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Permissioned Distributed Ledger (PDL); Application Scenarios

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Reference

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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 (Verbal forms for the expression of provisions).

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1 Scope

The present document describes Permissioned Distributed Ledger Application Scenarios. The aim is to consider and describe the potential application scenarios for the operation of PDLs, including provision models with special emphasis on as-a-service paradigms, and PDL infrastructure governance aspects. The present document provides definition of terms to be used in the scenarios and recommendations for future normative specifications.

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 TC307: "Blockchain and distributed ledger technologies".

[i.2] ISO 22739: "Blockchain and distributed ledger technologies -- Vocabulary".

[i.3] Recommendation ITU-T SG13: "Future networks including cloud computing, mobile and next-generation networks".

[i.4] ETSI GR PDL 001: "Permissioned Distributed Ledger (PDL); Landscape of Standards and Technologies".

[i.5] ITU-T Technical Specification FG DLT D1.1: "Distributed ledger technology terms and definitions", Definition number 6.22 "Fork".

[i.6] ITU-T Technical Specification FG DLT D1.1: "Distributed ledger technology terms and definitions", Definition number 6.25 "Hard Fork".

[i.7] World Economic Forum (04/2020): "Inclusive Deployment of Blockchain for Supply Chains: Part 6 - A Framework for Blockchain Interoperability".

NOTE: Available at https://www.weforum.org/whitepapers/inclusive-deployment-of-blockchain-for-supply-chains-part-6-a-framework-for-blockchain-interoperability.

[i.8] Jennifer J.Xu.:"Are blockchains immune to all malicious attacks?".

NOTE: Available at https://jfin-swufe.springeropen.com/track/pdf/10.1186/s40854-016-0046-5.

[i.9] Aljosha Judmayer, Nicholas Stifter, Alexei Zamyatin, Itay Tsabary, Ittay Eyal, Peter Gaži, Sarah Meiklejohn, Edgar Weippl: "Pay-To-Win: Cheap, Crowdfundable, Cross-chain Incentive Manipulation Attacks on Cryptocurrencies".

NOTE: Available at https://eprint.iacr.org/2019/775.pdf.

[i.10] ETSI GR PDL 004: "PDL: Smart Contracts Permissioned Distributed Ledgers System Architecture and Functional Specification".

[i.11] ETSI GR PDL 006: "Permissioned Distributed Ledger (PDL); Inter-Ledger Interoperability".

3 Definition of terms, symbols and abbreviations

3.1 Terms

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

API Gateway: API management tool that sits between a client and a collection of backend services and acts as a reverse proxy to accept all Application Programming Interface (API) calls, aggregate the various services required to fulfil them, and return the appropriate result

NOTE: See Red Hat® at https://www.redhat.com/.

chain: collection of PDL records concatenated to each other through a unique format and a specific order that may vary depending on PDL type

common functionalities: such functionalities that offer similar or same behaviour across multiple applications

core functionalities: such functionalities that exist in all applications

fork: occurence where a single blockchain is split into two or more separate blockchains by having different blocks appended to it. Once Forked, each blockchain becomes an individual Chain

node: device (real or virtual) that transacts on a Chain

omni-Lateral: PDL that all (Omni) nodes in a platform participate in

PDL Platform: collection of Nodes transacting in a coordinated manner on one or more Chains

PDL Type: PDL variations by Functional components such as Chain structure, Consensus mechanism, Publicity, Implementation, Security, Discoverability

Permissioned Distributed Ledger (PDL): distributed Ledger that maintains access control to allow certain actions to be performed only by certain identifiable participants

NOTE: See clause 4.1 of the present document.

transacting node: node that transacts on a PDL but does not participate in a Consensus Vote

validating node: node that participates in a Consensus vote

3.2 Symbols

Void.

3.3 Abbreviations

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

AML	Anti-Money Laundering
API	Application Programmable Interface
AS	Autonomous System
BGP	Border Gateway Protocol
CPU	Central Processing Unit
DLT	Distributed Ledger Technology
DNS	Domain Name Service
ETSI	European Telecommunications Standards Institute
EU	European Union
GDPR	General Data Protection Regulation

GPS	Global Positioning Service
GR	Group Report
GUI	Graphical User Interface
HR	Human Resources
ICT	Information and Communications Technology
IP	Internet Protocol
ISG	Interim Study Group
ISO	International Organization for Standardization
IT	Information Technology
ITU	International Telecommunication Unit
ITU-T	ITU Telecommunication standardization sector
KYC	Know Your Customer
MVP	Minimum Viable Product
NAS	Network Attached Storage
OS	Operating System
OSI	Open Systems Interconnection
P2P	Peer-to-Peer
PDL	Permissioned Distributed Ledger
RAID	Redundant Array of Independent Disks
RAM	Random Access Memory
SATA	Serial Advanced Technology Attachment
SHA	Secure Hash Algorithm
SLA	Service Level Agreement
SMS	Short Message Service
SWIFT	Society for Worldwide Interbank Financial Telecommunication
TCP	Transmission Control Protocol
TLS	Transport Layer Security
TPS	Transactions Per Second
VM	Virtual Machine
WEF	World Economic Forum
ZKP	Zero Knowledge Proof

4 PDL Reference Framework

4.1 Introduction

Chains differ from one another by multiple dimensions, such as consensus mechanism, transaction rate, programmability (through smart contracts), tamper-immunity and many others. The present document does not intend to compare different chain types nor is it the intention here to make a recommendation of a specific, or group, of chains. The commonalities are that PDL platforms can be Manageable and Governable, have to be Accessible by Applications and Services through APIs, and could, depending on DLT type, be programmable through Templates (that may be dependent on chain type).

4.2 Definition of PDL

PDL is a Distributed Ledger architecture offering modular possibilities with permission based processes.

Permissioned Distributed Ledger are commonly divided into two different approaches:

a) Public Permissioned Distributed Ledger.

b) Private Permissioned Distributed Ledger.

The operational scenarios of such ledgers are discussed in greater detail in clause 6.2.3 of the present document and can be generally defined as follows:

- Public PDL scenarios operate with no restrictions once an acceptance process is completed. Such process is part of the governance and operation of a DLT, which also include other policies with the aim to provide trustworthiness and a public or general-purpose service.

- Private PDL scenarios allow access to select members that have passed a certain selection criteria defined through the governance structure, and are aimed for a private or a specific purpose service.

4.3 Abstract PDL Architecture

In order to provide a basis for discussing various PDL Application Scenarios, an abstract, simplified, reference framework and functional diagram is used. Figure 1 herewith defines the three abstract layers that appear in most PDL implementations. They are discussed here one by one, as well as the relations and dependencies therein.

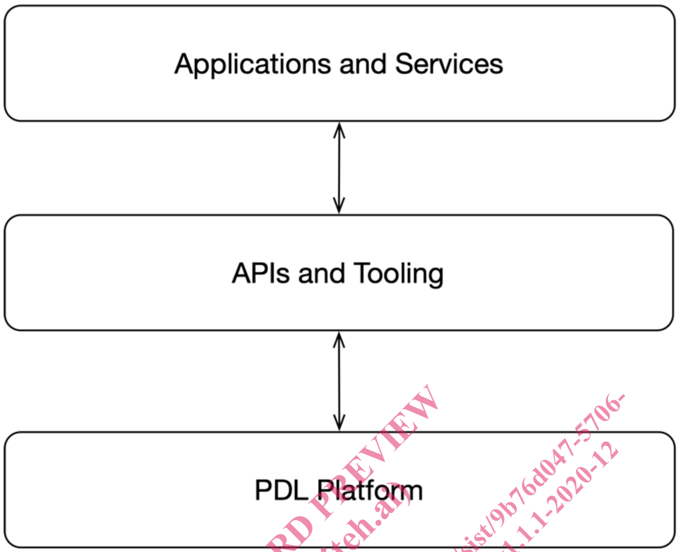

Figure 1: Abstract PDL Reference Framework

The Applications and Services layer represents the actual customer/consumer facing application, be that consumer an individual accessing the PDL platform through a portal or an application, or another platform/device accessing the PDL platform through an API or other means of electronic transactions. Depending on PDL type, an application can be implemented as a smart contract, as an external code/application (which may be platform or operating system specific e.g. mobile phone, desktop computer, IoT device) or as a mix of both.

It is beyond the scope of the present document to discuss the applications themselves and the methods by which they interface (northbound) with the customer/consumer.

Applications would require exchange of information with the PDL Platform itself, possibly more than one PDL, through a southbound interface. Such PDLs may be developed and operated by different entities.

APIs and Tooling layer allows interaction between the applications/services and the PDLs. This layer is referenced by ISO as the ***API Layer.*** For consistency, the present document follows the term used by the EU Blockchain Observatory and Forum. This layer allows abstraction of the PDL Platform and Application layers in a manner that may allow applications to operate on more than one PDL Type and vice-versa. This layer consists of consoles, dashboards, and development environments made available to developers, institutional users, auditors and regulators.

The ***PDL Platform layer*** contains the PDL nodes as well as smart contracts, management and governance tools, and other software elements that are embedded into code running on the PDL nodes. The PDL platform may use any of the multitude of PDL types available at the time and may use governance and management tools that are compatible/interoperable with said PDL Type.

In certain scenarios, specifically when the application is embedded into the PDL platform (e.g. as a smart-contract) and the users interface the PDL Platform layer directly, the Application and/or API layers may not be required.

Examples would be:

1) Scheduled actions taken without external intervention occur on the PDL Platform layer and do not require the API and Application layers.

2) A smart contract in a PDL platform that can be accessed through an API through a third party application (e.g. wallet) that is not part of the PDL platform itself.