SEEBLOCKS.eu

Supporting Europe's effort in Blockchain/DLT Standardisation

Teaching Module 2 (Basic)
Role of standards in ICT with a focus on blockchain

Funded by
the European Union

SEEBLOCKS.eu
Supporting Europe's effort in Blockchain/DLT Standardisation

Contents

General Information

- Accompanying textbook:
  - Understanding ICT Standardization: Principles and Practice (Published 2021)
    - Includes supporting material, e.g. quizzes to prove knowledge
    - More detailed information about the topics
    - Available at: www.etsi.org/standardization-education

Role of standards in ICT

- The learning objectives of this lecture are:
  - To know the various **functions of standards**
  - To understand **Compatibility/ Interface Standards, Minimum Quality/ Safety Standards, Variety Reduction Standards, and Information/ Measurement Standards**
  - To be able to **apply the different types of standards to ICT specific topics**
  - To be able to apply the insights on functions of standards in general and ICT standards in particular to **blockchain standards**

1 Introduction

1. Introduction

- Standards support everyday private and professional life much more than people think
- Society recognized importance of standardised measurements thousands of years ago: e.g. weight, distance or length
- Development of common reference systems agreed within and across societies

1. Introduction

- Rapid technological progress → need for new standards, but also update of existing standards grows
- Dynamics especially high in Information and Communications Technologies (ICT)
- Standardisation and standards boost progress and create basis upon which technology, but also science can evolve

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

- The most general definition for a «standard» may be

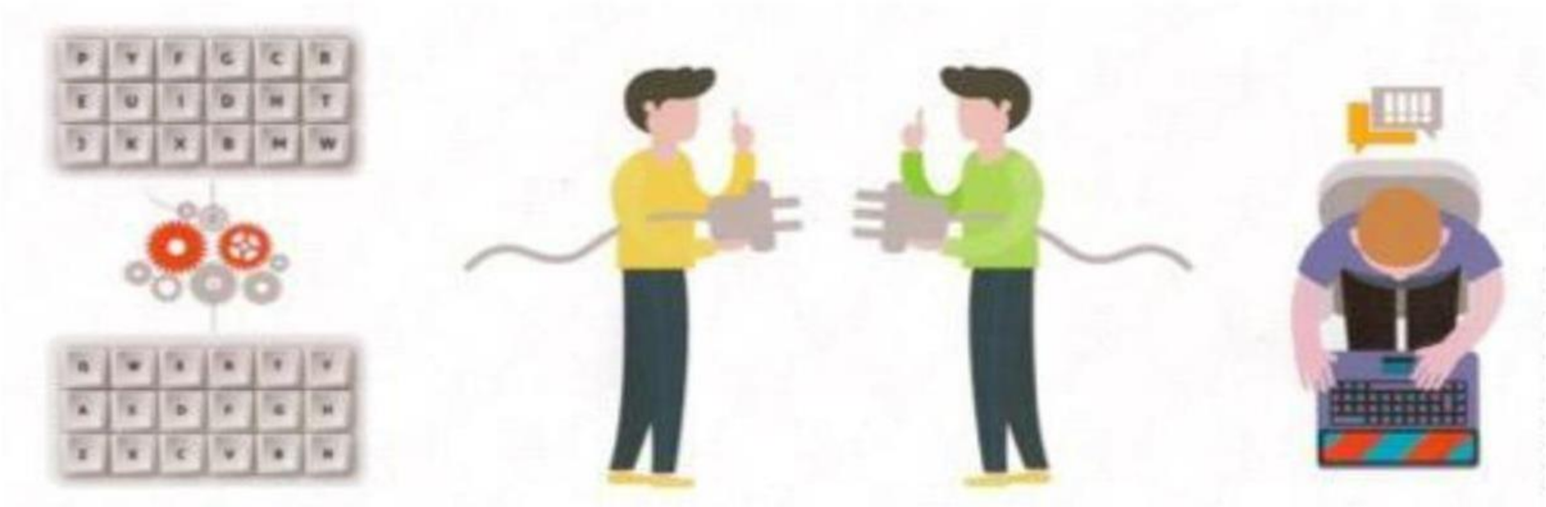
  «**a widely agreed way of doing something**» .....

.... 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 much 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 the next slide)

each device had its own protocol for interoperation

2. Basics of standards
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.

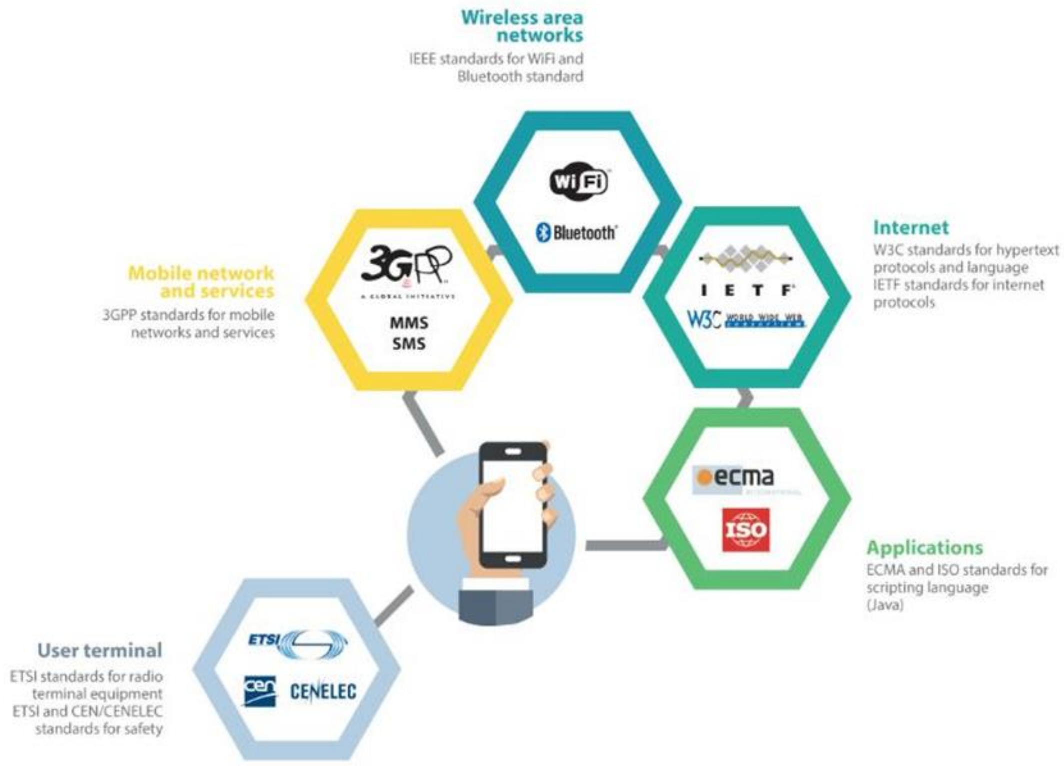
SDO standards are produced by devoted organizations, called Standards Development Organizations (SDOs). SDOs are organizations whose main purpose is to develop standards. They have that put in place formal well-defined procedures to guarantee a fair development process.

ETSI ISO IEC ITU

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 probably deployed standards):
  - User equipment, e.g. hardware characteristics and safety/security aspects
  - Connectivity between user devices and wireless network, functionality of this network
  - Internet access and the protocols to support web browsing



2. Basics of standards
Standards in everyday life

- Using a Personal Computer (some probably deployed standards)

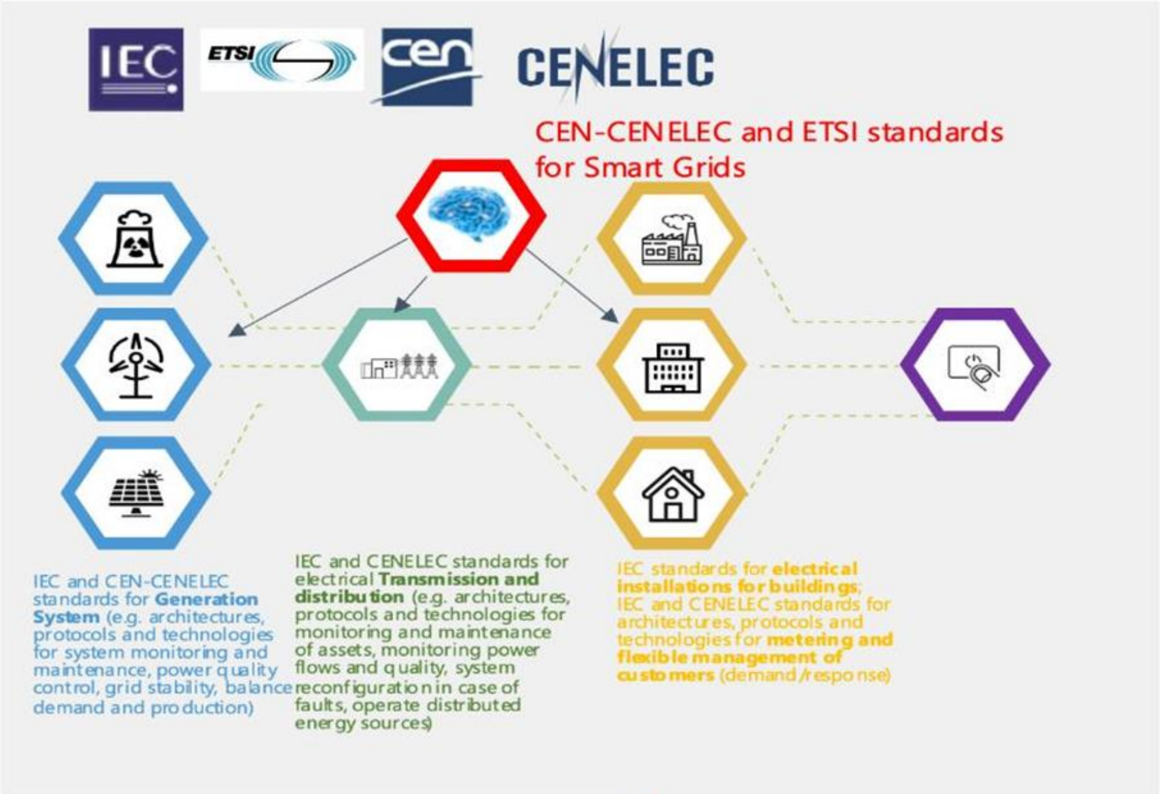
A 2010 paper (Biddle & al., 2010) identifies 251 technical interoperability standards implemented in a laptop computer, but total number estimated to be over 500

Out of the 251 identified standards, "202 (80%) were developed by SDOs and 49 (20%) by individual companies"

Standards in everyday life

- Switching on lights

(some of the standards deployed)



3. Effects of standards

	Positive Effects	Negative Effects
Compatibility/ Interface Standards	• Network externalities, like enabling seamless global communication • Avoiding lock-in in old technologies • Increased variety of system products • Efficiency in supply chains	• Anti-competition, leading to monopoly • Lock-in in old technologies in case of strong network externalities
Minimum Quality/ Safety Standards	• Avoiding adverse selection, i.e. supply of bad quality drives out good quality • Creating trust • Reducing transaction costs	• Regulatory capture • Increasing barriers to entry
Variety Reduction Standards	• Economies of scale • Building focus and critical mass	• Reduced choice • Leading to monopoly, barriers to market access
Information/ Measurement Standard	• Facilitating trade • Reduced transaction costs • Providing codified knowledge	• Regulatory Capture

Source: Swann (2000), Pham (2006), Blind (2013), modified

3. Effects of standards

	Positive Effects	Negative Effects
Compatibility/ Interface Standards	• Network externalities, like enabling seamless global communication • Avoiding lock-in in old technologies • Increased variety of system products • Efficiency in supply chains	• Anti-competition, leading to monopoly • Lock-in in old technologies in case of strong network externalities
Minimum Quality/ Safety Standards	• Avoiding adverse selection, i.e. supply of bad quality drives out good quality • Creating trust • Reducing transaction costs	• Regulatory capture • Increasing barriers to entry
Variety Reduction Standards	• Economies of scale • Building focus and critical mass	• Reduced choice • Leading to monopoly, barriers to market access
Information/ Measurement Standard	• Facilitating trade • Reduced transaction costs • Providing codified knowledge	• Regulatory Capture

Source: Swann (2000), Pham (2006), Blind (2013), modified

3. Effects of standards
Compatibility / Interface Standards

- Compatibility

An essential role of standards is to ensure compatibility.

- Compatibility includes two sub characteristics (ISO 25010):
  - **Coexistence:** An IT service/product sharing a common environment and resources with other independent services/products without adverse side effects
  - **Interoperability:** Ability of those components to work constructively with one another

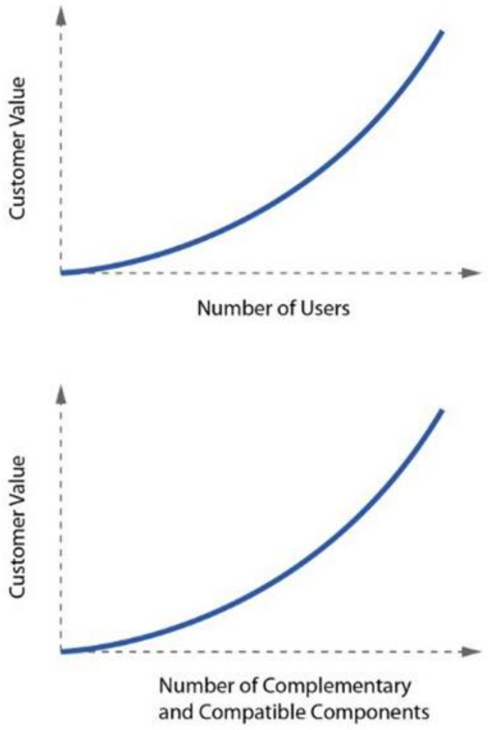
3. Effects of standards
Compatibility / Interface Standards

- Developments in the ICT sector demonstrate the economic importance of compatibility/interface
- Two economic phenomena can influence customers and producers in such markets:
  - **Network effects**
  - **Switching costs**
- If both exist, there is a risk that another economic phenomenon occurs:
  - **Lock-in effect**

- Network effects – two forms:
  - **Direct:** The value of a good/ services increases with the number of people using it

  Examples: Telephone, e-mail, Facebook, X, …
  - **Indirect:** The value of a good/service does not depend directly on the number of users but rather on the availability of complementary and compatible components

  Examples: Video game consoles, computer hardware and software, …



Source: Greenstein and Stango (2008)

3. Effects of standards
Compatibility / Interface Standards

- Switching costs:

Once producers or customers have invested into a particular interface or standard, switching to another one will become increasingly expensive

- Examples:
  - **Acquisition costs:** When new equipment has to be bought or adapted
  - **Training costs:** Associated with learning to use a new product
  - **Testing costs:** If there is uncertainty regarding the suitability of alternative products/services

Source: Parr et al. (2005)

3. Effects of standards
Compatibility / Interface Standards

- Lock-in: Markets and companies can get locked into inferior products/services/technologies because producers and customers will only switch to a better design if:
  - All others do so, too
  - They can afford the switching costs
- If one of the two conditions is not satisfied, a lock-in will occur
- If a standard has not been developed according to the principles of formal standardization and is owned by one single organization, lock-in is more likely to occur, because one party has full control over the standard.
- **For the markets, lock-ins mean:**
  - Barriers to market entry
  - Monopolies

Source: Parr et al. (2005), de Vries et al. (2008)

3. Effects of standards
Compatibility / Interface Standards

Lock-in Examples:

Microsoft (Windows API, file formats etc.)

Microsoft

Regarding the Windows API, Microsoft's general manager for C++ development Aaron Contorer stated in an internal Microsoft memo for Bill Gates:

"The Windows API […] is so deeply embedded in the source code of many Windows apps that there is a huge switching cost to using a different operating system instead" (European Commission 2004, pp. 126–127).

- **Windows' exclusive franchise:** Windows grants other suppliers the right to use the Windows API (application programming interface) to produce systems according to its specifications
- The strategic role of API is to maintain network effects and block competition
- Use of proprietary file formats in Microsoft's application software drives the lock-in effect.

Source: Deek and Am McHugh (2007)

Lock-in Examples:

Apple Inc. (iPod)

- Digital music files with DRM (digital rights management) are purchased from Apple's iTunes store in proprietary AAC format only compatible with Apple Music media player software
- Users could not play purchased music in other software environments
- After the launch of the iPod in 2001 and following a licence deal with major music labels, Apple controlled almost 75% of US market for paid downloads
- DRM conditions and incompatibility with other music players caused conflicts with consumer rights
- After several suits for “unlawful bundling” DRM has been removed from digital music files since 2009

Source: based on Raustiala and Springman (2012)

3. Effects of standards
Compatibility / Interface Standards

- **Open standards** have several positive effects on the market
- Whether or not a standard is considered as open depends on the openness of the standardization process
  - In an open standardization process, any entity, be it an organization or individual, can participate in the creation of the standard.
  - The output of an open standardization process is an open standard.
  - As formal standardization process is expected to meet all World Trade Organization (WTO) principles of standardization, i.e. transparency, openness, impartiality, consensus, efficiency, relevance and consistency.
- With an open standard, the risk of lock-in is reduced, because the standard is accessible and implementable, leading to lower barriers to entry and lower switching costs for consumers.

"[…] it is better to have a share of a large market than a monopoly of a tiny one." Swann (2000), p.5

3. Effects of standards
Compatibility / Interface Standards

- Compatibility standards help to reduce transaction costs: If buyers know that a particular piece of software is compatible with a particular operating system, the burden to verify that the software will run as expected is significantly reduced
- These reductions of transaction costs also facilitate division of labour; example from the computer industry:
  - A computer contains components from all over the world
  - Internationally accepted compatibility standards have led to a complete globalization of the industry
  - Producers specialize in a small part of the value chain to achieve economies of scale and sell their products around the world

3. Effects of standards

	Positive Effects	Negative Effects
Compatibility/ Interface Standards	• Network externalities, like enabling seamless global communication • Avoiding lock-in in old technologies • Increased variety of system products • Efficiency in supply chains	• Anti-competition, leading to monopoly • Lock-in in old technologies in case of strong network externalities
Minimum Quality/ Safety Standards	• Avoiding adverse selection, i.e. supply of bad quality drives out good quality • Creating trust • Reducing transaction costs	• Regulatory capture • Increasing barriers to entry
Variety Reduction Standards	• Economies of scale • Building focus and critical mass	• Reduced choice • Leading to monopoly, barriers to market access
Information/ Measurement Standard	• Facilitating trade • Reduced transaction costs • Providing codified knowledge	• Regulatory Capture

Source: Swann (2000), Pham (2006), Blind (2013), modified

3. Effects of standards
Minimum Quality / Safety Standards

- **Minimum quality standards** identify minimum acceptable requirements for the reliability, durability, and safety of products and services, as well as to other fields such as working conditions.
  - They can improve welfare in an economy (also in the areas of health and environment)
  - They help reduce the risk felt by the buyers and increase trust between traders
  - If set at an unnecessarily high level, they can also function as a barrier to entry
- **A minimum quality standard** can relate, for instance, to CO_2 emissions generated through car usage. When adopted by regulation, such standards are compulsory by law, making it necessary for car producers to respect the minimum quality standard.

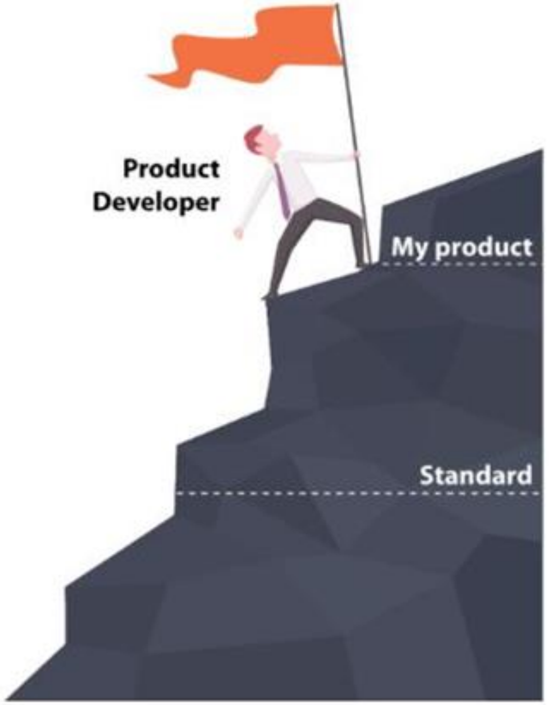
Source: based on Swinnen (2015) and Locksley (1990)

3. Effects of standards
Minimum Quality / Safety Standards

- Customers face a huge variety of different products and find it hard to assess which one is suited for their purpose
- If buyers cannot distinguish between different product variants, it is hard for the quality seller to sustain a price premium (if costs exceed those of low-quality sellers)
- Gresham's law: "bad drives out the good"
- Worst case: The market will break down and lead to market failure

3. Effects of standards
Minimum Quality / Safety Standards

- This problem is due to **information asymmetries**. It arises if one party (e.g., seller) has more or better information than the other (here the buyer), making it hard for the buyer to make an informed decision
- Leland (1979) showed **minimum quality standards can help to overcome information asymmetries**, as they function as a reference and define the minimum requirements a product should fulfil
- Some companies even trade on their reputation and can sustain a price premium because of a quality well above the minimum threshold of a standard
- Ex-post restitution (e.g., a guarantee) can also work as a substitute for a certified minimum quality standard



SEEBLOCKS.eu
Supporting Europe's effort in Blockchain/DLT Standardisation

3. Effects of standards
Minimum Quality / Safety Standards

- Minimum quality standards **reduce transaction and search costs** caused by economic exchange
- If a product is defined in a way that reduces buyer uncertainty:
  - The buyer's risk is reduced
  - Less need for the buyer to spend money and time on evaluating different products before a purchase
- Product certification can function as a shortcut for buyers as it proofs the compliance to a standard

Source: Pham (2006); Swann (2000); Swann (2010)

3. Effects of standards
Minimum Quality / Safety Standards

- What do minimum quality standards mean for new market entrants?
  - General presumption: When a product characteristics are documented in a standard, the playing field between incumbent and entrant gets levelled
  - In the absence of the standard, incumbents have an information advantage over entrants
  - **BUT:** Quality standards can be set at an unnecessarily high level to deter entrants from entry
  - Even if those standards impose a cost burden on incumbents, this strategy can be very effective when the cost burden on entrants is greater still (raising rival's costs or increasing entry barriers)
- The concept of **"regulatory capture"** can be considered as a variant of the "raising rival's costs" concept
- **Basic idea:** Some producers may **lobby to persuade the regulator** to define regulations in their interest rather than in the interest of the buyer/customer (original intention of standards)

3. Effects of standards

	Positive Effects	Negative Effects
Compatibility/ Interface Standards	• Network externalities, like enabling seamless global communication • Avoiding lock-in in old technologies • Increased variety of system products • Efficiency in supply chains	• Anti-competition, leading to monopoly • Lock-in in old technologies in case of strong network externalities
Minimum Quality/ Safety Standards	• Avoiding adverse selection, i.e. supply of bad quality drives out good quality • Creating trust • Reducing transaction costs	• Regulatory capture • Increasing barriers to entry
Variety Reduction Standards	• Economies of scale • Building focus and critical mass	• Reduced choice • Leading to monopoly, barriers to market access
Information/ Measurement Standard	• Facilitating trade • Reduced transaction costs • Providing codified knowledge	• Regulatory Capture

Source: Swann (2000), Pham (2006), Blind (2013), modified

3. Effects of standards
Variety Reduction Standards

- Two main functions:
  - Support of **economies of scale**, by minimizing the proliferation of minimally differentiated models
  - Reduction of **transaction costs** for customers, because they do not have to choose between a vast number of slightly different products
- Many advantages:
  - **Prevention of market fragmentation** and support of a **joint vision**
  - For suppliers, less fragmentation also means reduced risk
  - Variety reduction standards can also reduce barriers to entry
    - Variety proliferation is sometimes used by incumbents to limit competition from small scale entrants who cannot provide the same degree of variety
    - Some incumbents try to restrict entry by companies with an idiosyncratic product specification

3. Effects of standards
Variety Reduction Standards

- Do variety reduction standards need to be defined publicly?
  - **Not necessarily:** Economies of scale (best-known function of this type of standard) can also be obtained with an idiosyncratic model range
  - **But:** A store selling cloth in idiosyncratic sizes will not perform well

3. Effects of standards

	Positive Effects	Negative Effects
Compatibility/ Interface Standards	• Network externalities, like enabling seamless global communication • Avoiding lock-in in old technologies • Increased variety of system products • Efficiency in supply chains	• Anti-competition, leading to monopoly • Lock-in in old technologies in case of strong network externalities
Minimum Quality/ Safety Standards	• Avoiding adverse selection, i.e. supply of bad quality drives out good quality • Creating trust • Reducing transaction costs	• Regulatory capture • Increasing barriers to entry
Variety Reduction Standards	• Economies of scale • Building focus and critical mass	• Reduced choice • Leading to monopoly, barriers to market access
Information/ Measurement Standard	• Facilitating trade • Reduced transaction costs • Providing codified knowledge	• Regulatory Capture

Source: Swann (2000), Pham (2006), Blind (2013), modified

3. Effects of standards
Information / Measurement Standard

- **Information and measurement standards:** Standards that contain codified knowledge and product descriptions
- These standards an be seen as **important instruments of technology transfer** as they…
  - …contain the work and experience of generations
  - …act as instruments in the dissemination of best practices

3. Effects of standards
Information / Measurement Standard

- Information and measurement standards have a positive effect on the market by **disseminating knowledge.** They support…
  - …building up competencies
  - …spreading essential production knowledge, thus levelling the playing field for incumbents and entrants
  - …reducing information asymmetries
  - …reducing barriers to market entry
- These standards lower transaction costs between companies and contractors, e.g. employees, suppliers and customers, by providing a common language and therefore…
  - …ease the writing of job descriptions, contracts etc.
  - …achieve a feasible division of labour

3. Effects of standards
Example: Digital Image compression

- During 1990s: rapid diffusion of image and video processing applications and advancement of multimedia technologies
  - ➢ Increased importance of compression methods
- International SDOs developed several standards describing different compression methods, e.g. JPEG (“Joint Photographic Experts Group”)
  - ➢ Offered new solutions for saving storage place and reducing transmission rate requirements to industry
- Many software products are based on these compression methods, e.g. sharing of digital images, remote sensing, archiving, image search

Source picture: Schelkens (2015)

Source: ANSI (n.d.)

4. Categories and Examples of Blockchain and DLT Standards

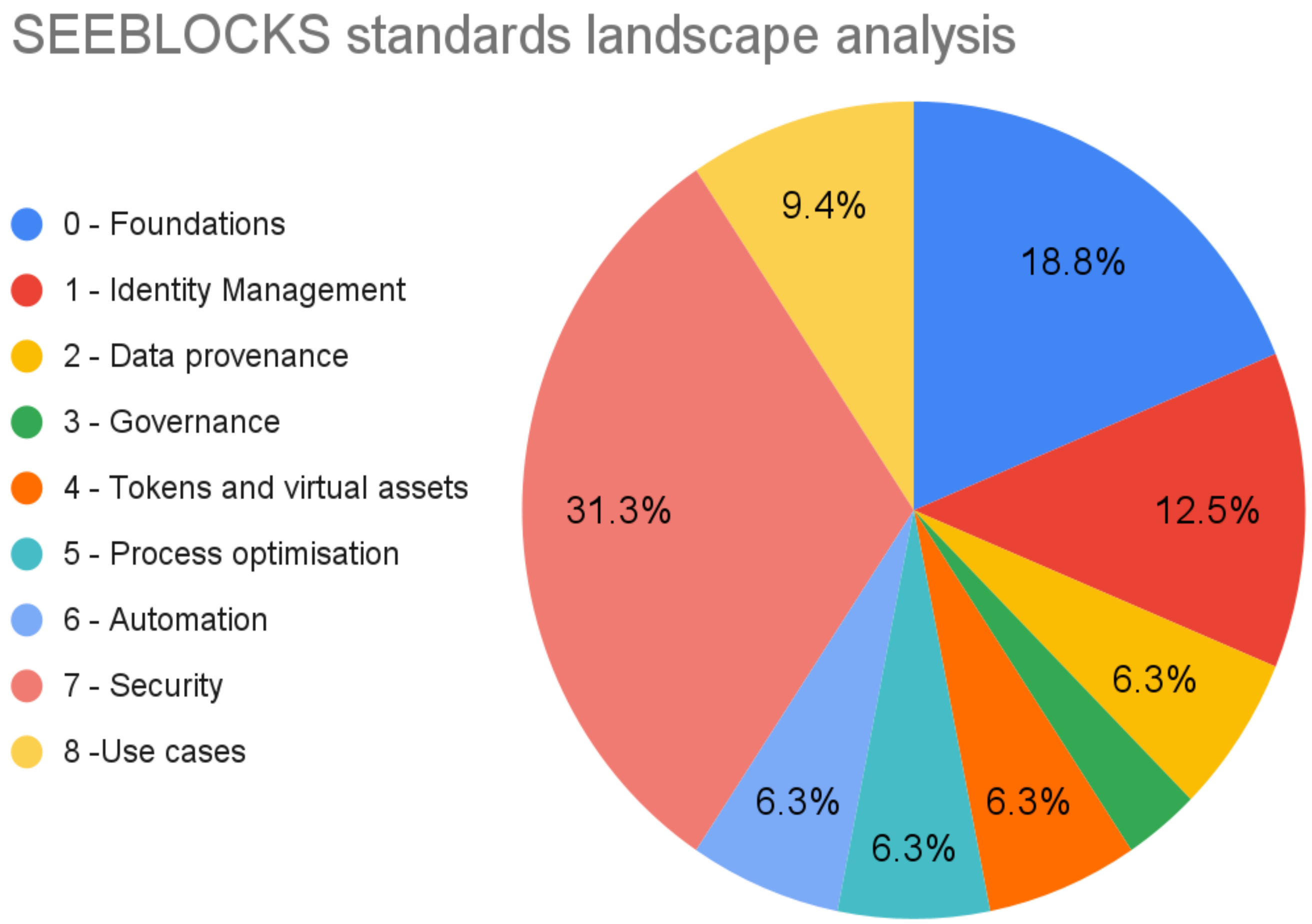
- In the following section, we present various types of blockchain and DLT standards
- They have their origin either in ISO/TC 307 Blockchain and distributed ledger technologies, the ETSI Industry Specification Group (ISG) Permissioned Distributed Ledger (PDL), but also the Ethereum Improvement Proposals (EIPs)

4. Categories of Blockchain Standards

- Identity management (e.g., self-sovereignty; privacy; anonymity; account abstraction; secure wallet management);
- Data provenance (e.g., on/off-chain data flows; data trustworthiness; verifiable oracle services/registries);
- Governance (e.g., stakeholder reputation including roles, rights and responsibilities; online voting; DAOs; peer-to-peer virtual communities);
- Token and asset creation and exchange (e.g., cryptocurrency; virtual assets; fungible and non-fungible tokens; exchange protocols);
- Process optimisation (e.g., process transparency; multi-party, interoperable, cloud-based resource-sharing; 5G and mobile edge computing; energy-efficiency);
- Automation (e.g., smart contracts; intelligent agency; robotics);
- Cybersecurity and applied game theory (e.g., open source, distributed and decentralised system architectures; end-point security; encryption; consensus mechanisms);
- Use cases that elaborate these niches or other relevant domains

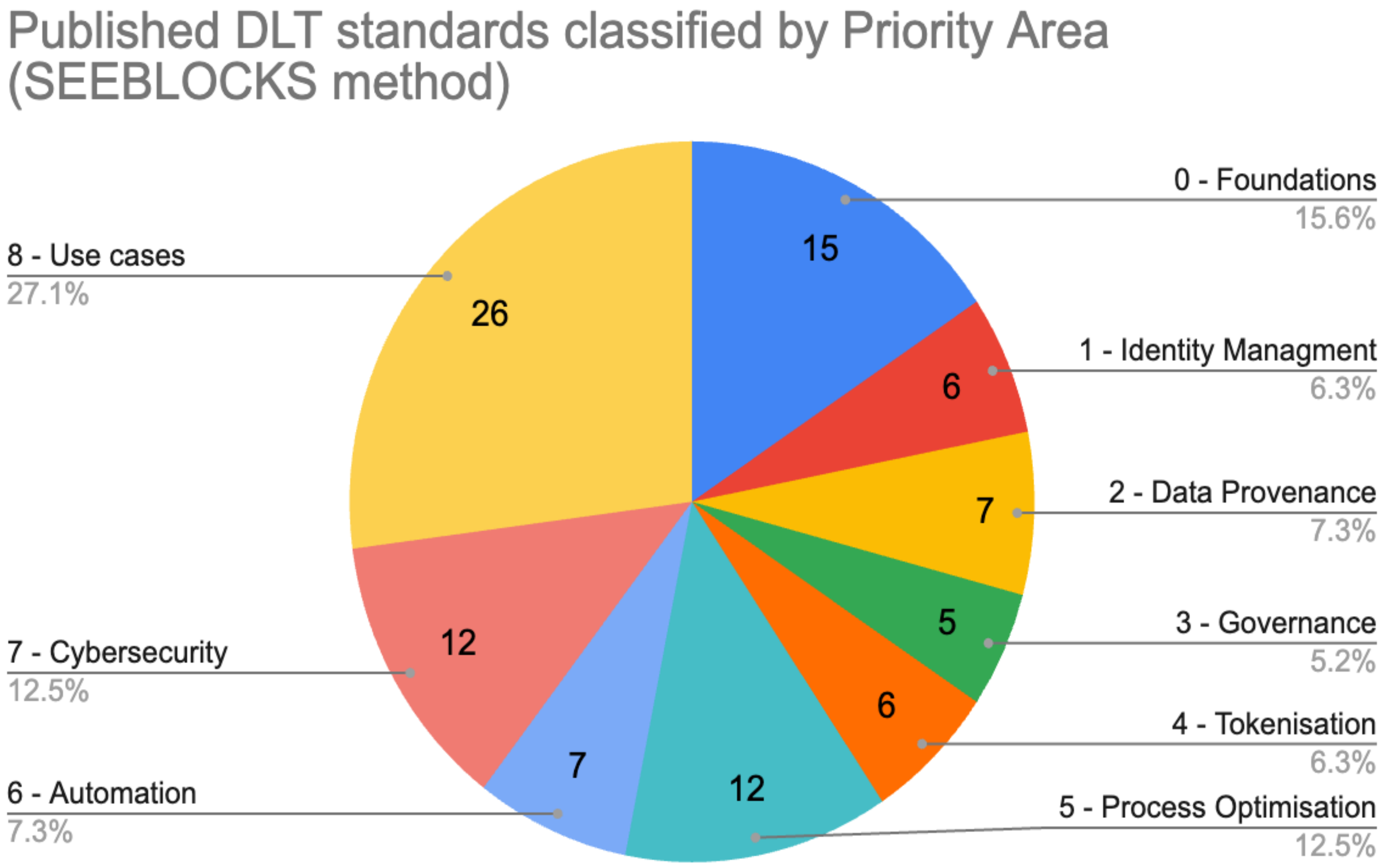
Source: SEEBLOCKS (2023): D3.1 Blockchain and DLT standardisation landscape report

4. Breakdown of published, emerging, and transversal Blockchain standards based on review conducted 2023



Source: SEEBLOCKS (2023): D3.1 Blockchain and DLT standardisation landscape report

4. Breakdown of published, emerging, and transversal Blockchain standards based on review conducted 2024



Source: SEEBLOCKS (2024): D3.3 Landscape & Gap Analysis Report on Blockchain - Mid Term

4. Standards published by ISO TC 307

- ISO/TR 3242:2022 Blockchain and distributed ledger technologies – Use cases
- ISO/TR 6039:2023 Blockchain and distributed ledger technologies — Identifiers of subjects and objects for the design of blockchain systems
- ISO/TR 6277:2024 Blockchain and distributed ledger technologies — Data flow models for blockchain and DLT use cases
- ISO 22739:2024 Blockchain and distributed ledger technologies — Vocabulary
- ISO/TR 23244:2020 Blockchain and distributed ledger technologies — Privacy and personally identifiable information protection considerations
- ISO/TR 23249:2022 Blockchain and distributed ledger technologies – Overview of existing DLT systems for identity management
- ISO 23257:2022 Blockchain and distributed ledger technologies — Reference architecture
- ISO/TS 23258:2021 Blockchain and distributed ledger technologies — Taxonomy and Ontology
- ISO/TR 23455:2019 Blockchain and distributed ledger technologies — Overview of and interactions between smart contracts in blockchain and distributed ledger technology systems
- ISO/TR 23576:2020 Blockchain and distributed ledger technologies — Security management of digital asset custodians
- ISO/TS 23635:2022 Blockchain and distributed ledger technologies — Guidelines for governance
- ISO/TR 23644:2023 Blockchain and distributed ledger technologies (DLTs) — Overview of trust anchors for DLT-based identity management

4. Draft standards published by ISO TC 307

- ISO/AWI TR 6277 Blockchain and distributed ledger technologies — Data flow models for blockchain and DLT use cases
- ISO/CD TS 18126 Taxonomy and classification for smart contracts
- ISO/CD 20435 Representing Physical Assets using Non-Fungible Tokens
- ISO/WD TS 23353 Blockchain and distributed ledger technologies — Auditing guidelines
- ISO/CD TS 23516 Blockchain and Distributed Ledger Technology — Interoperability Framework
- ISO/AWI PAS 24874 Guidebook on the Use of Smart Contracts in Contributing to the Sustainable Development Goals
- ISO/AWI TR 24878 New and emerging DLT/Blockchain Use Cases
- ISO/WD 24946 Requirements and guidance for improving, preserving, and assessing the privacy capability of DLT systems.
- ISO/WD 25126 Information security controls based on ISO/IEC 27002 for distributed ledger services
- ISO/WD TR 25145 Overview of DLT- based collections and collections management

4. Example: ISO/TS 23635:2022 Blockchain and distributed ledger technologies — Guidelines for governance

- ISO/TS 23635:2022 is a standard proposed by experts at ISO TC307 WG 5 Governance, who recognised that for organisations and broader industries, it is difficult to engage in the development of DLT systems in the absence of effective DLT-governance mechanisms.
- In the case of permissionless public distributed ledgers, they can comprise an unrestricted number of potentially pseudonymous DLT users and nodes. In permissioned public blockchains they can have hybrid governance structures.
- In the absence of a central governing authority, several governance questions regarding ownership, decision rights, responsibilities and accountabilities, and incentive structures emerge that cannot be addressed by applying traditional mechanisms.
- ISO/TS 23635:2022 Blockchain and distributed ledger technologies — Guidelines for governance provides guiding principles and a framework for the governance of DLT systems. The document also provides guidance on the fulfilment of governance, including risk and regulatory contexts, that supports the effective, efficient, and acceptable use of DLT systems.

Source: SEEBLOCKS (2023): D3.1 Blockchain and DLT standardisation landscape report

4. Example: ISO/IEC 27002:2022 Information security, cybersecurity and privacy protection — Information security controls

- **ISO/IEC 27002:2022 Information security, cybersecurity and privacy protection — Information security controls** provides a reference set of generic information security controls including implementation guidance. It is designed to be used by organizations: a) within the context of an information security management system (ISMS) based on ISO/IEC27001; b) for implementing information security controls based on internationally recognized best practices; c) for developing organization-specific information security management guidelines

Source: SEEBLOCKS (2023): D3.1 Blockchain and DLT standardisation landscape report

4. Example: Proposed Work Item 23095 - 27002 for distributed ledger services

- **PWI 23095** is a proposal to pursue an extension to the internationally recognised cybersecurity standard ISO/IEC 27002:2002 for DLT applications and services. It is proposed by experts at ISO TC307 JWG4 Security, privacy and identity for Blockchain and DLT. The proposal is at stage 0.0.

Source: SEEBLOCKS (2023): D3.1 Blockchain and DLT standardisation landscape report

4. Standards published by ETSI Industry Specification Group (ISG) Permissioned Distributed Ledger (PDL)

- ETSI GS PDL 024 V1.1.1 (2024-11) Permissioned Distributed Ledgers (PDL); Architecture enhancements for PDL service provisioning in telecom networks
- ETSI GR PDL 017 V1.1.1 (2024-07) Permissioned Distributed Ledger (PDL); Application of PDL to Amended Regulation 910/2014 (eIDAS 2) Qualified Trust Services
- ETSI GS PDL 026 V1.1.1 (2024-05) Permissioned Distributed Ledgers (PDL); PDL in Settlement of Usage-Based Services
- ETSI GS PDL 023 V1.1.1 (2024-04) PDL service enablers for Decentralized Identification and Trust Management
- ETSI GS PDL 022 V1.1.1 (2024-03) Permissioned Distributed Ledgers (PDL); PDL in Wholesale Supply Chain Management
- ETSI GR PDL 021 V1.1.1 (2023-10) Permissioned Distributed Ledgers (PDL); Overview of use cases in 3GPP network and impact analysis on architecture integration
- ETSI GR PDL 018 V1.2.1 (2023-10) Permissioned Distributed Ledger (PDL); Redactable Distributed Ledgers
- ETSI GR PDL 020 V1.1.1 (2023-06) Permissioned Distributed Ledger (PDL); Wireless Consensus Network
- ETSI GS PDL 012 V1.2.1 (2023-06) Permissioned Distributed Ledger (PDL); Reference Architecture
- ETSI GR PDL 019 V1.1.1 (2023-05) PDL Services for Decentralized Identity and Trust Management
- ETSI GR PDL 018 V1.1.1 (2023-04) Permissioned Distributed Ledger (PDL); Redactable Distributed Ledgers
- ETSI GS PDL 015 V1.1.1 (2023-01) Permissioned Distributed Ledger (PDL); Reputation management
- ETSI GR PDL 014 V1.1.1 (2022-10) Permissioned Distributed Ledger (PDL); Study on non-repudiation techniques
- ETSI GS PDL 013 V1.1.1 (2022-10) Permissioned Distributed Ledger (PDL); Supporting Distributed Data Management
- ETSI GS PDL 011 V2.1.1 (2022-09) Permissioned Distributed Ledger (PDL); Specification of Requirements for Smart Contracts' architecture and security
- ETSI GR PDL 006 V1.1.1 (2022-08) Permissioned Distributed Ledger (PDL); Inter-Ledger interoperability
- ETSI GS PDL 012 V1.1.1 (2022-05) Permissioned Distributed ledger (PDL); Reference Architecture
- ETSI GS PDL 011 V1.1.1 (2021-12) Permissioned Distributed Ledger (PDL); Specification of Requirements for Smart Contracts' architecture and security
- ETSI GR PDL 008 V1.1.1 (2021-09) Permissioned Distributed Ledger (PDL); Research and Innovation Landscape
- ETSI GR PDL 009 V1.1.1 (2021-09) Permissioned Distributed Ledger (PDL); Federated Data Management
- ETSI GR PDL 010 V1.1.1 (2021-08) PDL Operations in Offline Mode
- ETSI GR PDL 004 V1.1.1 (2021-02) Permissioned Distributed Ledgers (PDL); Smart Contracts; System Architecture and Functional Specification
- ETSI GR PDL 003 V1.1.1 (2020-12) Permissioned Distributed Ledger (PDL); Application Scenarios
- ETSI GR PDL 002 V1.1.1 (2020-11) Permissioned Distributed Ledger (PDL); Applicability and compliance to data processing requirements
- ETSI GR PDL 001 V1.1.1 (2020-03) Permissioned Distributed Ledger (PDL); Landscape of Standards and Technologies
- ETSI GS PDL 005 V1.1.1 (2020-03) Permissioned Distributed Ledger (PDL); Proof of Concepts Framework
- ETSI SR 002 564 V1.1.1 (2006-12) Applicability of existing ETSI and ETSI/3GPP deliverables to eHealth

4. Examples: Ethereum Improvement Proposals (EIPs)

- Protocol standards, such as those governing the internet or other decentralised infrastructure, have a less conclusive, though similarly discursive process that may lead to a rough consensus. One example is the original proposal for the now-ubiquitous HTTP protocol (1996) documented on the Internet Engineering Task Force (IEFT) data tracker archive. RFC-1945 was contributed by Neilson, Fielding and Berners-Lee. It is in essence a protocol proposal, which "provides information for the Internet community" and "does not specify an Internet standard of any kind." Despite the disclaimer, the Memo is flagged by the Internet Engineering Steering Group (IESG) "The IESG has concerns about this protocol, and expects this document to be replaced relatively soon by a standards track document", thereby demonstrating that proposals are monitored and guided toward appropriate tracks for consideration.
- In relation to DLT-based improvements, developing standards by agreement is also part of the process: Ethereum Improvement Proposals (EIP) and Requests for Comments (RFC) processes. An EIP is the improvement proposal process for any changes to the Ethereum environment, protocol and token standards. Unlike at ISO, the proposer is responsible for building consensus within the community and documenting dissenting opinions.

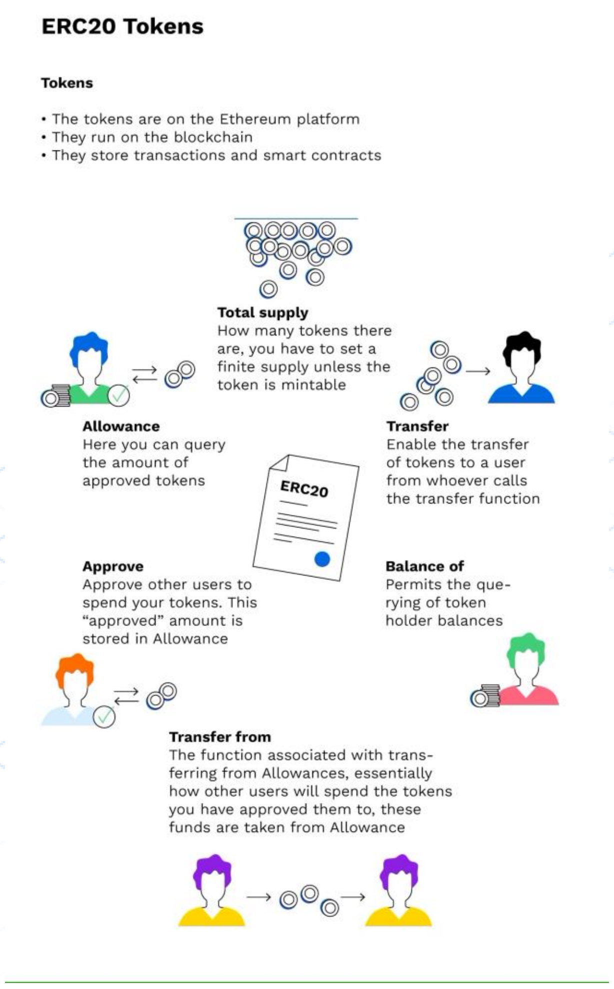
4. Examples: Ethereum Improvement Proposals and Requests for Comment

- *What are EIPs?*
  - EIPs are the primary mechanisms for proposing new features, for collecting community technical input on an issue, and for documenting design decisions.
- *EIP repository*
  - EIPs are maintained as text files in a versioned repository. Their revision history is the historical record of the feature proposal.
- *Types of EIPs*
  - Standard, Meta and Informational.
  - Standards track EIPs can be further categorised as Core, Networking, Interface and Ethereum Improvement Proposals (EIPs). They consist of three parts—a design document, an implementation, and (if warranted) an update to the formal specification
  - Ethereum Improvement Proposals (EIPs) describe novel application-level conventions that affect most (or all) existing Ethereum implementations, including contract standards such as token standards (ERC20 fungible token, ERC-720 non-fungible token standards), name registries (ERC-137), URI schemes, library/package formats, and wallet formats.

Source: SEEBLOCKS (2023): D3.1 Blockchain and DLT standardisation landscape report

4. Examples: ERC20 Tokens

- The ERC20 is a standard for building tokens on the Ethereum blockchain. Before ERC20 tokens, cryptocurrency exchanges had to build custom bridges between platforms to support the exchange of any token. For this reason, six rules were created by an Ethereum developer named Fabian Vogelsteller and placed under the name ERC20, which means "ethereum request for comment." The ERC20 standard is the foundation of each fully operational ERC20 contract. Such a smart contract can dispense tokens as well as control their supply and monitor their movement and balances.
- In order for a token to be compatible with ERC20, at least the features and behavior specified by ERC20 need to be implemented. Further functionalities can be added by implementing functions that are not part of the standard.
- The main purpose of the guidelines behind the ERC20 standard is to promote **interoperability between smart contracts**. As a consequence, all infrastructure components such as user interfaces, exchanges and wallets can be connected to a contract in a predictable manner.
- Interoperability itself is achieved because the ERC20 standard establishes an application programming interface (API). This way, third parties can access information and execute transactions and third-party apps can be coded for each ERC20 in a generic way without needing to be familiar with a specific token.



Source: https://www.bitpanda.com/academy/en/lessons/what-is-the-erc20-token-standard/

4. Examples: ERC-1155 MULTI-TOKEN STANDARD

- *ERC-1155 standard outlines a smart contract interface that can represent any number of fungible and non-fungible token types. Existing standards such as ERC-20 require deployment of separate contracts per token type. The ERC-721 standard's token ID is a single non-fungible index and the group of these non-fungibles is deployed as a single contract with settings for the entire collection. In contrast, the ERC-1155 Multi Token Standard allows for each token ID to represent a new configurable token type, which may have its own metadata, supply and other attributes*

Source: SEEBLOCKS (2023): D3.1 Blockchain and DLT standardisation landscape report

4. Examples: ERC-5725 Transferable Vesting NFT

- *A Non-Fungible Token (NFT) standard used to vest ERC-20 tokens over a vesting release curve. The standard allows for the implementation of a standard API for NFT based contracts which represent the vested and locked properties of underlying ERC-20 tokens that are emitted to respective NFT owners. This standard is an extension of the ERC-721 token which provides basic functionality for creating vesting NFTs, claiming underlying tokens and reading vesting curve properties*

Source: SEEBLOCKS (2023): D3.1 Blockchain and DLT standardisation landscape report

List of abbreviations

- AAC: Advanced Audio Coding
- AFNOR: Association Française de Normalisation
- ANSI: American National Standards Institute
- API: Application Programming Interface
- CEN: European Committee for Standardization
- CENELEC: European Committee for Electrotechnical Standardization
- DRM: Digital Rights Management
- DTI: Department of Trade and Industry (United Kingdom)
- ESS: European Standardization System
- ETSI: European Telecommunications Standards Institute
- EY: Ernst & Young Consulting Company
- GDP: Gross Domestic Product
- IEC: International Electrotechnical Commission
- ISO: International Standardization Organization
- ITU: International Telecommunication Union
- JPEG: Joint Photographic Experts Group
- SDO: Standard Development Organization
- SME: Small and Medium-sized Enterprises
- TFP: Total Factor Productivity
- 3GPP: 3rd Generation Partnership Project

References

- Blind, K. (2022): Standards and innovation: What does the research say? https://www.iso.org/publication/PUB100466.html. Accessed December 2024.
- Blind, K., Ramel, F. & Rochell, C. (2022): The influence of standards and patents on long-term economic growth. Journal of Technology Transfer 47, 979–999. https://doi.org/10.1007/s10961-021-09864-3
- De Vries, H., De Vries, H., & Oshri, I. (2008). Standards Battles in Open Source Software. London: Palgrave Macmillan UK.
- Deek, F. P., & McHugh, J. A.M. (2007). Open source: Technology and policy: Cambridge University Press.
- Dosi, G. (1982). Technological paradigms and technological trajectories: A suggested interpretation of the determinants and directions of technical change. Research Policy, 11(3), 147–162.
- DTI. (2005). The Empirical Economics of Standards. https://www.iso.org/sites/materials/standards-and-innovation/education_innovation-list/educational_innovation-detailbdbc.html?emid=1321. Accessed December 2024.
- ETSI. (2014). New European Standard on accessibility requirements for public procurement of ICT products and services. http://www.etsi.org/news-events/news/754-new-european-standard-on-accessibility-requirements-for-public-procurement-of-ict-products-and-services. Accessed December 2024.
- European Commission. (2004). Commission Decision of 24.03.2004: relating to a proceeding under Article 82 of the EC Treaty (Case COMP/C-3/37.792 Microsoft).
- Greenstein, S., & Stango, V. (2008). The Economics and Strategy of Standards and Standardization. In S. Shane (Ed.), The Handbook of Technology and Innovation Management, 267–293.
- Haimowitz, J., & Warren, J. (2007). Economic Value of Standardization.
- Leland, H. E. (1979). Quacks, lemons, and licensing: A theory of minimum quality standards. Journal of political economy, 87(6), 1328–1346.
- Locksley, G. (Ed.). (1990). The single European market and the information and communication technologies (Studies in the information economy Urban and regional development). London: Belhaven Pr.
- Miotti, H. (2009). The Economic Impact of standardization: Technological Change, Standards Growth in France.
- Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. Information systems research, 2(3), 192–222.
- Parr, A. N., Finbow, R. J., & Hughes, M. J. (2005). UK merger control: Law and practice (2nd ed.). London: Sweet & Maxwell.
- Pham, T. H. (2006). Economic Aspects of Standardization. In W. Hesser (Ed.), Standardization in companies and markets (pp. 61–99). Hamburg: Helmut-Schmidt-Univ. [u.a.].

References

- Miotti, H. (2009). The Economic Impact of standardization: Technological Change, Standards Growth in France.
- Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. Information systems research, 2(3), 192–222.
- Parr, A. N., Finbow, R. J., & Hughes, M. J. (2005). UK merger control: Law and practice (2nd ed.). London: Sweet & Maxwell.
- Pham, T. H. (2006). Economic Aspects of Standardization. In W. Hesser (Ed.), Standardization in companies and markets (pp. 61–99). Hamburg: Helmut-Schmidt-Univ. [u.a.].
- Raustiala, K., & Sprigman, C. J. (2012). The knockoff economy: How imitation sparks innovation. Oxford, New York: Oxford University Press.
- Salop, S. C., & Scheffman, D. T. (1983). Raising Rivals' Costs. The American Economic Review, pp. 267–271.
- Schelkens, P. (2015). JPEG Standards: Are we prepared for the next disruptive evolution in digital imaging markets?, June, 4.
- Swann, G. M. P. (2000). The Economics of Standardization. Final Report for Standards and Technical Regulations Directorate Department of Trade and Industry. Manchester Business School. https://assets.publishing.service.gov.uk/media/5a790abd40f0b679c0a0812d/10-1135-economics-of-standardization-update.pdf. Accessed January 2025.
- Swann, G. M. P. (2010). International Standards and Trade: A Review of the Empirical Literature, OECD Trade Policy Papers, No. 97, OECD Publishing, Paris, https://doi.org/10.1787/5kmdbg9xktwg-en
- Swann, G. M. P., & Gill, J. (1993). Corporate vision and rapid technological change: The evolution of market structure. New York, N.Y: Routledge.
- Swann, G. M. P., & Watts, T. (2002). Visualization needs vision: The pre-paradigmatic character of virtual reality. Virtual society, 41–60.
- Swinnen, J. F. M. (2015). Quality standards, value chains, and international development: Economic and political theory.
- Williamson, O. E. (1989). Transaction cost economics. Handbook of industrial organization, 1, 135–182.
- Wurster S, Ron E, Hofmann F. Standardisation of a terminology for blockchains: Distributed ledger technology. Standardisation of a terminology for blockchains. JoS [Internet]. 2024 Mar. 14 [cited 2024 Aug. 5];3(1). Available from: https://journals.open.tudelft.nl/jos/article/view/7274

SEEBLOCKS.eu

Supporting Europe's effort in Blockchain/DLT Standardisation

https://www.linkedin.com/company/seeblocks-eu/

@SEEBLOCKS_eu

Funded by
the European Union