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PDL Landscape of Standards and Technologies

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**Group Report**

Reference

DGR/PDL-001\_Landscape

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# Foreword

This Group Report (GR) has been produced by ETSI Industry Specification Group (ISG) Permissioned Distributed Ledger (PDL).

# Modal verbs terminology

In the present document "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx) (Verbal forms for the expression of provisions).

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# Introduction

Standards are everywhere and are playing a key role to protect consumers, workers and environment. Blockchain and Distributed Ledger Technologies represent a key performance indicator for the Standardization Bodies and Organizations worldwide. First initiative was launched by ISO in 2016, as an initiative from Australian mirror Committee which conformed the Committee ISO/TC 307 [i.1] with the Scope "Standardisation of Blockchain technologies and distributed ledger technologies".

Following the aim of standardization at the European level, CEN-CENELEC conformed a Focus Group [i.2] for Blockchain and Distributed ledger technologies in 2017 which is under liaison with ISO TC307 and a "White Paper "Recommendations for Successful Adoption in Europe of Emerging Technical Standards on Distributed Ledger/Blockchain Technologies" [i.2] was approved and published by CEN-CENELEC in 2018.

At United Nations level, the International Telecommunication Union is working very efficient with various Study Groups and related materials and it is relevant the Focus Group [i.2] on Application of Distributed Ledger Technology in May 2017.

There are also initiatives and programs which are focus on standardization like the Joint Initiative on Standardization under the Single Market Strategy [i.3] which is a voluntary collaborative effort and does not establish any new legal commitments whereby Standards are key for innovation and progress within the European competitiveness. Basically, this Joint Initiative on Standardization sets out a shared vision for European standards in order to take steps to better prioritize and to modernize the current European Standardization system, as well as to strive for the timely delivery of standardization deliverables. It supports the relevant aspects of the ten European Commission's Priorities and other policy objectives, while clearly respecting the distribution of different competences between the EU and the Member States.

The European Blockchain Observatory and Forum (<https://www.eublockchainforum.eu/>) is an open project to create most comprehensive map of the European Blockchain ecosystem and as European Commission Initiative to accelerate blockchain innovation and the development of blockchain ecosystem within the EU and so help cement Europe´s position as a global leader in this transformative new technology.

There are also other alternative efforts related to the standardization of some properties that DLTs can provide which are considered within this GR like W3C (<https://www.w3.org/>) or <https://opentimestamps.org/> .

# 1 Scope

The present document will identify current activities in standardization and in research which are particularly relevant to PDL, with the goal of identifying applicable solutions, required enhancements and recommendations for further collaboration. As appropriate, activities of professional or non-profit initiatives will also be considered.

# 2 References

## 2.1 Normative references

Normative references are not applicable in the present document.

## 2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non‑specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ISO/TC 307: "Blockchain and distributed ledger technologies".

NOTE: Available at <https://www.iso.org/committee/6266604.html>.

[i.2] CEN-CENELEC Focus Group on Blockchain and Distributed Ledger Technologies: "Recommendations for Successful Adoption in Europe of Emerging Technical Standards on Distributed Ledger/Blockchain Technologies".

NOTE: Available at <ftp://ftp.cencenelec.eu/EN/EuropeanStandardization/Sectors/ICT/Blockchain%20+%20DLT/FG-BDLT-White%20paper-Version1.2.pdf>.

[i.3] European Commission: "The Single Market Strategy".

NOTE: Available at <https://ec.europa.eu/growth/single-market/strategy_en>.

[i.4] ISO/TR 23455:2019: "Blockchain and distributed ledger technologies -- Overview of and interactions between smart contracts in blockchain and distributed ledger technology systems".

NOTE: Available at <https://www.iso.org/standard/75624.html>.

[i.5] ITU Focus Group on Application of Distributed Ledger Technology.

NOTE: Available at <https://www.itu.int/en/ITU-T/focusgroups/dlt/Pages/default.aspx>.

[i.6] W3C Working Draft 8 February 2019: "Verifiable Credentials Data Model 1.0".

NOTE: Available at <http://www.w3.org/TR/2019/WD-verifiable-claims-data-model-20190208/>.

[i.7] Directive 2000/31/EC of the European Parliament and of the Council of 8 June 2000 on certain legal aspects of information society services, in particular electronic commerce, in the Internal Market.

# 3 Definition of terms, symbols and abbreviations

## 3.1 Terms

Void.

## 3.2 Symbols

Void.

## 3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AI Artificial Intelligence

AML Anti-Money Laundering

API Application Program Interface

CEN European Committee for Standardization

CENELEC European Committee for Electrotechnical Standardization

CFT

CTN

DAO Decentralized Autonomous Organization

DIN

DINRG

DLT Distributed Ledger Technology

EBP European Blockchain Partnership

EBSI European Blockchain Service Infrastructure.

EC European Commission

EEA

EFTA European Free Trade Association

eIDAS Electronic Identification, Authentication and Trust Services

EIRA European Interoperability Reference Architecture

ESSIF European Self Sovereign Identity Framework

ETSI European Telecommunication Standards Institute

EU European Union

FG

FGBDLT

FGDLT

FG-DLT

FIG International Federation of Surveyors

GDPR General Data Protection Regulation

ICO Initial Coin Offering

ICT Information and Communications Technology

IoT Internet of Things

IRTF

ISO International Standards Organization

ITU International Telecommunication Unit

ITU-T

KYC Know Your Customer

OECD Organization for Economic Co-operation and Development

OGC

OMA

PDL Permissioned Distributed Ledger

PIA

RG

SBS

SC

SEP

SG Study Group.

SME Small and Medium Enterprise

STO Security Token Offering

TOOP The Once-only Principle

TSAG Telecommunication Standardization Advisory Group

UN/CEFACT United Nations Centre for Trade Facilitation and Electronic Business

UNCITRAL United Nations Commission on International Trade Law

UNE Spanish Association for Standardization

WS

# 4 Introduction to main areas of application of PDL technologies and role of standards

Distributed Ledgers Technology is categorized as a General Purpose Technology and as such can provide benefits to a large number of applications across most industries. Applications that use PDL technologies will benefit from distributed trusted databases with recorded verifiable transactions which can be automated to increase efficiency and reduce costs.

Typical applications, industrialized and emerging, may be divided into horizontal applications which provide common functions, and vertical applications that serves a more specific industry application typically leveraging one or more horizontal application. Some examples below.

Table 1: Main Areas of PDL Applications

|  |  |
| --- | --- |
| HORIZONTAL DOMAIN | VERTICAL DOMAIN |
| Identity Management: individuals, objects, legal entities and processes | eGovernment: Properties, benefits records |
| Data Management: data sharing, | Healthcare: Health records, Prescriptions |
| Logistics and Supply-Chain | Industries: Manufacturing distribution |
| Security Management | Automotive and IoT: Supply chain, data integrity, Autonomous vehicles |
| Digital Evidence | Commerce |
| Invoicing Management | Finance- securities trading, Trade finance, Micro-credits and remittance, insurance |
| Crypto-structures and DAO | Utilities: Share records and trading, Energy Sector, Smart-Metering, Smart-grids, Telecommunications, Water and Waste management. |
| Contract Management: Smart Contracts | Media and Social Media: Intellectual Properties management, e-Sport, Culture, Art, Advertisement |
| Currency Management | Agriculture |
| Decision Management: A.I.-decision traceability | Education: e-learning, Diplomas validation |
| Privacy management |  |

The many initiatives have created a fragmented market and many reports states the lack of standards as a significant barrier to adoption. Several initiatives are ongoing and examples of where standards can help include terminology, interoperability, security, privacy, and data management.

AI- data traceability: AI is a number of technologies of data processing nature that may assist decision making. The use of AI may be validated and enhanced by traceability. The traceability of a number of data management processes involving machine, scripting and human processing may be enhanced with the use of AI and its functionality.

# 5 Current activities in standardization

## 5.1 International Standards Organization (ISO TC-307)

ISO/TC 307 [i.1] Blockchain and Distributed Ledger Technologies since 2016 has 43 participating members and 13 observing members. It has liaisons committees to ISO/TC 307 and from ISO/ TC307. And it is relevant the Joint Working Groups ISO/TC46/SC11/JWG1 with title Joint ISO/TC46/SC 11-ISO/TC 307 WG: Blockchain. There are also organizations in liaison like European Commission, Enterprise Ethereum Alliance Inc, Institute of Electrical and Electronic Engineers Inc, ITU, OECD, SWIFT, UNECE and International Federation of Surveyors.



NOTE [i.4]

Figure 1: ISO TC307 - Standards under development

## 5.2 CEN-CENELEC FGBDLT

CEN-CENELEC: CEN (European Committee for Standardization) and CENELEC (European Committee for Electrotechnical Standardization) are recognized by the EU and EFTA as European Standardization Organizations responsible for developing standards at European level. These standards set out specifications and procedures in relation to a wide range of materials, processes, products and services. The members of CEN-CENELEC are the National Standardization Bodies and National Electrotechnical Committees of 34 European countries. European Standards and other standardization deliverables adopted by CEN-CENELEC are accepted and recognized in all these countries. For Blockchain and Distributed Ledger Technologies the Focus Group in 2019 will identify specific European needs and release a new version of its technical white paper for the successful implementation of Blockchain and DLT in Europe.

There are numerous standards under development within CEN-CENELEC and the strategy which is public consider between their pivotal highlights' Digital transformation, International cooperation like task force with Gulf, India, Japan, China and Africa; seminars and workshops. Some of the interesting standards under development are: For Digital Society, CEN/WS 084 Self-Sovereign Identifier for Personal Data Ownership and Usage Control, CEN/CLC/WS SEP2 Industry Best Practices and Industry Code of Conduct for Licensing of Standard Essential Patents in the field of 5G and Internet of Things, CLC/TC108X Safety of electronic equipment within the fields of Audio/Video, Information Technology and Communication Technology, CLC/TC 209 Cable networks for television signals, sound signals and interactive services. For Mechanical and machinery mainly focus for safety and segments like entertainment technology and amusement park machinery and structures. For services CEN/TC 445 Digital Information Interchange in the Insurance Industry, CEN/TC 278 Intelligent transport systems. Recently CEN-CENELEC has approved liaison with ETSI ISG PDL and a new TC will act as mirror with ISO/TC 307 [i.1].

## 5.3 ITU-T FG-DLT

ITU The Focus Group for Distributed ledger technologies (DLT) was established in May 2017 and concluded August 2019. A parent group is TSAG (Telecommunication Standardization Advisory group) the participation in FG DLT is open. Deliverables of the FGDLT can be found at [i.5].



NOTE: There are other Study Groups which are related to DLTs like SG 13 of ITU-T about Future Internet, the Work Item is Decentralized Network Infrastructure. The interaction with the SG 16 about Multimedia has launched three new areas of exploration for the ITU-T FG DLT.

Figure 2: Related standards

## 5.4 IEEE Standards Association

IEEE Standards Association is doing prospection in some areas with some projects for Blockchain and Distributed ledger with some report and documents that can be found herein <https://blockchain.ieee.org/standards>.

## 5.5 ETSI

European Telecommunication Standards Institute: ETSI ISG PDL is the unique Working Group specifically working on DLT however there are others standards from ETSI that are usefully elements for DLT considerations.

# 6 Current activities in research

Information can be found in the excel file attached to the present document "Cordis\_DatabaseSearch\_DLT\_Blockchain\_EU\_H2020\_Projects\_List\_NEC.xlsx" which is contained in the zip file gr\_pdl001v000010p0.zip.

# 7 Activities of professional initiatives and alliances

## 7.1 Opentimestamps: <https://opentimestamps.org/>

This is a relevant jointly initiative for a Timestamping Proof Standard, accordingly with their focus to prove that some data existed prior to some point in time. OpenTimestamps defines a set of operations for creating provable timestamps and later independently verifying them.

The exploration of this open source initiative is bringing to a key attribute for trust on the DLT system which is very easily compatible for hybrid and permissioned distributed ledger systems, a variety of tools on JAVA, RUST, PYTHON and JAVASCRIPT.

## 7.2 W3C: W3C (<https://www.w3.org/>)

World Wide Web Consortium is a well known international community where a diverse of members deploy together Web Standards, between other initiatives within this organization, last version about Verifiable Credentials Data Model [i.6] is published which is a standardization effort with relevant commonalities for identity management on distributed ledger technologies. There is also an open repository for technical specifications at github herein <https://github.com/w3c/vc-data-model/issues>.

## 7.3 Alastria: <https://alastria.io/en/>

Alastria is a non-profit association that promotes the digital economy. It is a framework for networks based on Public Permissioned Distributed Ledgers. Public and Private sector and governmental administrative bodies are composing a whole economic coverage on Distributed Ledger Initiatives which compete and cooperate between their members to help the harmonization of Standards and regulation with their Use Cases. The Association has presented at UNE a proposal of "de-facto" standard implemented on Alastria, the new work item was accepted and it is under revision by UNE CTN 71/SC 307/GT1 for a Decentralized Model of Identity.

## 7.4 Dutch Blockchain Coalition (Private Public Partnership Netherlands): <https://dutchblockchaincoalition.org/en>

## 7.5 Hyperledger Project: <https://www.hyperledger.org/>

Hyperledger is the leader of private permissioned distributed ledger initiatives with Hyperledger Fabric but it is also a combination with other tools and functionalities which are impacting for interoperability with Permissionless Distributed Ledgers and Public Permissioned Distributed Ledgers. It is a well-organized charter by Linux Foundation. It has got a variety of projects available which incubates and promotes for a business blockchain technologies industry, in Permissioned Distributed Ledgers: Burrow for permissionable smart contracts machine, Fabric with a range of use cases from finance to supply-chain, Indy for a decentralized identity management, Iroha a consensus with multi-signature support or Swatooth with a Proof of Elapse Time with the aim of a minimal resource consumption. It is also noted their libraries like Aries, Quilt or Transact between others and some tools for ledger independent implementation.

## 7.6 EEA: [Enterprise Ethereum Alliance Inc](https://entethalliance.org/)

Enterprise Ethereum Alliance is a member-driven standards organization whose charter is developing open, blockchain specifications that facilitate harmonisation and interoperability for business and consumers worldwide. It is a complete community with key players in the industry cooperating on specifications under working groups leadership and some of their publications are interesting like Telecommunications Use cases, Real Estate Use Case Overview and a Token Taxonomy Initiative Flyer.

## 7.7 SEP: Common denominator with SEP (Standards Essential Patent) Landscape <http://ec.europa.eu/growth/content/landscaping-study-standard-essential-patents-europe-0_en>

## 7.8 INATBA: [https://inatba.org](https://inatba.org/)

The International Association for Trusted Blockchain Applications was founded in April 2019 and is organically under coordination and establishment of various Working Groups and liaisons with Standards Developing Bodies. It is well organized and closely connected in this inception with the European Commission and European Blockchain Observatory and Forum perspective. It is actively promoting the dialogue with policy makers and public administrative bodies, and connected the private sector envisioned for the European Blockchain Service Infrastructure.

## 7.9 Alliance for Internet of things Innovation: <https://aioti.eu/>

It is an Alliance focus for a five years period until 2024 with the vision on the European Union policies and in particular within the work with the programme of the next European Commission. Some of their key activities are focus to leveraging IoT data, enabling cross-sectoral data marketplaces. The objective of this Association is to enhance innovation and economic development in the Internet of Things in Europe with a non-profit aim.

## 7.10 Industrial Internet Consortium: <https://www.iiconsortium.org/>

It is a Global Not-For Profit Partnership of industry, government and Academia, it was founded in March 2014 to bring the organizations and technologies necessary to accelerate the growth of the industrial internet by identifying assembling, testing and promoting best practices.

## 7.11 IETF IRTF

A Research Group is in formation in the IRTF on the topic of Decentralized Internet Infrastructure (DIN). The Decentralized Internet Infrastructure Research Group (DINRG) will investigate open research issues in decentralizing infrastructure services such as trust management, identity management, name resolution, resource/asset ownership management, and resource discovery. The focus of DINRG is on infrastructure services that can benefit from decentralization or that are difficult to realize in local, potentially connectivity-constrained networks. Other topics of interest are the investigation of economic drivers and incentives and the development and operation of experimental platforms. DINRG will operate in a technology- and solution-neutral manner, i.e. while the RG has an interest in distributed ledger technologies, it is not limited to specific technologies or implementation aspects. More details of the DIN RG are available: <https://trac.ietf.org/trac/iab/wiki/Multi-Stake-Holder-Platform#Ledger>.

## 7.12 OASIS: <https://www.oasis-open.org/standards>

OASIS is non-profit consortium that drives the development, convergence and adoption of open standards for the global information society. The consortium has more than 2000 participants representing over 600 organizations and individual members in more than 65 countries.

Existing OASIS standards projects with e-commerce applications are being applied to define blockchain-based serialization methods, as alternative representations of their content (such as e-invoices).

## 7.13 SBS: <https://www.sbs-sme.eu/>

Small Business Standards: was established on 25th October 2013 and it is an international non-profit association, in line with Regulation 1025/2012 on the European Standardization System. Its mission is representing the interest of 12 million SMEs in the standardization process, raise their-awareness about standardization and facilitating their uptake of standards, and motivate them to engage in the standardization process.

## 7.14 OGC

Open Geospatial Consortium (OGC): announced the creation of a new Domain Working Group for Blockchain and Distributed Ledger Technologies. In October 2018, OGC published a Discussion Paper "Geospatial Standardization of Distributed Ledger Technologies with the purpose of improving the understanding of Blockchain and distributed ledger technologies (<http://www.opengeospatial.org/projects/groups/bdltdwg>).

## 7.15 FIG: <http://www.fig.net/>

International Federation of Geomatics (FIG). It is the international organization representing the interests of surveyors worldwide. It is a federation of the national member associations and covers the whole range of professional fields within the global surveying, geomatics, geodesy and geo-information community. It wants to keep, and even improve, its role as the premier non-governmental organization that represents the interests of surveyors worldwide. Members are associations, affiliates, corporate members and academic members. It is structurally organized on Commissions.

FIG Commission 9 on Valuation and Management of Real Estate and FIG Commission 7 on Cadastre and Land Management are the two groups looking into implications on Blockchain and DLTs.

## 7.16 oneM2M: <http://www.onem2m.org/>

oneM2M, it deploys standards for Machine-to-Machine and the Internet of Things, it is almost 200 members. The purpose and goal is to develop technical specifications which for a common M2M Service Layer that can be embedded within various hardware and software, and relied upon to connect the devices in the field with M2M application servers worldwide.

## 7.17 OMA

Open Mobile Alliance, it deploys specification and promoting standards in mobile and internet of things technology development, in particular APIs it is a part of components with DLT´s scenarios, and OMA has got an interesting API Inventory. <https://www.openmobilealliance.org/wp/API_Inventory.html>

# 8 Highlights of PDL solutions and needs

## 8.1 Regulatory Aspects

There are a number of existing laws that are applicable to DLT like KYC (Know Your Customer) and AMl (Anti-Money Laundering) requirements, at the same time there are initiatives from countries to include exemptions or benefit to startups using DLT like Switzerland or the sandbox rule in Swiss banking law. France and Germany proposed to introduce a uniform regulation of DLT in 2018 at G20 summit but did not convince the G20 for a suitable law. A number of countries are running recommendations from their central banks and other regulatory authorities which increase the proliferation of needs for a legal framework with no uncertainty. For pioneering countries which start DLT‑specific legislation. Legislators are more focus on ICOs and STOs and financial regulation. CFT (Counter‑financing of Terrorism or Combating the financing terrorism) involves investigating, analysing, deterring and preventing sources of funding activities for political achievement, religious or ideological goals thru violence. For financial industry there are a number of risks identified mainly for Cryptocurrencies.

On regards on the Node operators and within telecommunication law the instrument called "provider privilege" in Europe it has been defined as per Directive 2000/31/EC [i.7] in particular with the liability of intermediary service providers in Section 4, article 12:

*"Mere conduit"*

1. *Where an information society service is provided that consists of the transmission in a communication network of information provided by a recipient of the service, or the provision of access to a communication network, Member States shall ensure that the service provider is not liable for the information transmitted, on condition that the provider:*

*a) does not initiate the transmission;*

*b) does not select the receiver of the transmission; and*

*c) does not select or modify the information contained in the transmission*

Legal liability within permissioned and access restricted DLT systems, to preserve the trust in the immutability, a node operator should not be forced to delete some part of a DLT system even when it is known to be in conflict with the law. Conflicts arise for copyrights, trademarks, privacy, antitrust or unfair competition which in public blockchains these are conflicts indeed. There are some existing laws for instance in Data protection for personal data like GDPR and other countries It is a recommended practice to deal a PIA, Privacy Impact Assessment to assists organizations in identifying and minimizing the privacy risks.

In trade and logistic it is relevant the UN/CEFACT which is preparing a White Paper on Blockchain, and UNCITRAL environment is ideal to conferred multijurisdictional approach.

Government services are increasingly utilizing DLT to provide trust services, e-government initiatives are enhancing their frameworks, for instance in Europe exists TOOP which is a pilot for interoperability. Anticipation is a relevant factor a new design with Policy Enforcement Points that are distributed among governed network. These areas can harmonize better data minimization and use limitation of data.

Regulation on electronic identification and trust services, there are a number of laws for digital signatures, electronic certificates and identification which sometimes are not neutral or consolidate a common denominator globally. eIDAS is a proper framework which is extensively improving these aspects.

Smart Contracts enforceability is other back-bone in permissioned distributed ledger systems.

Competition Law and Anti-Trust policies are a relevant part for regulatory areas and policy makers.

Conformance and compatible chip-sets and other components are also a compliance needs for a multijurisdictional framework. Hybrid ecosystems brings even new challenges in this sense, where multiple actors with different components can interoperate between them, safety of human beings is a public good that implies at many industries the perseverance in controlling and stewardship gives some ability to resolve clearance.

It is also of importance the common evolving of Sandboxes in different countries to granted a secured testing environment with the allowance of discoverability and improving the legal innovation and experimentation.

## 8.2 Ecosystem and EU-Market aspects:

European Blockchain Partnership (EBP) (https://ec.europa.eu/digital-single-market/en/news/european-countries-join-blockchain-partnership) was launched on the 10th April 2018 with the aim to develop a trusted, secure and resilient European Blockchain Services Infrastructure (EBSI) meeting the highest standards in terms of privacy, cybersecurity, interoperability and energy efficiency, as well as fully complaint with EU law. The European Blockchain Partnership will also develop a set of Guiding Principles and Specifications for the EBSI (European Blockchain Service Infrastructure) that will be enhanced to be recognized as a reference for development of Blockchain infrastructures and will propose a model to describe the overall policy and technical governance of the EBSI. Various organic development are managing different aspects like EIRA (European Interoperability Reference Architecture) and ESSIF (European Self-Sovereign Identify Framework). Some pilots are under deployment and will trace the state of the art for the EBP.

ICT Standardization priorities for the Digital Single Market is an indicator to overview the EU-Market development: <https://ec.europa.eu/digital-single-market/en/news/communication-ict-standardisation-priorities-digital-single-market>.

eIDAS regulation is the framework of preeminent success in Europe and an intrinsic part of the European Ecosystem.

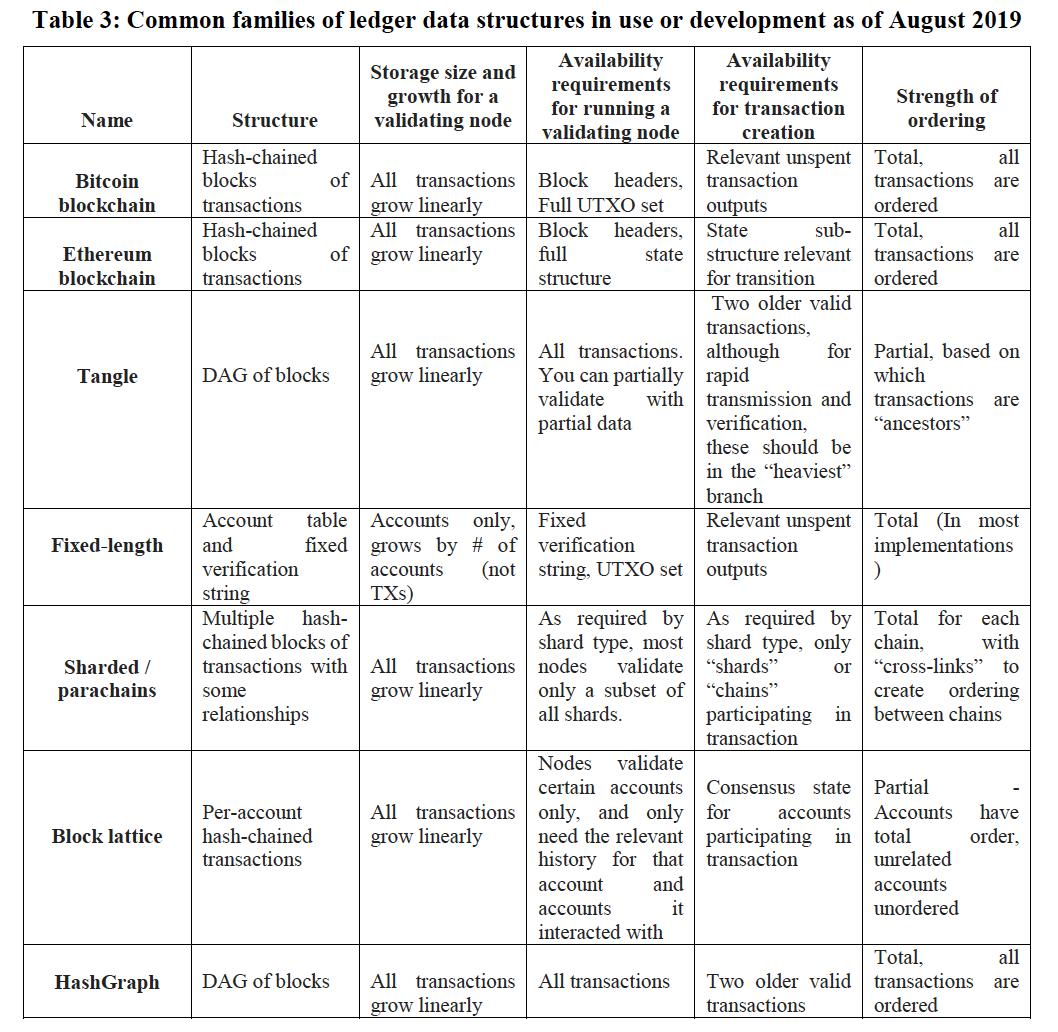
# 9 Enhancements and recommendations for further collaboration

Technical collaborations to be considered: CEN-CENELEC, ISO TC307, ITU-T FG DLT, W3C, IEEE Policy and ecosystem collaborations needed: OECD (focus on public sectors), EBP, EBSI, ESSIF, EIRA, INATBA, UN/CEFACT and UNCITRAL, Timelines of external organizations/events and their impact on collaborations: <https://www.gsma.com/>, <http://www.opengeospatial.org/>.

Annex A:  
Ledger Data Structures:

ITU-T FG DLT, previously described within the point 5.3 of this report, has published their recommendations and deliverables are published, between them at the document described on the NOTE to the table bellow it is based on a detailed study of the Focus Group on Distributed Ledger Technologies and their Applications and at an overview for ledger data structures in use.

Table A.1: Common families of ledger data structures in use or development as of August 2019



NOTE: Table published by ITU-T Focus Group on Application of DLT within its Technical Report FG DLT D5 OUTLOOK on Distributed Ledger Technologies.

# History

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