE TO BE CONSIDERED IN THE LIGHT OF THEIR POTENTIAL TO BECOME STANDARDS TO WHICH REFERENCE MAY BE MADE IN NATIONAL REGULATIONS.

RECIPIENTS OF THIS DRAFT ARE INVITED TO SUBMIT, WITH THEIR COMMENTS, NOTIFICATION OF ANY RELEVANT PATENT RIGHTS OF WHICH THEY ARE AWARE AND TO PROVIDE SUPPORTING DOCUMENTATION.

This document is circulated as received from the committee secretariat.



Reference number

ISO/IEC DIS 3721-1:2021 (E)

© ISO/IEC 2021

INTERNATIONAL STANDARD

ISO/IEC 23488

First edition
2022-05

Information technology — Computer graphics, image processing and environment data representation — Object/environmental representation for image-based rendering in virtual/mixed and augmented reality (VR/MAR)

Technologies de l'information — Infographie, traitement d'images et représentation des données environnementales — Représentation d'objets/environnements pour l'habillage à partir d'images réelles dans la réalité virtuelle/mixte et augmentée (VR/MAR)



Reference number

ISO/IEC 23488:2022 (E)

© ISO/IEC 2022

INTERNATIONAL STANDARD

ISO 17901-1

First edition
2015-07-01

Optics and photonics — Holography — Part 1: Methods of measuring diffraction efficiency and associated optical characteristics of holograms

Optique et photonique — Holographie — Partie 1: Méthodes de mesurage de l'efficacité de diffraction et caractéristiques optiques associées aux hologrammes



Reference number

ISO 17901-1:2015 (E)

© ISO 2015

Examples of XR standards



International Telecommunication Union

ITU-T
TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

G.1035
(11/2021)

SERIES G: TRANSMISSION SYSTEMS AND MEDIA,
DIGITAL SYSTEMS AND NETWORKS
Multimedia Quality of Service and performance – Generic
and user-related aspects

**Influencing factors on quality of experience for
virtual reality services**

Recommendation ITU-T G.1035



NORTH ATLANTIC TREATY
ORGANIZATION



AC/323(HFM-MSG-323)TP/1039

SCIENCE AND TECHNOLOGY
ORGANIZATION



www.sto.nato.int

STO TECHNICAL REPORT

TR-HFM-MSG-323

**Guidelines for Mitigating Cybersickness
in Virtual Reality Systems**
(Guide d'atténuation du cybermalaise
dans les systèmes de réalité virtuelle)

Peer-reviewed Final Technical Report of the Human Factors and Medicine /
Modeling Simulations Group, Activity Number 323. This Report describes
the outcome of the activity performed during the study.



Published October 2021

Distribution and Availability: on Back Cover

3GPP TR 26.928 v17.0.0 (2022-04)

Technical Report

**3rd Generation Partnership Project;
Technical Specification Group Services and System Aspects;
Extended Reality (XR) in 5G
(Release 17)**



A GLOBAL INITIATIVE

The present document has been developed within the 3rd Generation Partnership Project (3GPPTM) and may be further elaborated for the purposes of 3GPP. The present document has not been subject to any approval process by the 3GPP Organizational Partners and shall not be implemented. This Report is provided for future development work within 3GPP only. The Organizational Partners accept no liability for any use of this Specification. Specifications and Reports for implementation of the 3GPPTM system should be obtained via the 3GPP Organizational Partners' Publications Offices.

Examples of XR standards

ETSI GS ARF 005 V1.1.1 (2022-09)



GROUP SPECIFICATION

Augmented Reality Framework (ARF);
Open APIs for the Creation and Management of the
World Representation

Disclaimer

The present document has been produced and approved by the Augmented Reality Framework (ARF) ETSI Industry Specification Group (ISG) and represents the views of those members who participated in this ISG. It does not necessarily represent the views of the entire ETSI membership.

IEEE SA
STANDARDS
ASSOCIATION

INDUSTRY CONNECTIONS
REPORT



THE IEEE GLOBAL INITIATIVE ON ETHICS OF
EXTENDED REALITY (XR) REPORT

EXTENDED REALITY (XR) ETHICS
AND DIVERSITY, INCLUSION, AND
ACCESSIBILITY

Authored by

Dylan Fox
Isabel Guenette Thornton
Chapter Leaders

IEEE

© 2022 IEEE. All rights reserved.

IEEE STANDARDS ASSOCIATION

IEEE

IEEE Standard for Distributed
Interactive Simulation—
Application Protocols

IEEE Computer Society

Sponsored by the
SISO Standards Activity Committee

IEEE
3 Park Avenue
New York, NY 10016-5997
USA

IEEE Std 1278.1™-2012
(Revision of
IEEE Std 1278.1-1995)

19 December 2012

Authorized licensed use limited to: Hochschule Heilbronn. Downloaded on September 26, 2022 at 12:46:50 UTC from IEEE Xplore. Restrictions apply.

Examples of XR standards



COLLADA – Digital Asset Schema Release 1.5.0

Specification

April 2008

Editors: Mark Barnes and Ellen Levy Finch, Sony Computer Entertainment Inc.

ANSI/CTA Standard

Definitions and Characteristics for VR Video and
VR Images

ANSI/CTA-2085

November 2019



Consumer
Technology
Association™

Consumer
Technology
Association™

CTA Standard

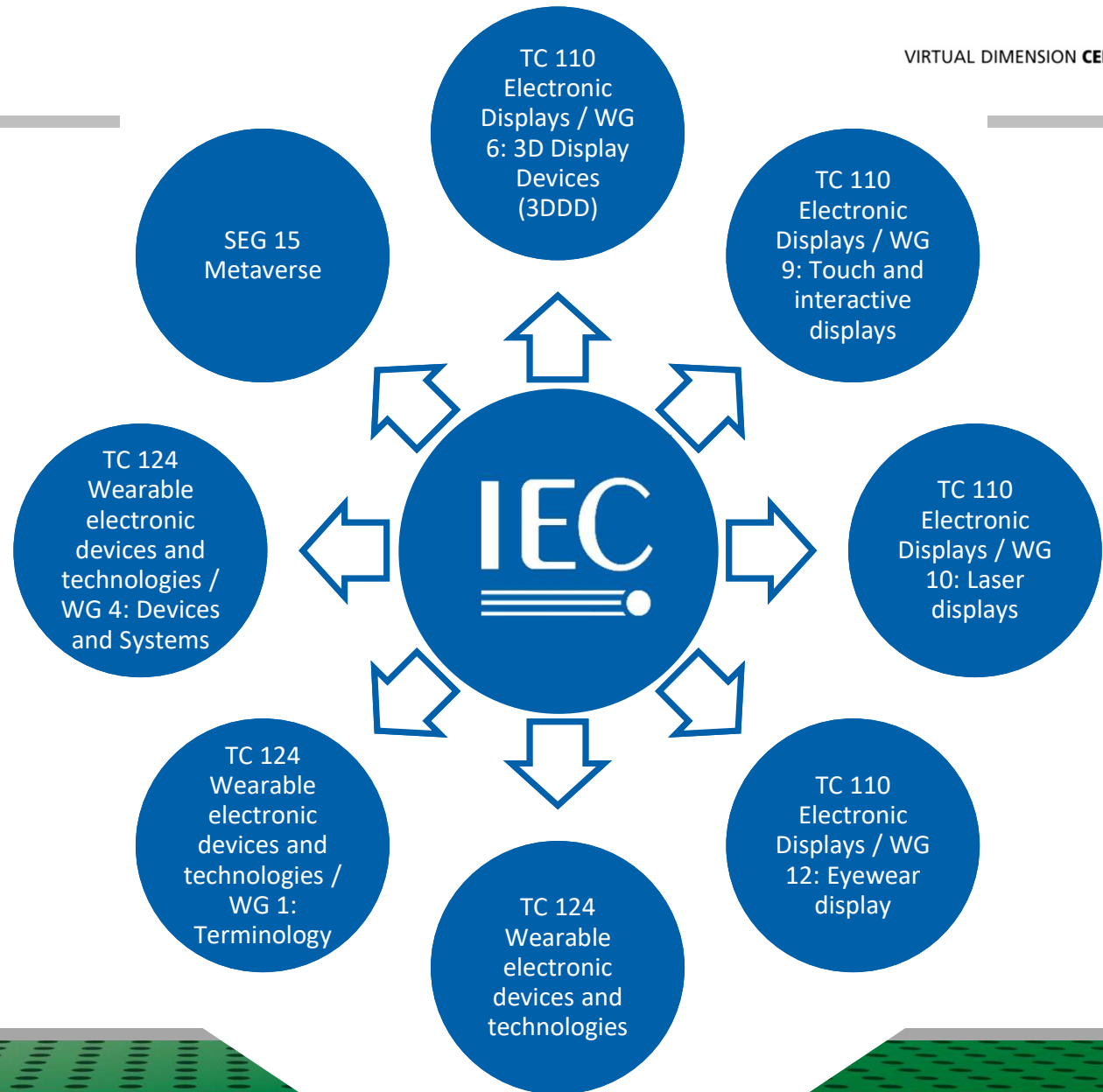
Best Practices for Limited Mobility in XR

CTA-2095

May 2021

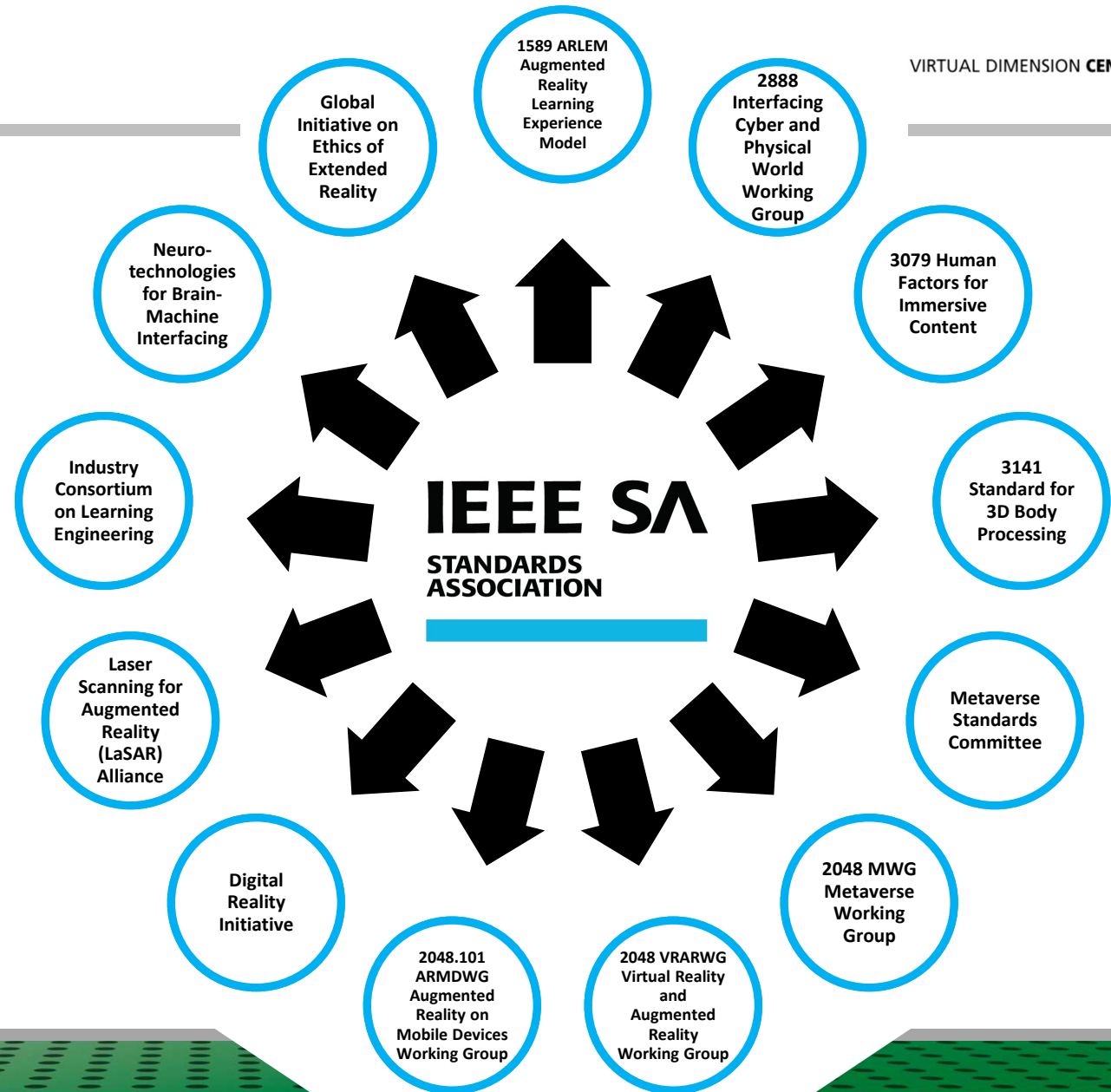
XR Standards Working Groups

The **International Electrotechnical Commission (IEC)** is an international standardization organization for standards in the field of electrotechnology and electronics, based in Geneva. Some standards are developed jointly with ISO (International Organization for Standardization). IEC was founded in 1906 and is located in Geneva. IEC played a crucial role in standardizing units of measurement, particularly Gauss, Hertz, and Weber. It also first proposed a system of standards, the Giovanni-Giorgi-System, which ultimately became the SI, the International System of Units. The IEC charter encompasses the entire field of electrotechnology, including the transformation and distribution of energy, electronics, magnetism and electromagnetism, electroacoustics, multimedia, telecommunications, and medical technology as well as general disciplines such as terminology and symbols, electromagnetic compatibility, measurement technology and operational behavior, reliability, design and development, safety, and the environment.



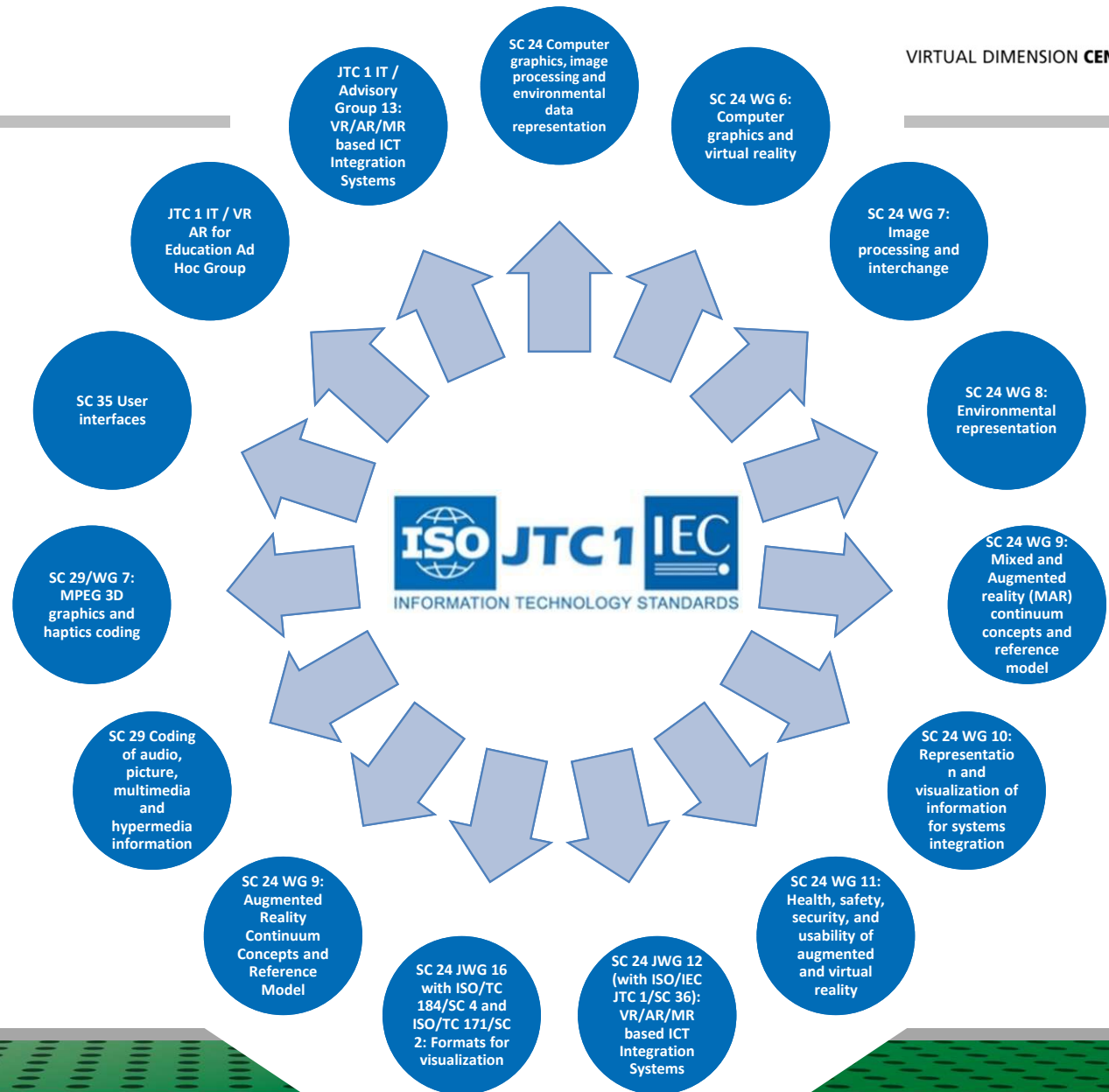
XR Standards Working Groups

The **Institute of Electrical and Electronics Engineers (IEEE)** is a global professional association of engineers primarily from the fields of electrical engineering and information technology, legally based in New York City with operational headquarters in Piscataway, New Jersey. It organizes professional conferences, publishes various professional journals, and forms committees for the standardization of techniques, hardware, and software. Scientific contributions in journals or to IEEE conferences are generally presumed to be of particularly high professional quality. With publications like the IEEE Spectrum journal, the organization also promotes interdisciplinary information and discussion on the societal impacts of new technologies. The IEEE organizes several subgroups addressing VR or AR topics, including (1) Digital Reality, (2) Augmented Reality Learning Experience Model (AR-LEM), the (3) IEEE 2048 VR/AR Working Group (VRARWG), and a (4) Smart Glasses Interest Group. Additionally, the IEEE operates a Standards Group. Where the latter collaborates with one of the aforementioned four theme groups, V/AR-relevant norms, standards, and guidelines are created..



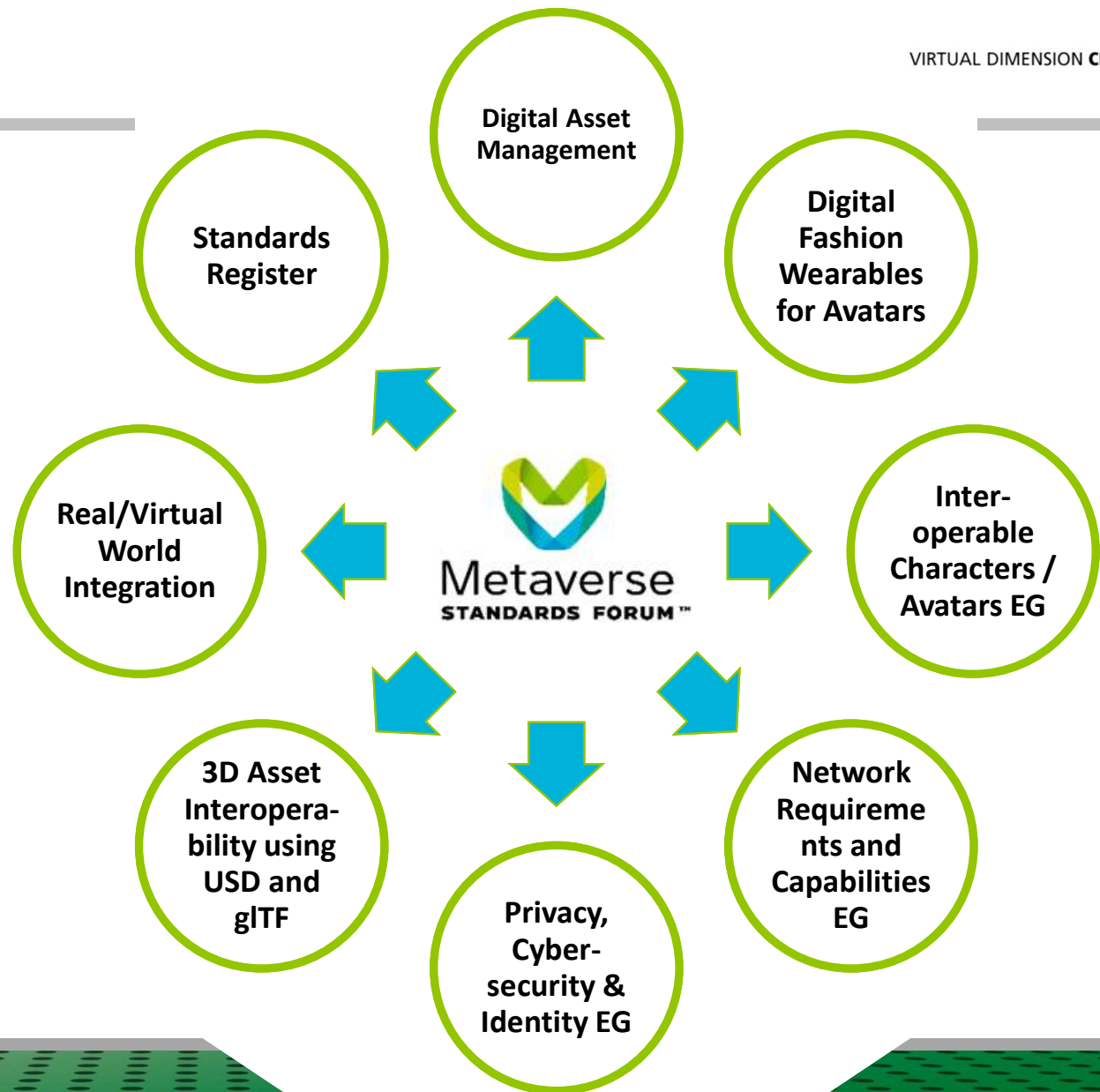
XR Standards Working Groups

The **International Organization for Standardization (ISO)** is an independent, non-governmental organization, whose members consist of various national standardization bodies. As of 2022, there are 167 members who represent ISO in their country, with each country having only one member. The organization develops and publishes international standards in all technical and non-technical areas, except for electrical engineering and electronics, which fall under the jurisdiction of the International Electrotechnical Commission. By February 2023, ISO has developed over 24,676 standards that cover all areas from industrial products and technology to food safety, agriculture, and healthcare. **The Moving Picture Experts Group (MPEG)** is a group of experts dealing with the standardization of video compression and related areas, such as audio data compression or container formats. Colloquially, "MPEG" usually refers not to the group of experts, but to a specific MPEG standard. The MPEG meets three or four times a year for five-day meetings. About 350 experts from 200 companies and organizations from 20 countries participate in these meetings, the MPEG meetings. MPEG is part of ISO/IEC JTC1/SC29.



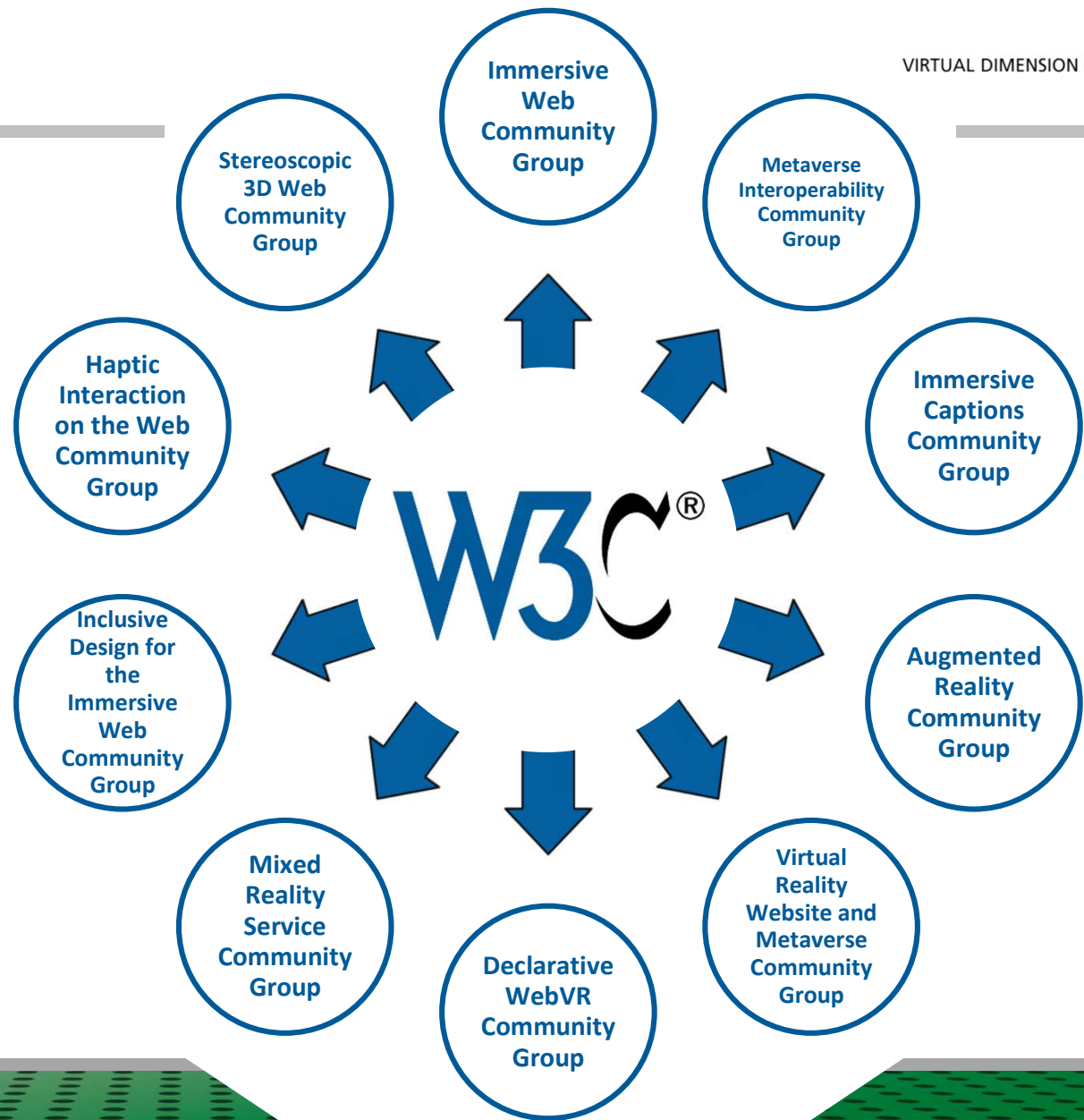
XR Standards Working Groups

The **Metaverse Standards Forum (MSF)** was founded in June 2022 to foster the development of interoperability standards for an open and inclusive metaverse, and accelerate their development and deployment through pragmatic, action-based projects. Since the vision of the metaverse is still a work in progress, the group also has the stated purpose of bringing some order to the underlying terminology of the metaverse. The MSF is an industry-wide effort to harmonize standards and best practices for the metaverse. Its members, which to date number 1,800, include tech titans Google, Meta, Microsoft and Nvidia; standards bodies Khronos Group and Web3D Consortium; multinational software companies Adobe, Autodesk and Epic; and professional technology services firm Accenture. Members of the forum hope the process will help build trust among the builders of the metaverse. This is important as the industry explores new technologies and new business models. Early blockchain and decentralized finance efforts attempted to address trust programmatically, only to discover new vulnerabilities and types of abuse no one had previously imagined. The MSF is free for all participants, including companies, standards organizations, non-profit organizations, industry associations and universities.



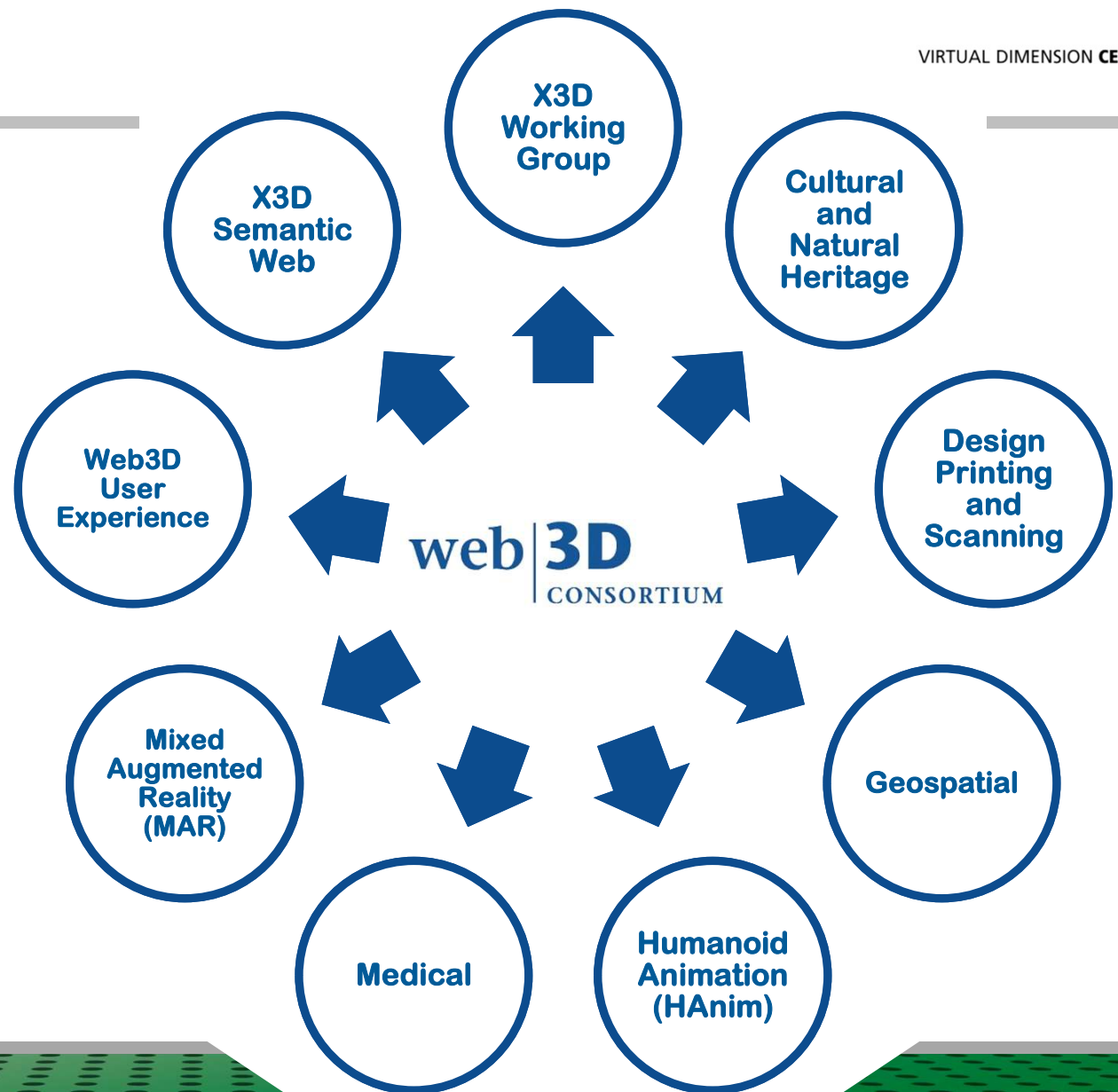
XR Standards Working Groups

The **World Wide Web Consortium (shortly W3C)** is the body responsible for standardizing technologies on the World Wide Web. It was founded on October 1, 1994, at the MIT Laboratory for Computer Science in Cambridge, Massachusetts. The W3C is a membership organization. It develops technical specifications and guidelines through a mature, transparent process to achieve maximum consensus about the content of technical protocols, high technical and editorial quality, and approval by the W3C and its followers. Examples of technologies standardized by the W3C include HTML, XHTML, XML, RDF, OWL, CSS, SVG, and WCAG. Within its "Immersive Web Community Group," the W3C addresses VR and AR topics. Already in the early 1990s, ideas for a 3D extension of the internet emerged at the first HTML conferences, which then resulted in the Virtual Reality Language (VRML) as a counterpart to HTML.



XR Standards Working Groups

The **Web3D Consortium** is an international, non-profit, member-funded, industry organization dedicated to the development of standards (SDO) established in 1997. The Web3D Consortium champions the deployment of ISO-ratified X3D standards for communicating interactive 3D scenes across various applications, use cases, platforms, and industries. It provides robust web-based 3D capabilities and long-term stability for enterprise solutions, as well as interoperability with other standards. Members collaboratively work on the development of the X3D standards and tools to ensure their broad dissemination across various markets, catering to academia, government, industry, and individual users. Today, the Web3D Consortium leverages its extensive industry backing to continue the evolution of the X3D specification..





DIN-NA 043-01-24 AA „*Metaverse und Extended Reality*“ is the German mirror committee to ISO/IEC JTC 1/SC 24 “*Computer graphics, image processing and environmental data representation*”

ISO/IEC JTC 1/SC 24 consists of the following groups:

- WG 6 – Augmented Reality Continuum Presentation and Exchange
- WG 7 - Image Processing and Interchange
- WG 8 – Environmental Representation
- WG 9 – Augmented Reality Continuum Concepts and Reference Model
- WG 10 – Representation and Visualization of Information for Systems Integration
- WG 11 – Health, Safety, Security and Usability of Augmented and Virtual Reality (AR/VR)
- JWG 12 – VR/AR/MR based ICT Integration Systems
- JWG 16 – Formats for Visualization and Other Derived Forms of Product Data
- CAG – Chair’s Advisory Group



ISO/IEC JTC 1/SC 24 is responsible for 96 published documents

ISO/IEC JTC 1/SC 24 has 15 active work items and 15 preliminary work items:

- | | | | |
|------------------------|---|-------------------------|--|
| 1. ISO/IEC PWI 23620-2 | Information technology - VR/AR/MR based information systems for learning, education, and training — VR/AR/MR based information systems for learning, education and training — Part 2: Reference model | 7. ISO/IEC PWI 24931-3 | Information Technology — Metaverse — Part 3: Use cases |
| 2. ISO/IEC PWI 23620-4 | Information technology - VR/AR/MR based information systems for learning, education, and training — VR/AR/MR based information systems for learning, education and training — Part 4: Virtual human model | 8. ISO/IEC PWI 24931-4 | Information Technology — Metaverse — Part 4: Reference model |
| 3. ISO/IEC PWI 26952 | Information technology — Use cases and design guidelines for VR/AR/MR based learning, education and training | 9. ISO/IEC PWI 24931-5 | Information Technology — Metaverse — Part 5: Information mode |
| 4. ISO/IEC PWI 26951 | Computer graphics, image processing and environmental data representation — Metaverse — Visual security in the metaverse | 10. ISO/IEC PWI 24931-6 | Information Technology — Metaverse — Part 6: Metaverse governance |
| 5. ISO/IEC PWI 24931-2 | Information Technology — Metaverse — Part 2: Framework and architecture | 11. ISO/IEC PWI 23620-3 | VR/AR/MR based information systems for learning, education and training — Part 3: Virtual environment model |
| | | 12. ISO/IEC PWI 23554 | Computer graphics, image processing and environmental data representation - Privacy Policy Requirements in Modelling and Simulation Environments |
| | | 13. ISO/IEC PWI 23546 | Environmental Data Visualization |
| | | 14. ISO/IEC PWI 23457 | Big Data Visualization |
| | | 15. ISO/IEC PWI 22626 | Motion capture |



ISO activities: WG06 Computer Graphics & Virtual Reality

topics / activities:

- WG6 mirrors the activities of the Web3D consortium
- Web3D Consortium Liaison and WG6 Convenor: Don Brutzman

projects:

Reference	stage type	Document title	WG	Current stage
ISO/IEC CD 19775-2	CD	Information technology — Computer graphics, image processing and environmental data representation — Extensible 3D (X3D) — Part 2: Scene access interface (SAI)	WG 6	30.60
ISO/IEC PWI 22626	PWI	Motion capture	WG 6	00.00



ISO activities: WG07 - Image Processing and Interchange

topics / activities:

- image formats (2D, 3D, volumetric), compression and encoding methods, image interchange standards, metadata integration, compatibility between systems

projects:

Reference	stage type	Document title	WG	stage
ISO/IEC AWI 24940	AWI	Information technology — Computer vision — Terminology	WG 7	20.00
ISO/IEC PRF 12087-5	PRF	Information technology — Image Processing and Interchange (IPI) Functional specification — Part 5: Basic Image Interchange Format (BIIF)	WG 7	50.00

ISO activities: WG08 – Environmental Representation

topics / activities:

- modeling real or virtual environments, geospatial and terrain data standards, representation of physical spaces, data structures for simulation and VR, interoperability of environmental models

projects:

Reference	stage type	Document title	WG	stage
ISO/IEC AWI 18024-5	AWI	Information technology — SEDRIS language bindings — Part 5: C ++	WG 8	20.00
ISO/IEC 18026		Information technology — Spatial Reference Model (SRM)	WG 8	60.00



ISO activities: WG09 MAR continuum concepts & reference model

topics / activities:

- Basics, terms, definitions, use cases, business models for MAR

projects:

Reference	stage type	Document title	WG	Current stage
ISO/IEC AWI 18038-2	AWI	Computer graphics, image processing and environmental representation — Sensor representation in mixed and augmented reality — Part 2: Information model	WG 9	20.00
ISO/IEC AWI 25768	AWI	Information technology — Computer graphics, image processing and environmental data representation — Augmented mutual space representation for remote collaboration	WG 9	20.00
ISO/IEC AWI 25767	AWI	Information technology — Computer graphics, image processing and environmental data representation — Bare-face representation of XR glasses wearers for communication	WG 9	20.00
ISO/IEC DIS 21134	DIS	Information technology — Computer graphics, image processing and environmental data representation — Benchmarking of integrated indoor localization and tracking methods using dead reckoning	WG 9	40.20
ISO/IEC DTR 16088	DTR	Information technology — Computer graphics, image processing and environmental representation — Constructs for visual positioning systems in mixed and augmented reality (MAR)	WG 9	50.20



ISO activities: WG10 Representation and Visualization of Information for Systems Integration

topics / activities:

- visual representation of complex systems, standards for integrating visual and data models, support for decision-making systems, semantic and syntactic interoperability, visualization in command, control, and simulation

projects:

Reference	stage type	Document title	WG	stage
ISO/IEC PWI 26951	PWI	Computer graphics, image processing and environmental data representation — Metaverse — Visual security in the metaverse	WG 10	00.00
ISO/IEC DIS 24931-1	DIS	Information Technology — Metaverse — Part 1: Concepts, definitions and terminology	WG 10	40.00
ISO/IEC PWI 24931-2	PWI	Information Technology — Metaverse — Part 2: Framework and architecture	WG 10	00.00
ISO/IEC PWI 24931-3	PWI	Information Technology — Metaverse — Part 3: Use cases	WG 10	00.00
ISO/IEC PWI 24931-4	PWI	Information Technology — Metaverse — Part 4: Reference model	WG 10	00.00
ISO/IEC PWI 24931-5	PWI	Information Technology — Metaverse — Part 5: Information mode	WG 10	00.00
ISO/IEC PWI 24931-6	PWI	Information Technology — Metaverse — Part 6: Metaverse governance	WG 10	00.00
ISO/IEC PWI 23546	PWI	Environmental Data Visualization	WG 10	00.00
ISO/IEC PWI 23457	PWI	Big Data Visualization	WG 10	00.00
ISO/IEC DIS 20538	DIS	Information technology — Computer Graphics, image processing and environmental data representation — Human information data model for VR-based smart cities	WG 10	40.00



ISO activities: WG11 Health Safety Security Usability of AR and VR

topics / activities:

- ISO/IEC 5927:2024 Computer graphics, image processing and environmental data representation - Augmented and virtual reality safety — Guidance on safe immersion, set up and usage

projects:

Reference	stage type	Document title	WG	stage
ISO/IEC AWI 23595	AWI	Computer graphics, image processing and environmental data representation - User Experience Design in AR/MR/VR	WG 11	20.00
ISO/IEC PWI 23554	PWI	Computer graphics, image processing and environmental data representation - Privacy Policy Requirements in Modelling and Simulation Environments	WG 11	00.00



ISO activities: JWG 12 VRARMR based ICT Integration Systems standards

topics / activities:

- VAR based learning: Information modeling, Terminology and concepts

projects:

Reference	stage type	Document title	WG	stage
ISO/IEC DIS 9234	DIS	Information technology — Information modelling for VR/AR/MR based learning, education and training systems	JWG-12	40.60
ISO/IEC NP 25689	NP	Information technology — Use case classification for VR/AR/MR based learning, education and training	JWG-12	10.60
ISO/IEC PWI 23620-2	PWI	Information technology - VR/AR/MR based information systems for learning, education, and training — VR/AR/MR based information systems for learning, education and training — Part 2: Reference model	JWG-12	00.00
ISO/IEC PWI 23620-4	PWI	Information technology - VR/AR/MR based information systems for learning, education, and training — VR/AR/MR based information systems for learning, education and training — Part 4: Virtual human model	JWG-12	00.00
ISO/IEC PWI 26952	PWI	Information technology — Use cases and design guidelines for VR/AR/MR based learning, education and training	JWG-12	00.00
ISO/IEC CD 23620-1	CD	Information technology - VR/AR/MR based information systems for learning, education, and training — VR/AR/MR based information systems for learning, education, and training — Part 1: Terminology and concepts	JWG-12	30.60
ISO/IEC PWI 23620-3	PWI	VR/AR/MR based information systems for learning, education and training — Part 3: Virtual environment model	JWG-12	00.00



ISO (JTC1 SC24 and further) work in progress

1. [ISO 3151-2 Visualization elements of PLM-MES interface. Part 2: 3D error feedback in heavy industry](#)
2. [ISO, IEC 4932 Information technology — Learning, education and training — Access For All Metadata: Accessibility Core Properties](#)
3. [ISO 5087-3 Information technology - City data model - Part 3: Service level concepts - Transportation planning](#)
4. [ISO, IEC 5087-4 Information technology - City data model - Part 4: Service level concepts for public health emergencies](#)
5. [ISO, IEC 9234 Information technology — Information modelling for VR AR MR based education and training systems](#)
6. [ISO/IEC JTC1 SC24 9234 Information technology - Information modelling for VR AR MR based learning, education and training systems](#)
7. [ISO 9241-161 Ergonomics of human-system interaction - Part 161: Guidance on visual user-interface elements \(ISO 9241-161:2016\); German version EN ISO 9241-161:2016](#)
8. [ISO 9241-313 Ergonomics of human-system interaction — Part 313: Optical measurement methods for reflective displays](#)
9. [ISO 9241-382 Ergonomics of human-system interaction - Part 382: General requirements for reducing undesirable biomedical effects during visual interactive tasks using head-mounted displays](#)
10. [ISO 9241-391 Ergonomics of human-system interaction — Part 391: Requirements, analysis and compliance test methods for the reduction of photosensitive seizures](#)
11. [ISO, IEC 11034 Information technology - Cloud computing - Trustworthiness in cloud computing](#)
12. [ISO/IEC JTC1 SC24 11072 Information technology - Computer graphics - Computer Graphics Reference Model](#)
13. [ISO/IEC JTC1 SC24 12089 Information technology - Computer graphics and image processing - Encoding for the Image Interchange Facility \(IIF\)](#)
14. [ISO, IEC 16088 Constructs for visual positioning systems in mixed and augmented reality \(MAR\)](#)
15. [ISO, IEC 16248 Information technology - Learning, education, and training - Access-for-All \(AfA\) cognitive and learning difficulties access to resource content \(AfA-cognition-terms\)](#)
16. [ISO 16551 Health informatics — Reference model for VR based clinical practice simulation](#)
17. [ISO/IEC JTC1 SC24 18026 Information technology - Spatial Reference Model \(SRM\)](#)
18. [ISO 19135 Geographic information — Procedures for item registration](#)
19. [ISO, IEC 19274 Information technology — Cloud computing and distributed platforms — Networking in cloud computing and edge computing](#)
20. [ISO, IEC 20151 Information technology — Cloud computing and distributed platforms — Dataspace concepts and characteristics](#)
21. [ISO, IEC 20538 Human Information Data Model for 3D Virtual Smart Cities](#)
22. [ISO, IEC 20996 Information technology - Cloud computing - Cloud service customer business continuity and resilience](#)
23. [ISO, IEC 21134 Benchmarking of integrated indoor localization and tracking methods using dead reckoning](#)
24. [ISO/IEC JTC1 SC24 22626 Motion capture](#)
25. [ISO/IEC JTC1 SC24 23457 Big Data Visualization](#)
26. [ISO/IEC JTC1 SC24 23546 Environmental Data Visualization](#)
27. [ISO/IEC JTC1 SC24 23554 Privacy Policy Requirements in Modelling and Simulation Environments](#)
28. [ISO, IEC 23595 User Experience Design in AR VR MR](#)
29. [ISO/IEC JTC1 SC24 23884 Material property and parameter representation for model-based haptic simulation of objects in virtual, mixed and augmented reality](#)



ISO (JTC1 SC24 and further) work in progress

30. [ISO/IEC JTC1 SC24 24940 Information technology - Computer vision --Terminology](#)
31. [ISO/IEC JTC1 SC24 26951 Computer graphics, image processing and environmental data representation - Metaverse - Visual security in the metaverse](#)
32. [ISO/IEC JTC1 SC24 26952 Computer graphics, image processing and environmental data representation - Use cases and design guidelines for VR AR MR based learning, education and training](#)
33. [ISO 10303-1856 Industrial automation systems and integration - Product data representation and exchange. Part 1856: Annotated 3d model equivalence triangulated shape module](#)
34. [ISO 10303-1857 Industrial automation systems and integration - Product data representation and exchange. Part 1857: Annotated 3d model equivalence display attribute module](#)
35. [ISO 10303-81 Express Query \(EXPRESS-Q\) Language Specification](#)
36. [ISO/IEC JTC1 SC24 12087-5 Information technology - Image Processing and Interchange \(IPI\) Functional specification - Part 5: Basic Image Interchange Format \(BIIF\)](#)
37. [ISO, IEC 18024-5 SEDRIS language bindings - Part 5: C++](#)
38. [ISO/IEC JTC1 SC24 18038-2 Computer graphics, image processing and environmental representation - Sensor representation in mixed and augmented reality - Part 2: Information model](#)
39. [ISO/IEC JTC1 SC24 18042-5 Computer graphics, image processing and environmental data representation - Spatial reference model \(SRM\) language bindings - Part 5: C++](#)
40. [ISO 18126.2 Taxonomy and classification for smart contracts](#)
41. [ISO/IEC JTC1 SC24 19774-1 Information technology - Computer graphics, image processing and environmental data representation - Part 1: Humanoid animation \(HAnim\) architecture](#)
42. [ISO/IEC JTC1 SC24 19774-2 Information technology - Computer graphics, image processing and environmental data representation - Part 2: Humanoid animation \(HAnim\) motion data animation](#)
43. [ISO/IEC JTC1 SC24 19775-2 Information technology - Computer graphics and image processing - Extensible 3D \(X3D\) language bindings - Part 2: Scene access interface \(SAI\)](#)
44. [ISO/IEC JTC1 SC24 19777-1 Information technology - Computer graphics and image processing - Extensible 3D \(X3D\) language bindings - Part 1: ECMAScript](#)
45. [ISO/IEC JTC1 SC24 19777-2 Information technology - Computer graphics and image processing - Extensible 3D \(X3D\) language bindings - Part 2: Java](#)
46. [ISO/IEC JTC1 SC24 19777-3 Information technology - Computer graphics and image processing - Extensible 3D \(X3D\) language bindings - Part 3: C](#)
47. [ISO/IEC JTC1 SC24 19777-4 Information technology - Computer graphics and image processing - Extensible 3D \(X3D\) language bindings - Part 4: Part 4 - C++](#)
48. [ISO/IEC JTC1 SC24 19777-5 Information technology - Computer graphics and image processing - Extensible 3D \(X3D\) language bindings - Part 5: Part 5 - C#](#)
49. [ISO, IEC 20016-1 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](#)
50. [ISO 20435.2 A Framework for Representing Physical Assets using Tokens](#)
51. [ISO, IEC 23090-1 Information technology — Coded representation of immersive media — Part 1: Architectures for immersive media](#)
52. [ISO, IEC 23090-11.2 Information technology — Coded representation of immersive media. Part 11: Network-based media processing implementation guidelines](#)
53. [ISO, IEC 23090-18/CD Amd 2 Information technology — Coded representation of immersive media — Part 18: Carriage of geometry-based point cloud compression data — Amendment 2: Point reliability indication and other improvements](#)
54. [ISO, IEC 23090-23 Information technology — Coded representation of immersive media. Part 23: Conformance and reference software for MPEG immersive video](#)
55. [ISO, IEC 23090-24 Information technology — Coded representation of immersive media — Part 24: Conformance and reference software for scene description](#)



ISO (JTC1 SC24 and further) work in progress

62. [ISO, IEC 23090-24 Part 24: Conformance and reference software for scene description — Amendment 1: Conformance and reference software for scene description on haptics, augmented reality, avatar integration, interactivity and lighting](#)
63. [ISO, IEC 23090-26 Information technology — Coded representation of immersive media — Part 26: Conformance and reference software for carriage of geometry-based point cloud compression data](#)
64. [ISO, IEC 23090-27 Information technology — Coded representation of immersive media — Part 27: Media, renderers, and game engines for render-based systems and applications](#)
65. [ISO, IEC 23090-28 Information technology — Coded representation of immersive media — Part 28: Efficient 3D graphics media representation for render-based systems and applications](#)
66. [ISO, IEC 23090-29 Information technology — Coded representation of immersive media — Part 29: Video-based dynamic mesh coding \(V-DMC\)](#)
67. [ISO, IEC 23090-30 Information technology — Coded representation of immersive media — Part 30: Low latency, low complexity LiDAR coding](#)
68. [ISO, IEC 23090-32 Information technology — Coded representation of immersive media — Part 32: Carriage of haptics data](#)
69. [ISO, IEC 23090-39 Information technology — Coded representation of immersive media — Part 39: Avatar Representation Format](#)
70. [ISO, IEC 23090-5 DIS Information technology — Coded representation of immersive media. Part 5: Visual volumetric video-based coding \(V3C\) and video-based point cloud compression \(V-PCC\)](#)
71. [ISO 23353.3 Blockchain and distributed ledger technologies - Auditing Guidelines](#)
72. [ISO 23516.3 Blockchain and Distributed Ledger Technology - Interoperability Framework](#)
73. [ISO, IEC 23620-1 VR AR MR based information systems for learning, education, and training – Part 1: Terminology and Concepts](#)
74. [ISO/IEC JTC1 SC24 23620-2 VR AR MR based information systems for learning, education and training - Part 2: Reference model](#)
75. [ISO/IEC JTC1 SC24 23620-3 VR AR MR based information systems for learning, education and training - Part 3: Virtual environment model](#)
76. [ISO/IEC JTC1 SC24 23620-4 VR AR MR based information systems for learning, education and training - Part 4: Virtual human model](#)
77. [ISO/IEC JTC1 SC24 24931-1 Computer graphics, image processing and environmental data representation - Metaverse - Part 1: Concepts, definitions and terminology](#)
78. [ISO/IEC JTC1 SC24 24931-2 Computer graphics, image processing and environmental data representation - Metaverse - Part 2: Framework and architecture](#)
79. [ISO/IEC JTC1 SC24 24931-3 Computer graphics, image processing and environmental data representation - Metaverse - Part 3: Use cases](#)
80. [ISO/IEC JTC1 SC24 24931-4 Computer graphics, image processing and environmental data representation - Metaverse - Part 4: Reference model](#)
81. [ISO/IEC JTC1 SC24 24931-5 Computer graphics, image processing and environmental data representation - Metaverse - Part 5: Information model](#)
82. [ISO/IEC JTC1 SC24 24931-6 Computer graphics, image processing and environmental data representation - Metaverse - Part 6: Metaverse governance](#)
83. [ISO, IEC 25005-1 Information technology - Data use in smart cities - Part 1: Framework](#)
84. [ISO, IEC 25005-2 Information technology - Data use in smart cities - Part 2: Use case analysis and common considerations](#)
85. [ISO, IEC 25005-3 Information technology - Data use in smart cities - Part 3: Measurement, evaluation and reporting](#)
86. [ISO, IEC 27091.3 Cybersecurity and Privacy - Artificial Intelligence - Privacy Protection](#)



Technology Trend Report (TTR) on Metaverse

This report describes JTC 1 standards and standardization that can be used in the complete an all-encompassing range of metaverse areas. This document includes discussions of:

- JTC 1 technologies for the metaverse
- Metaverse service areas
- Standards required for the Metaverse
- JTC 1 standards and projects for the Metaverse
- JTC 1 governance for the Metaverse
- JTC 1 strategies for the Metaverse
- Further JTC 1 standards development for the Metaverse

Download unter:

<https://jtc1info.org/slug/jtc-1-technology-trend-report-on-metaverse/>



Table of contents

Executive Summary	1
1 Introduction.....	4
2 Terms and Definitions.....	5
3 Concepts.....	6
3.1 General.....	6
3.2 Metaverse service areas.....	6
3.3 Requirements and relevant standards for metaverse services.....	7
4 JTC 1 Technologies for the Metaverse	11
4.1 General.....	11
4.2 Virtual world	11
4.3 Humanoid avatar	11
4.4 VR/AR/MR based information processing	11
4.5 Knowledge and semantic information processing.....	12
4.6 Cyber security, identity, and authorization for the metaverse.....	12
4.7 AI information processing for the metaverse	13
4.8 ICT integration technologies with industry areas	13
5 JTC 1 Standards and Standardization for the Metaverse.....	15
5.1 General.....	15
5.2 JTC 1/SC 6 Telecommunications and information exchange between systems.....	15
5.3 JTC 1/SC 7 Software and systems engineering.....	15
5.4 JTC 1/SC 24 Computer graphics, image processing and environmental data representation	15
5.5 JTC 1/SC 27 Information security, cybersecurity and privacy protection	16
5.6 JTC 1/SC 29 Coding of audio, picture, multimedia and hypermedia information	16
5.7 JTC 1/SC 32 Data management and interchange	17
5.8 JTC 1/SC 35 User interfaces	18
5.9 JTC 1/SC 36 Information technology for learning, education and training	18
5.10 JTC 1/SC 37 Biometrics.....	18
5.11 JTC 1/SC 38 Cloud computing and distributed platforms.....	18
5.12 JTC 1/SC 39 Sustainability, IT and data centres	19
5.13 JTC 1/SC 40 IT service management and IT governance.....	19
5.14 JTC 1/SC 41 Internet of things and digital twin.....	19
5.15 JTC 1/SC 42 Artificial intelligence	19
5.16 JTC 1/WG 11 Smart cities.....	20
6 Relevant Standardization Activities of Other Groups	21
6.1 ISO/IEC JSEG 15	21
6.2 IEC/TC 100	21
6.3 EC (European Commission).....	21
6.4 IEEE.....	21
6.5 ITU-T Focus Group on Metaverse (FG-MV).....	22

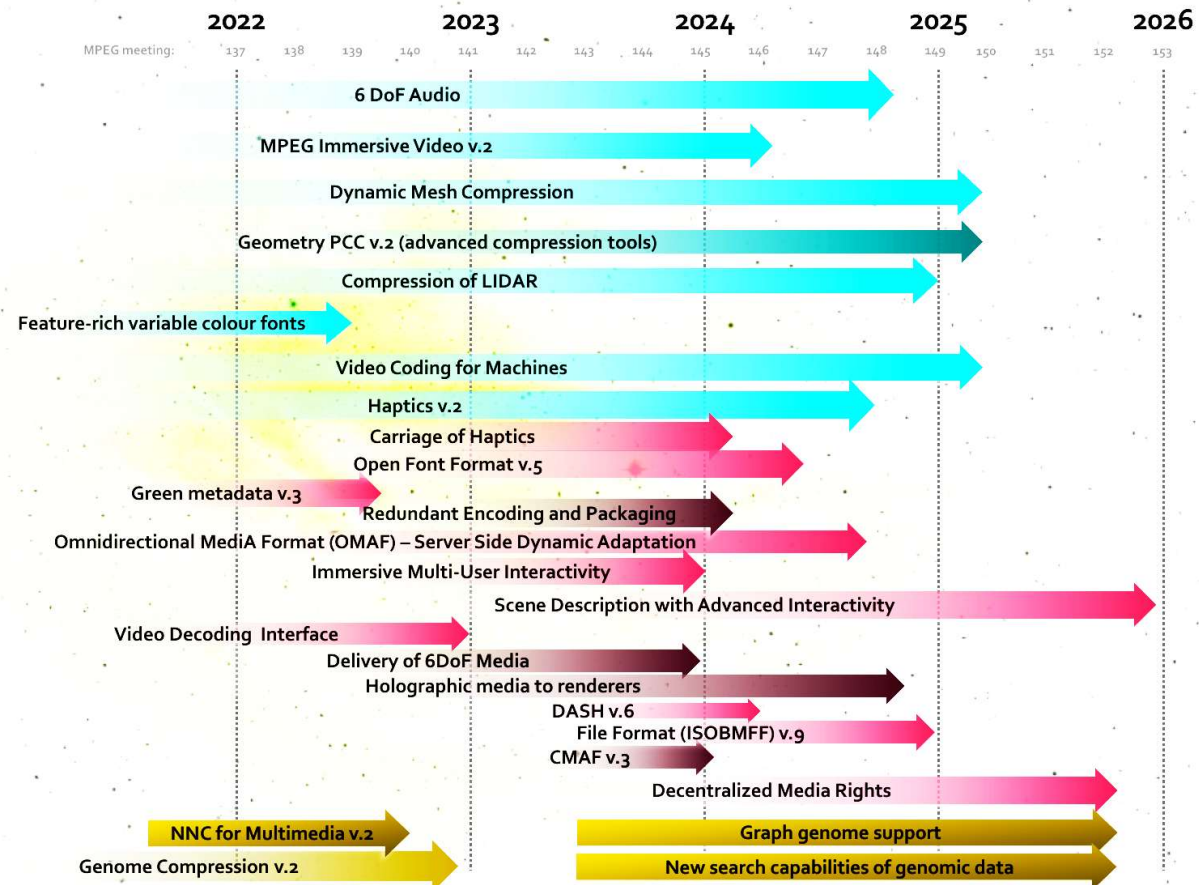
What's further interesting?

Many SDOs publish standardization roadmaps.

These roadmaps provide an excellent, combined perspective on many topics and their corresponding timelines.

This could well help to find a good starting point for an engagement.

Example on the right hand side: the MPEG roadmap



Media Coding

Systems and Tools

Beyond Media

VIRTUAL DIMENSION CENTER

OGC Standards Roadmap

Proposed Standards	SWG Work / Work Item	OAS Review	OGC-NA Review	Public Review	Prepare for Approval	TC Approval to Vote	TC Vote	PC Vote	Public Release
 Abstract Spec Topic 0 04-084									
 Abstract Spec Topic 2 - Referencing by Coordinates 19-005									
 Abstract Spec Topic 20 - Observations, Measurements and Samples 20-082									
 Abstract Spec Topic 21 - DGS v. 2.0 20-040									
 Abstract Spec Topic 22 - Tiling 19-014									
 Abstract Spec Topic 6 - Schema for coverage geometry and functions									
 CDB 1.2									
 CDB 2.0									
 CityGML 3.0									
 CityJSON									
 Common Object Model Container SWG									
 Coverage Implementation Schema - ReferenceableGridCoverage Extension 1.1 19-0036									
 EO Extension for OpenSearch 13-0269									
 EO Product Metadata GeoJSON/JSON-LD Encoding 17-003									
 GeoAPI 09-0034									
 GeoPackage 1.3 12-12816									
 GeoPose									
 GeoTIFF 19-003									
 GroundwaterML2 v2.3 19-013									
 HDF5 Core 18-043									
 IMDF 19-089									
 IndoorGML 1.1 19-011									
 MetOcean Profile and Extensions to WCS 2.1 15-045, 15									
 Moving Features Encoding Extension - JSON 19-045									
 OGC API - Common 19-072									

	SWG Work / Work Item	OAB Review	OGC-NA Review	Public Review	Prepare for Approval	TC Approval to Vote	TC Vote	PC Vote	Public Release
OGC OGC API - Coverages		🗳️							
OGC OGC API - Environmental Data Retrieval 19-086		✅	✅	✅	✅	✅	✅	✅	🗳️
OGC OGC API - Features - Part 1: Core 17-069		✅	✅	✅	✅	✅	✅	✅	✅
OGC OGC API - Features - Part 2: Coordinate Reference System by Reference 16-050		✅	✅	✅	✅	✅	✅	✅	✅
OGC OGC API - Features - Part 3: Filtering and the Common Query Language (CQL) 19-079		✅	✅	🗳️	✅	🗳️			
OGC OGC API - Features - Part 4: Create, Replace, Update and Delete 20-002		🗳️							
OGC OGC API - Features - Part 5: OpenAPI 3.1		🗳️							
OGC OGC API - Maps		🗳️							
OGC OGC API - Processes		✅	✅	✅	✅	🗳️			
OGC OGC API - Records		🗳️							
OGC OGC API - Styles		🗳️							
OGC OGC API - Tiles		🗳️							
Community OpenFlight 16.0		✅	✅	✅	✅	✅	✅	✅	✅
OGC OpenSearch GeoJSON/JSON-LD Response Encoding 17-047		✅	✅	✅	✅	✅	✅	✅	✅
OGC PipelineML 18-073		✅	✅	✅	✅	✅	✅	✅	✅
OGC Semantic Sensor Network Ontology 18-079		✅	✅	✅	✅	✅	✅	✅	✅
OGC SensorML 2.1 12-000r1		✅	✅	✅	✅	✅	✅	✅	🗳️
OGC SensorThings API 1.1 - Part 1 16-006		✅	✅	✅	✅	✅	✅	✅	🗳️
OGC Symbology Conceptual Model: Core 18-067		✅	✅	✅	✅	✅	✅	✅	✅
OGC Time Ontology in OWL 16-071		✅	✅	✅	✅	✅	✅	✅	✅
OGC TimeseriesML 1.3 15-042r6		✅	✅	✅	✅	✅	✅	✅	🗳️
OGC Two Dimensional Tile Matrix Set 17-083		✅	✅	✅	✅	✅	✅	✅	✅
OGC Well Known Text Representation of Coordinate Reference Systems 18-010		✅	✅	✅	✅	✅	✅	✅	✅
Community Zarr		✅	✅	🗳️	🗳️				

Standardization Strategies

What's further interesting?

Some SDOs and more often consultants and policy makers publish standardization requirements.

These requirement analyses could provide a valuable starting point to start own initiatives together with an SDO.

Virtual world requirements	Standardisation initiative
1. Representation and exchange of three-dimensional data assets	■ Graphics Language Transmission Format - glTF (Khronos Group) ■ GL Binary - GLB (Khronos Group) ■ Universal Scene Description - USD (Pixar) ■ COLLABorative Design Activity - COLLADA (Khronos Group) ■ Virtual Reality Modeling Language - VRLM
2. Cross-platform data/asset exchange APIs	■ MPEG-V ■ Khronos 3D Commerce
3. Extended reality (XR), including virtual reality (VR), augmented reality (AR) and mixed reality (MR) APIs and SDK	■ OpenXR (Khronos group) ■ OpenVR (Valve corporation) ■ WebXR (W3C groups)
4. Real/virtual world integration, including positioning and orientation in 3D and 4D space	■ GeoPose (Open Geospatial Consortium - OGC)
5. Avatars/characters interoperability	■ Avatar API (ReadyPlayerMe) ■ HAnim (Humanoid Animation) ■ VRM (Khronos Group)
6. Identity, cybersecurity and privacy preservation	■ Decentralised Identifier - DID ■ OpenID Connect - OIDC ■ OAuth 2.0 ■ InterPlanetary File System - IPFS
7. Networking protocols	■ Hyperspace Modeling Language - HSML
8. Metadata and asset discoverability	■ Cross-platform metadata - XMP (Adobe Systems) ■ Dublin Core

Standards requirements from initiative paper „Next Generation Virtual Worlds“ (European Commission, July 2023)

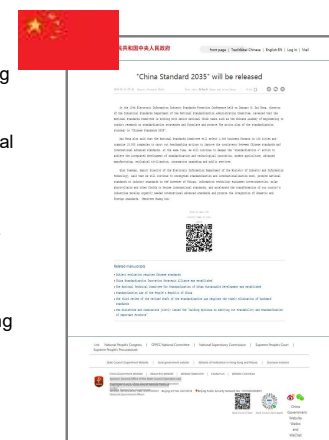
Standardization Strategies: global view



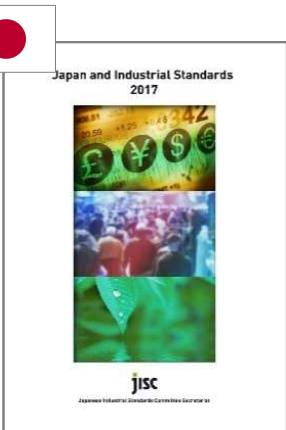
- Actively promote the consistent worldwide application of internationally recognized principles in the development of standards.
- work to prevent standards and their application from becoming technical trade barriers to U.S. products and services.
- Strengthen international outreach programs to promote understanding of how U.S. voluntary, consensus-based, market-driven standards can benefit businesses, consumers, and society as a whole.
- Respect diverse funding models for the U.S. standards system.
- Address the need for standards in support of emerging national priorities.



- supporting the EU's leading position as a forerunner in key technologies and promoting EU core values
- leveraging the European standardization system to deliver on the twin green and digital transition and support the resilience of the single market
- new High-Level Forum for Member States and European standardization organizations
- foster the development and deployment of international standards for a free, open, accessible and secure global internet
- establish an EU internet standards monitoring website
- monitor the effective implementation of existing commitments on standardization in EU trade agreements
- concerned about decision-making in ETSI



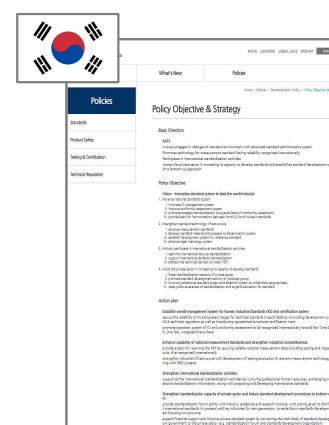
- 15-year plan to shape the future, to set the global standards for the next-generation of technologies.
- pushing domestic firms and experts to be part of the global effort to set standards
- research on China Standardization System, Method and Evaluation
- research on Supporting High-quality Development Standardization System
- research on Standardization Military-Civil Integration Development
- start with the national standards of **virtual reality technology**, integrated circuit design, intelligent health care and 5G key components, and gradually expand to the emerging areas of Internet of Things, photovoltaic, information equipment and other industries.



- Necessity of national standards
- Clarification of appropriate quality levels
- Revisions of the Industrial Standardization Law
- Observance of JIS standards and JIS markings
- Responses to Inappropriate ISO and IEC Standards
- Relationship with Standardization Organizations in Europe
- Support for Strategic Standard Proposal
- Active Contribution to Standardization Activities
- Programs for Developing Standardization Experts in Asia and the Pacific
- Standardization regarding Information Technology, environmental preservation, consumers, elderly people, and people with disabilities, manufacturing technology and industrial platform technology

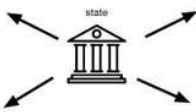
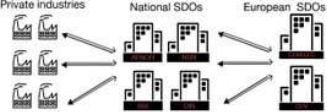


- International and European trade is facilitated by standardization
- Standardization relieves the burden on government regulation and supports it
- Germany is driving forward standardization worldwide in future topics by networking stakeholders, establishing new processes and open platforms for coordination.
- Industry and society are the driving forces in standardization
- Standardization is used as a strategic and attractive tool, especially by companies.
- Standardization has a high status in the public perception

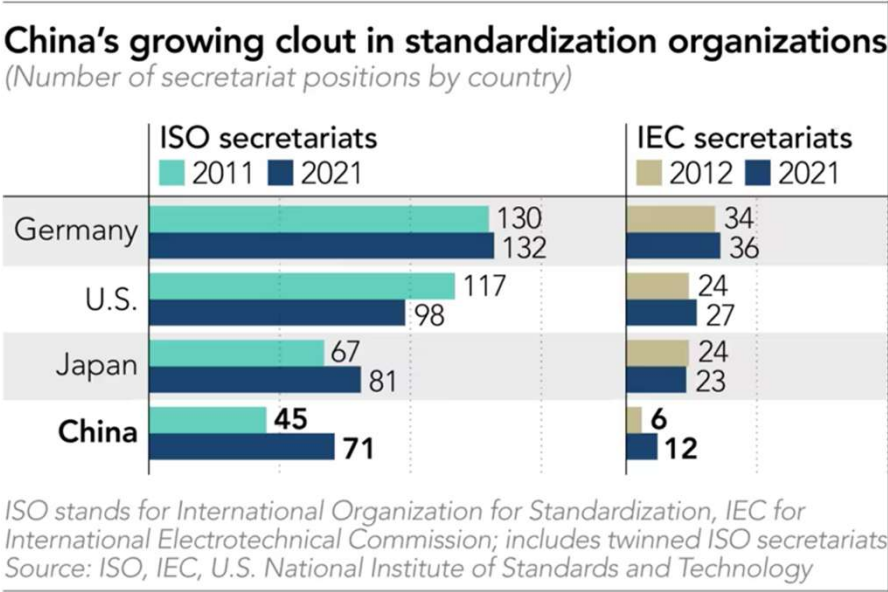


- advance national standards system
- innovate KS management system
- strengthen standard technology infrastructure
- advance measurement standards
- advance legal metrology system
- actively participate in international standardization activities
- lead the international de-jure standardization
- support international de-facto standardization
- address the technical barriers to trade (TBT)
- assist the private sector in increasing its capacity to develop standards
- foster standardization capacity of private sector
- promote standard development activity of producer group

Setting standards in China, Europe and the US

 CHINA a state-driven process  Coordinated by the Standardization Administration of China (SAC), which lies under the State Administration for Market Regulation (SAMR), an arm of the State Council.	 EUROPE a structured, market-driven process  Private industry actors coordinate largely under the auspices of non-governmental standards development organizations (SDOs) at the national and European level. This process typically respects a clear hierarchy.	 UNITED STATES a loose, market-driven process  600 standards development organizations, mostly industry associations, set standards for their industries in the spirit of competition. The American National Standards Institute (ANSI) represents US interests at the international level but plays a comparatively limited role.
--	---	--

Source: John Seaman, "China and the New Geopolitics of Technical Standardization", Notes de l'Ifri, Ifri, January 2020



Conclusion

- as cross-cutting technology, XR standardization is scattered among many organizations: thus hard to get an overview.
- individuals and companies are apparently not totally aware of what's on the table; lack of tech transfer
- state support could be an idea, the national approaches worldwide are different anyhow
- there is already a vast number of XR standards out there.
- they provide an excellent basis to build on, avoiding to re-invent the wheel and ensuring to concentrate on the real innovative aspects of one's work
- standards pave the way for today's and future markets

=> let's use them and extend them, engage!



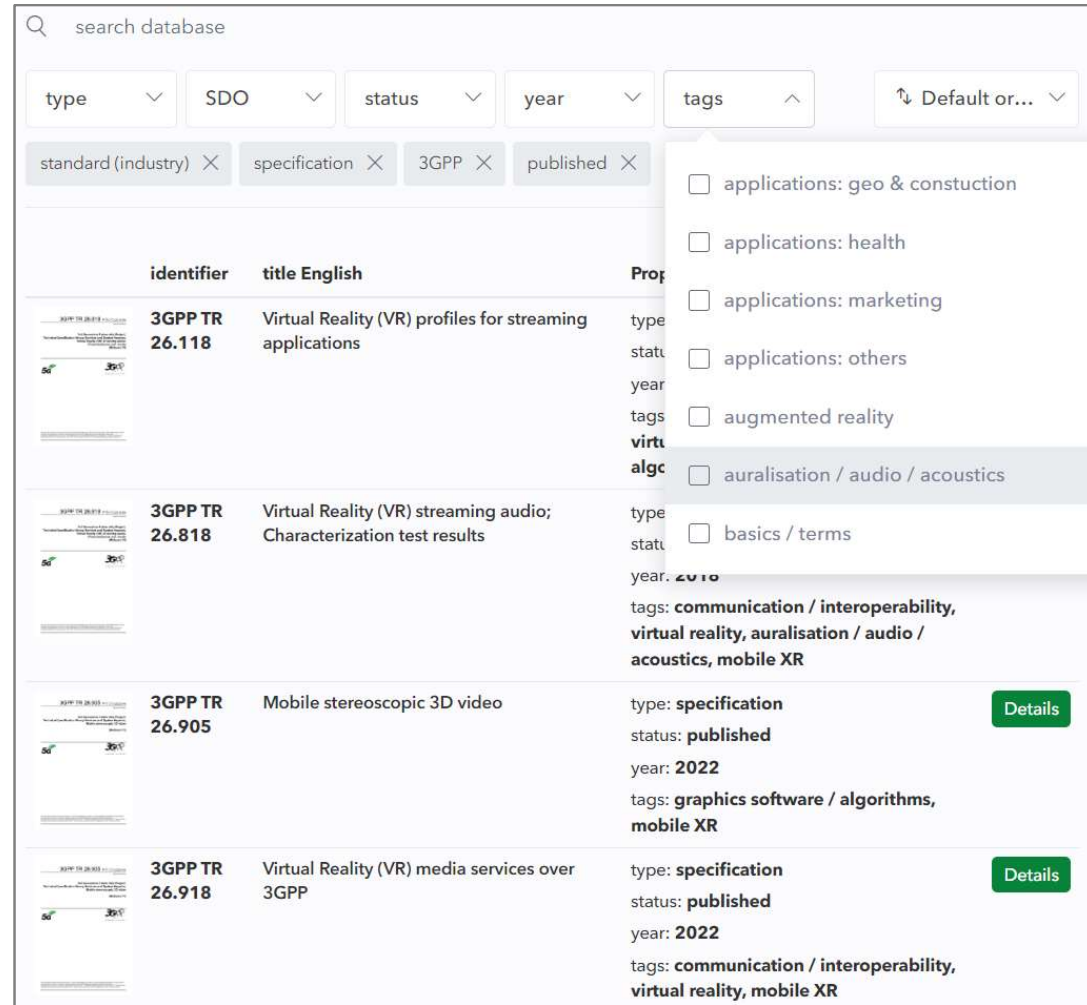
A free, online accessible database for the entire XR community with references to

- 1.500 XR standards, specifications, guidelines and recommendations
- 350 standardization working groups
- 140 SDOs

They are qualified (by tags) and with a searchable description. The group's entry further comprises the organizing/leading SDO and a link to this resource in the WWW.

Please support by adding standards and SDOs.

We may offer database as an iFrame for interested organizations' websites.



The screenshot displays the 'search database' interface. At the top, there are dropdown menus for 'type', 'SDO', 'status', 'year', and 'tags', along with a 'Default or...' button. Below these are filter buttons for 'standard (industry)', 'specification', '3GPP', and 'published'. The main table lists standards with columns for 'identifier', 'title English', and 'Properties'. A detailed view of a standard is shown on the right, including its type, status, year, and tags.

identifier	title English	Properties
3GPP TR 26.118	Virtual Reality (VR) profiles for streaming applications	type: specification status: published year: 2022 tags: communication / interoperability, virtual reality, auralisation / audio / acoustics, mobile XR
3GPP TR 26.818	Virtual Reality (VR) streaming audio; Characterization test results	type: specification status: published year: 2022 tags: communication / interoperability, virtual reality, auralisation / audio / acoustics, mobile XR
3GPP TR 26.905	Mobile stereoscopic 3D video	type: specification status: published year: 2022 tags: graphics software / algorithms, mobile XR
3GPP TR 26.918	Virtual Reality (VR) media services over 3GPP	type: specification status: published year: 2022 tags: communication / interoperability, virtual reality, mobile XR

search for actual standards

- example: search for published standard from ANSI and CTA

search database

type SDO status tags Default order

standard (industry) X standard (official) X technical report X ANSI X CTA X published X Reset all

identifier	title English	Properties
 ANSI/CTA 2085	Definitions and Characteristics for VR Video and VR Images	type: standard (official) status: published year: 2019 tags: basics / terms, virtual reality, graphics software / algorithms Details
 ANSI/CTA 2087	Recommendations and Best Practices for Connection and Use of Accessories for XR Technologies	type: standard (official) status: published year: 2019 tags: XR management, virtual reality, augmented reality, ergonomics / usability, other XR hardware, applications: others Details
 ANSI/HFES 100-2007	Human Factors Engineering of Computer Workstations	type: standard (official) status: published year: 2007 tags: evaluation / conformity, ergonomics / usability, graphics hardware / optics / displays Details
 CTA 2095	Best Practices for Limited Mobility in XR	type: standard (industry) status: published year: 2021 tags: XR management, regulation / ethics / governance, virtual reality, augmented reality, user experience (UX) / user interface design (UID) Details
 CTA 2103	Best Practices for Diversity in XR	type: standard (industry) status: published Details

search for recommendations

- example: search for recommendations on regulation / ethics / governance

search database

type SDO status tags Default order

recommendation / guideline X regulation / ethics / governance X Reset all

identifier	title English	Properties
 ConnectSafely MV & Parents	Metaverse and Virtual Reality Safety Tips for Parents	type: recommendation / guideline status: published tags: regulation / ethics / governance, applications: entertainment / culture Details
 Council of the European Union Metaverse	Metaverse - Virtual World, Real Challenges	type: recommendation / guideline status: published year: 2022 tags: XR management, regulation / ethics / governance, virtual reality, augmented reality Details
 Cyber-XR Coalition Cyber XR-2020-1.0	Immersive Technology Standards for accessibility, inclusion, ethics, and safety	type: recommendation / guideline status: published year: 2020 tags: regulation / ethics / governance Details
 European Parliament Metaverse	Metaverse Opportunities, risks and policy implications	type: recommendation / guideline status: published year: 2022 tags: XR management, regulation / ethics / governance, virtual reality, Details

search for upcoming standards

- example: search for standards with status “draft” or “work in progress” in the field of graphics hardware / optics / displays

search database

type: SDO status: tags: Default order

specification X standard (industry) X standard (official) X draft X work in progress X

graphics hardware / optics / displays X Reset all

identifier	title English	Properties
 IEC 62629-1-3	future IEC/TR 62629-1-3 ED1: 3D display devices - Part 1-3: Depth perception and determination of the position of 3D object on the non-physical screen	type: standard (official) status: work in progress tags: interaction / patterns, graphics hardware / optics / displays
 IEC 62629-1-3 ED1	3D display devices - Part 1-3: Depth perception and determination of the position of 3D object on the non-physical screen	type: standard (official) status: work in progress tags: graphics hardware / optics / displays
 IEC 62629-502-1	3D Display devices - Measurement method of plane-symmetrical real-image-forming optics for aerial display	type: standard (official) status: work in progress year: 2023 tags: evaluation / conformity, graphics hardware / optics / displays
 IEC 62629-52-1 ED1	3D Display devices - Part 52-1: Fundamental measurement methods of aerial display - Optical	type: standard (official) status: work in progress year: 2024 tags: evaluation / conformity, graphics hardware / optics / displays
 IEC 62629-62-12 ED1	3D display devices - Measurement methods for virtual-image type - Image Quality	type: standard (official) status: work in progress year: 2024

search for SDOs and working groups

- example: search for standards development organizations (SDOs) and working groups in the field of education and engineering

search database

type: SDO status: tags: Default order

SDO X working group X applications: education / training X applications: design / engineering X Reset all

identifier	title English	Properties
 AREA	Interoperability and Standards program	type: SDO year: 2013 tags: XR management, evaluation / conformity, augmented reality, applications: education / training, applications: design / engineering, applications: assistance, applications: others
 ASAM	Association for Standardization of Automation and Measuring Systems	type: SDO year: 1998 tags: evaluation / conformity, communication / interoperability, applications: design / engineering
 BDSV	BDCG Simulation	type: working group tags: applications: education / training
 DIN	DIN Work Innovation	type: working group tags: applications: education / training, applications: design / engineering, applications: collaboration, applications: others
 DIN	DIN I4.0	type: working group tags: applications: design / engineering, applications: others
 DIN	DIN NIA	type: working group tags: applications: education / training, applications: design / engineering, applications: health, applications: assistance, applications: collaboration, applications: marketing, applications: entertainment / culture, applications: geo & construction, applications: others
ETSI ISG-ARF	Industry Specification Group (ISG)	type: working group

standICT.eu: calls each 3 months



StandICT.eu will provide € 2,925,000 of crucial funding to support the participation of European standardisation specialists in key international and global SDOs. Through nine open calls this funding will enable the specialists to contribute to and help create a fully integrated European Standardisation Ecosystem, thereby strengthening Europe's position in global standardisation initiatives.

...

Topics list:

- ...
- **Web 4.0 and virtual worlds**

Three types of proposals can be funded under the StandICT.eu 2026 Open Calls, as shown below

Proposal type: LT – Long term contribution (with travel option)

Description: Contribution to ongoing standards development as a chair, convener, rapporteur or member of an SDO WG. E.g. comments on standards development and drafts, attending meetings also as an observer, paying membership fees.

Maximum Contract Duration: 6 months

Funding Range: Up to €10,000

Proposal type: ST – Short-Term contributions (with travel option)

Description: Contribution to standards documentation e.g. liaison to WG, comments on standards drafts, participation at meeting paying membership or registration fees.

Maximum Contract Duration: 3 months

Funding Range: Up to €5,000

Proposal type: OS – One-Shot contributions

Description: Support to ensure participation at workshop or event (e.g., participant, observer, presentation)

Maximum Contract Duration: 3 months

Funding Range: Up to €3,000

Please do note that the maximum funding requested per proposal cannot exceed that indicated for the respective type of application (LT, ST, OT), nor can the duration exceed that indicated.

Thank you very much for your attention.



*„Without standards,
there can be no improvement.“*

Ōno Taiichi

(* 29 February 1912 in Manchuria; † 28 May 1990) was the inventor of the Toyota production system. He developed today's basic logistics methods, the Kanban system and just-in-time production, between 1950 and 1982. The Japanese management concept Kaizen is also based on his ideas.



Thank you for your attention.

XR Standardization