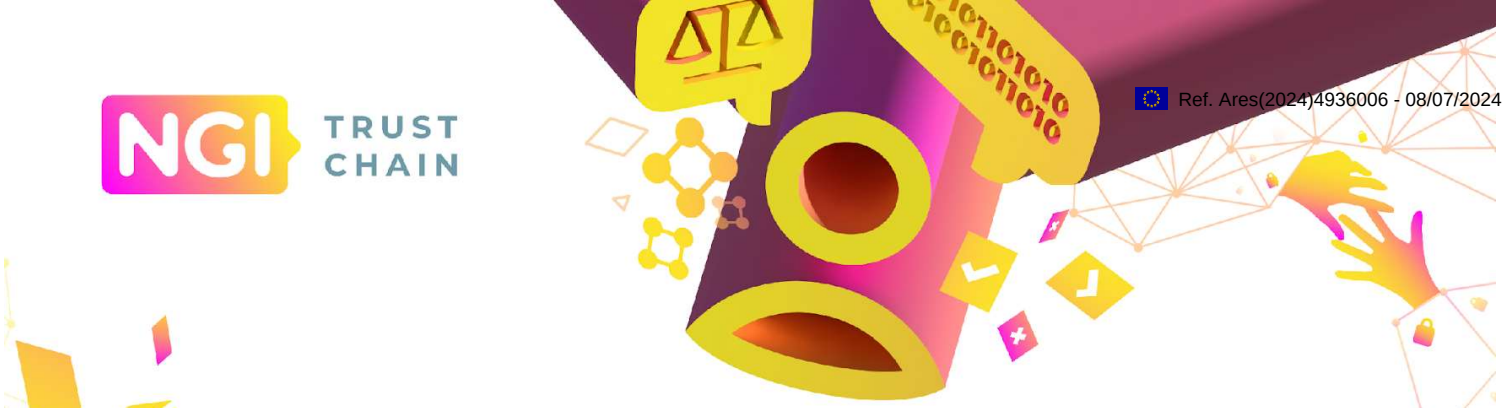
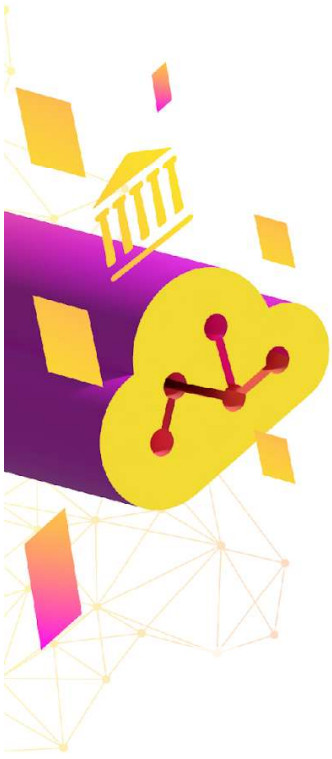
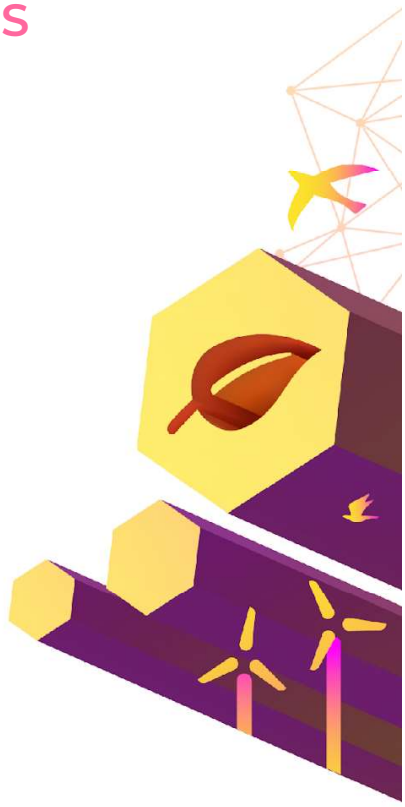
NGI TRUST CHAIN





D4.8
TRUSTCHAIN YEARLY REPORT ON STANDARDISATION ACTIVITIES

08/07/2024



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Abstract	This document presents the standardization activities within TRUSTCHAIN in the first 18 months of the project.
Keywords	TRUSTCHAIN, standardization activities

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Executive Summary

This document presents the coaching, monitoring, and evaluation activities in the context of the TRUSTCHAIN project OC3 and provide the information needed for the selected applicants to successfully conduct their subproject work.

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ABBREVIATIONS

BSD License	Berkeley Software Distribution License
CBOR	Concise Binary Object Representation
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CNCF	Cloud Native Computing Foundation
CSA	Cloud Security Alliance
DAA	Direct Anonymous Attestation
DC4EU	Digital Credentials for Europe
DID	Decentralized Identifier
DIF	Decentralized Identity Foundation
DIS	Draft International Standard
DLT	Distributed ledger technologies
EBSI	European Blockchain System Infrastructure
eIDAS	Electronic Identification, Authentication, and Trust Services
EMS	Environmental Management System
ERC	Ethereum Request for Comment
ETSI	European Telecommunications Standards Institute
EUBOF	EU Blockchain Observatory and Forum
FDIS	Final Draft International Standard
GDPR	General Data Protection Regulation
GNU	GNU's not Unix
GPL	General Public License

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IANA	Internet Assigned Numbers Authority
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
INATBA	International Association for Trusted Blockchain Applications
IRTF	Internet Research Task Force
ISMS	Information Security Management Systems
ITU	International Telecommunication Union
NIST	National Institute of Standards and Technology

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1 INTRODUCTION

The TRUSTCHAIN project, initiated under the European Commission's Next Generation Internet initiative, represents a transformative step towards a more human-centered, trustworthy, and sustainable internet. Given the critical role of standards, TRUSTCHAIN has already initiated efforts to enhance cooperation in standardization activities. The project has established a dedicated task for standardization, aiming to strengthen collaboration with relevant standardization organizations, EU-funded projects, and initiatives in the standardization domain.

Over the first 18 months, as part of Task 4.4, the project has focused on establishing a framework for standardization activities that prioritize trust and security, user-centricity, sustainability, and open-source code practices. Deliverable D4.8 serves as an introduction to the concerted efforts of consortium partners and third-party funded projects in standardization processes that are crucial for trust and security, user-centricity, sustainability, and the development of open-source code. The second version of this deliverable will be delivered in Month 36, and will deliver the final outcomes on the TRUSTCHAIN and OCs standardization activities.

TRUSTCHAIN task on standardization strategy and activities aims to contribute to the standardisation efforts in relation to activities of the European Commission's blockchain standardisation activities, the EU Blockchain Observatory and Forum (EUBOF) [1], International Association for Trusted Blockchain Applications (INATBA) [2], the World Wide Web Consortium (W3C) [3], the International Organization for Standardization (ISO) [4] and similar. Standardisation bodies that are actively working in the area of distributed ledger technologies (DLT) with which we shall reinforce relations include:

- ITU Focus Group on Application of Distributed Ledger Technology [5] that aims to identify and analyse DLT-based applications and services; to draw up best practices and guidance which support the implementation of those applications and services on a global scale; and to propose a way forward for related standardisation work in ITU-T Study Groups.
- ISO is also working on DLT standards with upcoming deadlines on terminology, on reference architecture on legally binding smart contracts.
- The Blockchain and Virtual Currencies Working Group (WG) [6] is a group of industry representatives; the WG is a member of the European Commission Payment Systems Market Expert Group (PSMEG).
- The CSA Blockchain Working Group [7] investigates and documents various forms of blockchain technology, relevant use cases, and security implications. The Blockchain Working Group is dedicated to producing usable content to educate the industry on this radical technology.

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- W3C develops standards and guidelines to help everyone build a web based on the principles of accessibility, internationalization, privacy and security.
- Contact with other projects and initiatives at European Union and World level

The rest of the deliverable is organized as follows. Section 2 provides an analysis of the prevailing standards within the domains relevant to TRUSTCHAIN. It also describes the standardization procedures at both European and international levels and enlists important initiatives. Section 3 details the activities carried out by the consortium partners in conjunction with the TRUSTCHAIN OC1 funded projects. Finally, Section 4 concludes this deliverable.

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2 State of the Art analysis

Standards and regulations, established by recognized institutions or organizations are essential for ensuring that products, processes, and services consistently meet their intended purposes. These documents outline requirements, specifications, guidelines, or characteristics to achieve this consistency. TRUSTCHAIN acknowledges the critical importance of standardization and regulatory alignment in realizing its vision. The project is committed to investigating existing standards and regulations and actively contributing to the standardization process.

Namely, TRUSTCHAIN is focused on standards and regulation that are related to self-sovereign identity, data privacy, trust and security on the Internet, decentralized ledger technologies, as well as fostering new business models based on decentralized and open source technologies. This includes standards and regulations such as EBSI Wallet Conformance, Ethical Guidelines for Trustworthy AI, Information Security Management Systems (ISMS), Privacy Information Management Systems (PIMS), National Institute of Standards and Technology (NIST) Cybersecurity Framework, the General Data Protection Regulation (GDPR), the Electronic Identification, Authentication, and Trust Services (eIDAS) regulation, Decentralized Identifiers (DIDs), and W3C standards.

A standard is essentially a technical specification established by a recognized standardization body for regular or ongoing use, and adherence to it is voluntary. Standards may be formulated by national, regional (e.g. European), or international bodies, consortia of companies (e.g. IEEE), or even individual corporations (company standards).

On the other hand, a regulation is a legally binding rule set forth by an authority (e.g. the European Council). While there are variations in the methods employed by European and International Standardization Organizations for developing standards, all such entities, whether national, European, or international, adhere to specific rules for document creation. The standardization procedures of CEN, CENELEC, ISO, and IEC are outlined in subsequent sections.

2.1 TRUSTCHAIN standardization domains

TRUSTCHAIN operates within several standardization domains to ensure a robust and reliable digital infrastructure. Trust and security are paramount, focusing on creating a resilient framework where data pathways and services are secure and reliable. User-centricity is another domain, emphasizing the importance of putting the technology in service of the potential end-user. In addition, it empowers users with control over their personal data and digital identities. Internet sustainability looks at the long-term

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viability of digital services, ensuring that data storage, transport, and sharing are energy-efficient and contribute to a sustainable digital ecosystem. Lastly, the open-source code domain underlines TRUSCHAIN's commitment to transparency and collaboration, fostering an environment where innovation thrives through shared knowledge and community-driven development. Together, these domains form the bedrock of the NGI TRUSTCHAIN, supporting a trustworthy data governance model that aligns with European values and regulatory frameworks.

Trust and Security

In the realm of decentralized applications and services, particularly those involving digital ledger technologies (DLT), data governance, Decentralized Identifiers (DIDs), and Self-Sovereign Identity (SSI), ensuring trust and security is essential. The following standards and guidelines provide comprehensive frameworks to address these needs.

Blockchain and distributed ledger technologies

- ISO 23257:2022 Blockchain and distributed ledger technologies — Reference architecture [8]: This document specifies a reference architecture for Distributed Ledger Technology (DLT) systems including blockchain systems. The reference architecture addresses concepts, cross-cutting aspects, architectural considerations, and architecture views, including functional components, roles, activities, and their relationships for blockchain and DLT.
- ISO 22739:2024 Blockchain and distributed ledger technologies — Vocabulary [9]: This document defines fundamental terminology for blockchain and distributed ledger technologies.

Ethical Guidelines for Trustworthy AI

The European Commission's Ethical Guidelines for Trustworthy AI [10] provide a framework to ensure AI systems are robust, safe, and trustworthy. These guidelines outline seven key requirements: human agency and oversight, technical robustness and safety, privacy and data governance, transparency, diversity, non-discrimination and fairness, societal and environmental well-being, and accountability. These principles are critical for building trust in decentralized AI applications integrated with DLT.

Information Security Management Systems (ISMS)

ISMS is a set of policies and frameworks that organizations implement to manage, monitor, and mitigate risks to their information assets [11]. The cornerstone of an ISMS is the ISO/IEC 27001 standard [12], which outlines the requirements for establishing, implementing, maintaining, and continually improving information security within the context of the organization. The latest edition of the standard emphasizes a risk-

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based approach, ensuring that organizations are proactive in identifying potential security threats and vulnerabilities. By adhering to these standards, organizations can demonstrate to stakeholders that they are committed to safeguarding data and managing information security risks effectively. An ISMS is not only a strategic asset but also a regulatory requirement in many sectors, providing a comprehensive set of controls that cover people, processes, and technology.

Privacy Information Management Systems (PIMS)

PIMS is a framework designed to help organizations manage and protect personally identifiable information (PII) [12]. The ISO 27701 standard, an extension of ISO/IEC 27001, provides guidelines for establishing, implementing, maintaining, and continually improving a PIMS. This standard is relevant in the context of stringent data protection regulations like the EU's General Data Protection Regulation (GDPR). A well-implemented PIMS can help organizations not only comply with legal requirements but also demonstrate their commitment to privacy. By adopting ISO 27701, organizations can show that they have robust systems in place to handle PII, potentially reducing the risk of data breaches and the associated consequences, such as fines and reputational damage. Moreover, this is crucial for decentralized applications that handle personal data, ensuring compliance with privacy regulations such as GDPR.

Cybersecurity Guidelines

The NIST Cybersecurity Framework [14] is a set of guidelines designed to help organizations manage and mitigate cybersecurity risks. The framework provides a common language and systematic methodology for addressing cybersecurity concerns. With the release of CSF 2.0, there is an enhanced emphasis on supply chain risk management and the introduction of new metrics for measuring cybersecurity performance. Organizations of all sizes and industries can leverage the NIST Cybersecurity Framework to enhance their security posture, communicate their cyber risk management strategies, and align their cybersecurity activities with their business requirements. In addition, this framework is applicable to decentralized applications, helping to prevent, detect, and respond to cyber threats effectively.

General Data Protection Regulation (GDPR)

GDPR sets stringent requirements for data protection and privacy for individuals within the EU. Decentralized applications must comply with GDPR to ensure the protection of personal data and build trust with users by demonstrating robust data governance practices.

Electronic Identification, Authentication, and Trust Services Regulation

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The eIDAS Regulation establishes standards for electronic identification and trust services within the EU [15]. It provides a legal framework for electronic signatures, seals, timestamps, and other trust services essential for securing transactions in decentralized applications. In addition, eIDAS 2.0 Regulation represents a significant advancement in the European Union's digital landscape. Building upon the original eIDAS framework, it aims to enhance the security, reliability, and interoperability of electronic identification and trust services across member states. With a focus on creating a standardized, technology-neutral framework, eIDAS 2.0 introduces new elements such as electronic archiving services and the management of remote electronic signatures, which are expected to streamline digital transactions and foster a cohesive digital ecosystem throughout the EU.

Decentralized Identifiers and Verifiable Credentials

W3C develops protocols and guidelines that ensure the long-term growth of the web. Key standards relevant to decentralized applications include:

- Decentralized Identifiers (DIDs) [16]: DIDs are a new type of identifier that enables verifiable, self-sovereign digital identities. The DID standard outlines how these identifiers can be created, resolved, and used, ensuring secure and privacy-respecting identity management in decentralized applications.
- Verifiable Credentials (VCs) [17]: VCs provide a standard for expressing credentials on the web in a cryptographically secure, privacy-respecting manner. This is crucial for SSI solutions, enabling users to control their digital identities and share verified information securely.

Data Governance Standards

Effective data governance is essential for managing the quality, integrity, and security of data in decentralized applications. Key standards include:

- ISO 8000-51:2023 Data quality and Data governance [18]: This document specifies requirements that support the exchange of data governance policy statements and automated conformance testing of data sets to the data specifications referenced by policy statements.
- ISO/IEC 38505 [19]: This standard provides guidance on the governance of IT-enabled investments, including data governance frameworks and principles.
- ISO/IEC 29100 [20]: This privacy framework establishes a common privacy terminology and defines the actors and their roles in processing personal data, ensuring comprehensive data governance in decentralized applications.
- IEEE 23026-2023 - Standard for a Blockchain-Based Data Management System (DMS) [21]: Defines the architecture and security requirements for a data

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management system based on blockchain technology. This standard aims to ensure the secure storage, access, and management of data on the blockchain.
- IEEE 3207-20202 - Standard for a Blockchain-Based Digital Asset Identifier [22]: This standard provides a framework for creating digital asset identifiers on blockchain, ensuring secure identification and tracking of digital assets.
- IEEE 2418.2-2020 - Standard Data Format for Blockchain Systems [23]: Defines a standard data format to ensure interoperability and security across different blockchain systems. This standard helps in establishing trust by providing consistent and secure data structures.
- Decentralized Identifiers (DIDs) v1.0 - Core architecture, data model, and representations: This document specifies the DID syntax, a common data model, core properties, serialized representations, DID operations, and an explanation of the process of resolving DIDs to the resources that they represent.

Industry-Specific Standards and Best Practices

Various industry groups and consortia, such as the Ethereum Foundation, OpenZeppelin Foundation or the Hyperledger Project, develop standards and best practices tailored to the needs of decentralized applications in specific sectors. These guidelines address issues such as smart contract security, interoperability, and scalability, ensuring that decentralized applications can operate securely and efficiently across different platforms and environments. During the initial 18 months, our focus was primarily on the ERC standard, as the bulk of projects are EVM-compatible, necessitating the deployment of smart contracts on Ethereum-based blockchains. Key ERC standards include:

- ERC-20: Defines a standard interface for fungible tokens, facilitating their integration and interaction across different platforms and applications [24].
- ERC-721: Establishes a standard for non-fungible tokens (NFTs), allowing unique digital assets to be created, owned, and traded securely [25].
- ERC-1155: Combines features of both ERC-20 and ERC-721, allowing for the creation of fungible, semi-fungible, and non-fungible tokens within a single smart contract [26].
- ERC-3643: Establishes standards for the creation and management of regulated tokens. This is essential for financial applications where compliance with regulatory requirements is critical [27]. ERC-3643 facilitates the issuance, transfer, and redemption of tokens that must adhere to specific regulatory standards, enhancing trust and security in financial transactions on the blockchain.

User-centricity

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User-centricity in software development is a design philosophy that places the end-user at the forefront of the development process. This approach emphasizes understanding the users' needs, behaviours, and contexts to create products that offer meaningful and relevant experiences. Standards for user-centricity involve iterative processes where feedback from user research, such as surveys and interviews, is integrated into design decisions. The goal is to create software that is not only functional but also intuitive and satisfying to use.

Incorporating a user-centric approach means engaging in a cycle of continuous improvement, where the design is regularly evaluated and refined based on user interaction. This requires a multidisciplinary team that can bring together different perspectives, including those of ethnographers, psychologists, and engineers, to build a comprehensive understanding of the user experience. Such teams often employ a variety of research and design techniques to ensure that the product aligns with user expectations and improves their interaction with the software.

In the following are enlisted some key standards, guidelines, and best practices that promote user-centricity in software development:

- ISO 9241 Series - Ergonomics of Human-System Interaction
    - ISO 9241-210: Principles and guidelines for human-centered design activities throughout the life cycle of computer-based interactive systems. It emphasizes the importance of understanding and specifying the context of use, involving users throughout design and development, and iterating design solutions [28]. It provides a framework for human-centered design processes, including planning, specifying user and organizational requirements, producing design solutions, and evaluating designs against requirements. Moreover, this standard delivers an overview of human-centred design activities and is intended to be used by those managing design processes, and is concerned with ways in which both hardware and software components of interactive systems can enhance human-system interaction.
    - ISO 9241-11: Guidance on usability, providing definitions of usability and explaining how it can be specified, measured, and achieved [29].
    - ISO 9241-171: Guidance on the accessibility of interactive systems for people with disabilities [30].
- ISO/IEC 25010: System and Software Quality Models: Part of the SQuaRE series, it defines a quality model for software, including usability characteristics such as appropriateness recognizability, learnability, operability, user error protection, user interface aesthetics, and accessibility [31].
- Accessibility Guidelines
    - Web Content Accessibility Guidelines (WCAG): Developed by W3C, WCAG provides guidelines to make web content more accessible to people with disabilities [32].

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- Material Design Guidelines: Developed by Google, Material Design is a comprehensive guide for visual, motion, and interaction design across platforms and devices, emphasizing a user-centered approach [33].

Environmental sustainability

Environmental sustainability standards for digital technologies are crucial for reducing the carbon footprint and promoting responsible innovation. For the Internet, this involves assessing and mitigating its environmental impact, which can be substantial, considering estimates suggest it could be responsible for the world's overall emissions. Therefore, developing novel software solutions is pivoting towards green practices, focusing on energy-efficient design, coding, and operation to minimize environmental impact. In the following are several sustainability standards that TRUSTCHAIN is closely following and is encouraging the funded projects to follow and apply.

- ISO 14001 - Environmental Management Systems provides a framework for organizations to manage and reduce their environmental impact [34]. It involves setting up an environmental management system (EMS) that includes policy development, planning, implementation, operation, checking, and management review. Data centers and internet service providers (ISPs) can use ISO 14001 to systematically reduce their energy consumption, manage e-waste, and implement sustainable practices.
- Energy Star is a program run by the U.S. Environmental Protection Agency and U.S. Department of Energy that certifies products and buildings, including data centers, for energy efficiency. Certified data centers use less energy, reducing their overall carbon footprint [35]. For instance, data centers can achieve Energy Star certification by meeting specific energy performance criteria, implementing energy-efficient equipment, and optimizing their cooling and power usage.
- Green Grid Metrics develops metrics (e.g. Power Usage Effectiveness-PUE and Data Center Infrastructure Efficiency-DCiE) that are used to measure the energy efficiency of data centers. PUE is calculated by dividing the total energy consumption of the data center by the energy consumed by the IT equipment alone. On the other hand, DCiE is reciprocal of PUE and measures the ratio of IT equipment energy consumption to total facility energy consumption. These metrics help data center operators identify inefficiencies and implement strategies to improve energy use.
- ITU-T L.1300 - Best Practices for Green Data Centers as part of the International Telecommunication Union's standard provides guidelines for designing and operating data centers with minimal environmental impact [36]. It covers energy management, renewable energy use, and efficient cooling technologies. Similar to the previous standards, data centers can follow these

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guidelines to reduce their energy consumption and greenhouse gas emissions, contributing to global sustainability goals.

Open-source software

Standards for open-source software encompass a variety of guidelines, licenses, and best practices aimed at promoting transparency, collaboration, and usability within the open-source community. Open standards are guidelines or specifications that ensure technologies remain "open." They are developed, approved, and maintained for the public by governing bodies and qualified contributors using a collaborative and consensus-driven process. These standards enable interoperability and data exchange among different products or services, allowing technologies to be widely adopted.

Standards boards, such as the W3C (for the Internet), IEEE (for engineering and technology), and CNCF (for cloud-native computing), provide guidelines for these standards. Several open-source software licenses adhere to open standards. These include:

- MIT License: Permissive license allowing reuse and modification with minimal restrictions.
- BSD License (revised and 2-clause variant): Allows free use, modification, and redistribution.
- Apache 2.0 License: Permissive license with patent grant and clear terms.
- GNU Lesser General Public License (LGPL): Ensures compatibility with proprietary software.
- GNU General Public License (GPL): Requires derivative works to be open source.

2.2 Mapping of European and international standardization activities

European Standardization Process

The European standardization process involves the development of voluntary standards that provide specifications for products, services, and processes, aiming to ensure quality, safety, interoperability, and environmental protection. This process is coordinated by three main European Standardization Organizations (ESOs): the European Committee for Standardization (CEN), the European Committee for Electrotechnical Standardization (CENELEC), and the European Telecommunications Standards Institute (ETSI). These organizations work closely with various stakeholders, including industry leaders, SMEs, consumer groups, and regulatory bodies, to develop

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standards that support innovation and facilitate trade within the single market and globally.

The standardization process is governed by principles of consensus, openness, transparency, and national commitment, ensuring that all interested parties have a voice in the development of standards. The Regulation (EU) No 1025/2012 sets the framework for this process, allowing the European Commission to request the ESOs to develop standards that align with EU legislation. This collaborative approach not only harmonizes technical specifications across member states but also plays a crucial role in supporting EU policies and legislation.

CEN and CENELEC, along with ETSI, are instrumental in this process, providing a platform for the creation of standards that reflect the consolidated results of science, technology, and experience, aimed at promoting the optimal benefits for the community. CEN and CENELEC bring together the national agencies of 34 countries. The involvement of over 200,000 experts from various sectors in the CEN and CENELEC network underscores the extensive collaboration and expertise that underpin the European standardization process. The national members of CEN and CENELEC re obliged to implement the European Standards s national standards and to withdraw any conflicting national standards.

Moreover, the European Standardization System is unique in its approach to inclusivity and sustainability. CEN and CENELEC are committed to making the standard development process more gender-responsive and contributing to the United Nations' Sustainable Development Goals, particularly Goal 5, which focuses on achieving gender equality.

The process of developing a new European Standard is composed of several consecutive steps:

1. Proposal and Proposal Acceptance: Standardization projects can be proposed by any stakeholder, including industry, consumer organizations, public authorities, and national standardization bodies. The standardization organization assesses the proposal. If accepted, a new work item is registered, and a technical committee is established or assigned to develop the standard.
2. Drafting: Technical committees form working groups consisting of experts from various sectors to draft the standard. The working group prepares the draft standard, which includes technical specifications, guidelines, and other relevant information.
3. Public Enquiry: The draft standard is released for public enquiry, allowing all stakeholders, including national standardization bodies, industry representatives, and the public, to review and comment. The working group reviews and addresses the comments received during the public enquiry. This may involve revising the draft standard based on the feedback.

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4. Formal Vote: Once the comments are resolved, the revised draft is submitted for formal voting by the national standardization bodies of the member countries. Each national body votes to approve, disapprove, or abstain. For CEN and CENELEC standards, approval typically requires a weighted majority vote.
5. Publication: If the draft standard is approved, it is adopted as an EN. The adopted EN must be implemented at the national level by the member countries, who withdraw any conflicting national standards.
6. Review and Maintenance: European Standards are periodically reviewed (usually every five years) to ensure they remain up-to-date and relevant. Based on the review, standards may be confirmed, revised, or withdrawn.

International Standardization Process

The international standardization process is a comprehensive and collaborative framework involving multiple stakeholders worldwide to develop standards that facilitate global trade, enhance product safety, and promote innovation and sustainability. This process is primarily coordinated by key international standardization bodies such as ISO, IEC, and ITU.

The process of developing a new international standard is composed of the following consecutive steps:

1. Proposal stage: Standardization projects can be proposed by any member, including national standardization bodies, industry groups, or other stakeholders. The proposal is submitted as an New Work Item Proposal (NWIP) and needs to be supported by several member bodies to proceed.
2. Preparatory Stage: A technical committee forms a working group of experts to develop a working draft. The working group prepares the initial draft, which includes technical specifications, guidelines, and other relevant content.
3. Committee Stage: The working draft is circulated among the technical committee members as a committee draft for review and comment. The working group revises the CD based on feedback, resolving comments and improving the draft.
4. Enquiry Stage: The revised draft is released as a Draft International Standard (DIS) and distributed to all ISO/IEC/ITU member bodies for public enquiry. Member bodies review the DIS, providing feedback and voting to approve, disapprove, or abstain.
5. Approval Stage: If the DIS receives majority approval, it is revised if necessary and issued as a Final Draft International Standard (FDIS). Member bodies vote on the FDIS. Approval usually requires a two-thirds majority of the participating members.

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6. Publication Stage: Upon approval, the FDIS is published as an official International Standard (IS). Member countries adopt the IS, ensuring it aligns with their national standards.
7. Maintenance and Review: International standards are periodically reviewed (typically every five years) to ensure they remain current and relevant. Standards may be confirmed, revised, or withdrawn based on the review outcomes.

Mapping of standardization activities

The table below lists relevant initiatives on EU and international level currently mapped that are related to the TRUSTCHAIN project. The mapping is a continuous activity and will be updated until month 36 of the project. The current overview is listed in the table below.

Table 1 LIST OF RELEVANT INITIATIVES FOR STANDARDIZATION

Organizations related to Standardization efforts	Description
CSA Blockchain Working Group	This group investigates relevant use cases and security implications of blockchain. Currently, they are creating a framework and glossary that would help provide guidance and security around: wallets, exchanges, cryptography, and more.
EU Blockchain Observatory and Forum	The European Blockchain Observatory and Forum, a European Commission initiative to accelerate blockchain innovation and the development of the blockchain ecosystem within the EU and so help cement Europe's position as a global leader in this transformative new technology. It takes an active role in the blockchain standards community, engaging and working closely with all relevant bodies around the world.
IEEE Standards Association	IEEE Standards Association (IEEE SA) is a leading consensus building organization that nurtures, develops and advances global technologies, through IEEE. It has been actively pursuing blockchain standardization efforts through various activities in multiple industry sectors. The IEEE Blockchain Technical Community will collaborate with IEEE SA to

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	further develop and progress blockchain related standards.
International Association for Trusted Blockchain Applications (INATBA)	The group is engaging with key topics in the dynamic space of standards. It has a Liaison category A in ISO TC307 and ITU-T. It maintains relationships with core regulatory, standardisation and market stakeholders around the globe.
Internet Engineering Task Force (IETF)	The Internet Engineering Task Force (IETF) is the premier standards development organization for the Internet. The IETF makes voluntary standards that are often adopted by Internet users, network operators, and equipment vendors, and it thus helps shape the trajectory of the development of the Internet.
Internet Research Task Force (IRTF)	The Internet Research Task Force (IRTF) promotes research of importance to the evolution of the Internet by creating focused, long-term Research Groups working on topics related to Internet protocols, applications, architecture and technology. The Internet Research Task Force (IRTF) focuses on longer term research issues related to the Internet while the parallel organization, the Internet Engineering Task Force (IETF), focuses on the shorter term issues of engineering and standards making.
ISO: Global standards for trusted goods and services	International standards ensure that the products and services you use daily are safe, reliable, and of high quality. They also guide businesses in adopting sustainable and ethical practices.
ISO/TC 307 Blockchain and distributed ledger technologies	Technical committee established by the International Organization for Standardization (ISO) that focuses on standardization in the field of blockchain and distributed ledger technologies (DLT). Its work includes developing standards to provide internationally agreed ways of working, which improve security, privacy, scalability, and interoperability of blockchain and DLT systems.
ITU Focus Group on and Application of Distributed Ledger technologies	The Study Groups of ITU's Telecommunication Standardization Sector (ITU-T) assemble experts from around the world to develop international standards

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	known as ITU-T Recommendations which act as defining elements in the global infrastructure of information and communication technologies (ICTs).
SEEBLOCKS.eu	SEEBLOCKS.eu aims at delivering a targeted, democratic, industry-driven initiative to support European interests in standardisation within the Blockchain/DLT domain, bringing together EU researchers and open standards specialists, along with industry and policy experts.
W3C	International consortium that web that develops standards optimized for interoperability, security, privacy, web accessibility, and internationalization

3 TRUSTCHAIN CONTRIBUTIONS TO STANDARDS

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In the first 18 months of the TRUSTCHAIN project, significant progress was made in the scope of standardization activities. The consortium together with the OC1 projects engaged in extensive collaboration with 14 prominent standardization organizations, institutions, and associations, including notable entities such as EUBOF, INATBA, ISO, W3C, and EBSI. This period saw active participation in 7 major events focused on standardization, such as the INATBA Digital Blockchain Week and the European Blockchain Week, facilitating knowledge exchange and networking. Moreover, the consortium contributed to the development and refinement of 7 different standards, demonstrating a strong commitment to advancing blockchain standardization. Further details on these efforts and their impacts will be revealed in the sections bellow.

3.1 TRUSTCHAIN CONSORTIUM AND STANDARDIZATION ACTIVITIES

The table below summarizes the consortium's standardization activities in the first reporting period of the project.

Table 2 STANDARDIZATION ACTIVITIES OF THE TRUSTCHAIN CONSORTIUM PARTNERS

	TRUSTCHAIN consortium member	Standardization activities until Month 18
1	ED	Engaged in collaboration with: • EUBOF Expert Pannel • SEEBLOCKS.eu
2	F6S	N/A
3	UL	Engaged in collaboration with: • EUBOF Expert Pannel • INATBA • SEEBLOCKS.eu • EBSI Participated in events: • EmpoderaLIVE: Tech event on Civic Technologies 2023

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		• European Blockchain Week (EBCW) 2023 • INATBA Digital Blockchain Week • NGI forum 2023 in Brussels
4	AUEB	Engaged in collaboration with: • EUBOF Expert Pannel • SEEBLOCKS.eu Participated in events: • NGI forum 2023 in Brussels • European Blockchain Week (EBCW) 2023
5	CIB	Launched Cyber.London - a not-for-profit organisation focused on cybersecurity and standardisation. Participated in events: • European Blockchain Week (EBCW) 2023
6	ALA	Engaged in collaboration with: • INATBA • BlockStand • ITU • Blockchain Association Forum Participated in events: • NGI forum 2023 in Brussels • European Blockchain Convention 2023 • Digital Enterprise Show 2024 • Salamanca Tech Summit 2024
7	TLX	Participated in events: • NGI forum 2023 in Brussels
8	NKUA	Engaged in collaboration with:

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		• EUBOF Expert Pannel • SEEBLOCKS.eu Participated in events: • European Blockchain Week (EBCW) 2023
9	ICS	Participated in events: • NGI forum 2023 in Brussels

3.2 TRUSTCHAIN THIRD PARTY FUNDED PROJECTS AND STANDARDIZATION ACTIVITIES

The table below summarizes the standardization activities carried out by the TRUSTCHAIN OC1 projects. More thorough information on their activities is available in the OC1 projects' D4 deliverables.

Table 3 STANDARDIZATION ACTIVITIES OF THE TRUSTCHAIN OC1 PROJECTS

TRUSTCHAIN OC1 project	Standardization activities
DIDroom	Collaborating with W3C on: • review of the BBS protocol (https://github.com/w3c/strategy/issues/449) • Quantum-proof W3C-VC (https://github.com/w3c-ccg/community/issues/247) Participated in the following international events on standardization: • CIFRIS 2023: https://www.decifris.it/cifris23/program • GAIN-POC standardization meetings: https://openid.net/cg/gain-poc/ • Trends in Digital Identity TDI 2024: https://st.fbk.eu/events/TDI2024/program

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	Main focus on: W3C-DID, EUDI-ARF, OpenID4VCI, SD-JWT, W3C-VC
CreatorCredentials	Collaborating with: • ISO/TC 46/SC 9/WG 18 on ISO 24138 ISCC • W3C on Verifiable Credentials Data Model v2.0 (Candidate Recommendation Draft) Participated in the following international events on standardization: • ISO 24138 ISCC Main focus on: OpenID Connect, OAuth2, OpenID for Verifiable Credentials JSON Schema for Verifiable Credentials and W3C VC data model.
MUSAP	Collaborating with IANA registry: • new KeyURI scheme for standardizing the reference to private keys and delivering key metadata Participated in the following international events on standardization: • NGI day • Interview with Juniper Research Main focus on: eIDAS 2, PKI (X.509 certificates), DID (signing DIDs)
TREVO	Collaborating with: N/A Participated in the following international events on standardization: N/A Main focus on: Hyperledger AnonCreds, Aries RFCs
Orchestral	Collaborating with: N/A Participated in the following international events on standardization: N/A

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	Main focus on: did:web, W3C VC, ESBI verifiable attestations, verifiable credential schema.
The Social Wallet	Collaborating with ISO, W3C on: • decentralized identities (DIDs) • verifiable credentials (VCs) Participated in the following international events on standardization: • Decentralized Identity Foundation DIF • Open Wallet Foundation • INATBA • ISO • Governmental and W3C Workshops, contributing insights on decentralized identities (DIDs) and verifiable credentials (VCs) Main focus on: W#C VC DM 1.1, DIF and Open ID (e.g. VC DM 1.1, JSON-LD, OID4VCI, OID4VP, SIOPv2, Statuslist 2021)
DID4EU	Collaborating with: • OpenID4VC • EBSI Participated in the following international events on standardization: N/A Main focus on: W3C DIDs and VCs, ISO mDL/mdocs, IETF SD-JWTs, OID4VC, IETF SD-JWTs
IM4DEC	Collaborating with EMTEL on: • ETSI TS 103 479 • ETSI TS 103 698 Participated in the following international events on standardization: N/A

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	Main focus on: W3C DID Core Spec v1.0, W3C Verifiable Credentials Data Model v2.0
WIDE	Collaborating with: N/A Participated in the following international events on standardization: • events within the EU/EEA pertaining to eIDAS and beyond Main focus on: SD-JWT, VCDM 2.0, OIDC{VC,VP,SIOP}, OAuth, CBOR
Client DIDs	Collaborating with W3C and DIF on: • DID and VCs Participated in the following international events on standardization: • W3C workshops, DIF meetings, and ToIP conferences Main focus on: W3C Verifiable Credentials Data Model for secure and interoperable digital credentials
EVI	Collaborating on: • OPCP protocol for Plug and Charge Participated in the following international events on standardization: N/A Main focus on: JWS2020 via Waltid
IS-CIS	Collaborating with: N/A Participated in the following international events on standardization: N/A Main focus on: Alastria-ID, web:did, web:eth, OIDC
PRIVÉ	Collaborating with UBITECH and DIF on:

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	• Device Binding Working Item and Direct Anonymous Attestation (DAA) as a building block for the Wallet security that enables a high level in the differential credential security model by anchoring a hardware-generated public key to the credential. Participated in the following international events on standardization: • Digital Credentials for Europe (DC4EU): https://www.dc4eu.eu/outputs/ • Meeting with GRNET DC4EU for educational credentials Main focus on: Zero-knowledge proofs to enable privacy-preserving credential verification. Such zero-knowledge proofs are wrapped as W3C Verifiable Credentials and Presentations

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4 CONCLUSION

This deliverable outlines the standardization activities within the TRUSTCHAIN project up to month 18. These activities were conducted by both the core TRUSTCHAIN team and the OC projects funded by TRUSTCHAIN. The deliverable also identifies the relevant standardization domains for TRUSTCHAIN and details pertinent EU and international standardization activities, which are subsequently mapped to the TRUSTCHAIN core group and the OC1 funded projects.

At the time of writing, only input from the OC1 projects was available, as they were the only projects to have reached the D4 milestone. A subsequent deliverable at month 36 will provide updated information on standardization, including activities from the projects that will participate in remaining OCs.

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