# ETSI GS PDL 015 V1.1.1 (2023-01)


# Permissioned Distributed Ledger (PDL); Reputation management



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# Foreword

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



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# Executive summary

The present document discusses the use and application of reputation in PDL. The aspects of reputation discussed include:

a) The meaning of reputation.

b) Representation of reputation and the use of a normalized score.

c) Types of reputation with specific focus on:

   i) Reputation based on technical performance and adherence to service level commitments.

   ii) Reputation based on behaviour and conformance with standards and regulations.

d) The use of reputation when conducting PDL related activities.

The present document also defines methods for deriving reputation based on heuristics and measurement of performance levels.

# Introduction

The present document discusses the use and applicability of reputation in PDL. The main content is broken down to four clauses as described herewith:

a) **Clause 4** defines the term and discusses the different types of reputation with respect to technology and ETSI deliverables. Focus is given to assignment of reputation to objects of different types and methods of presentation.

b) **Clause 5** defines the use of reputation with focus on indicators such as:

   i) *Quality of Service*, indicating a score based on performance of service against defined targets.

   ii) *Trustworthiness*, indicating the involvement of the object in fraudulent activities.

   iii) *Commercial reliability or stability* indicating the object's solidity when it comes to financial matters.

   iv) This clause also discusses *objective scores*, based on measurable attributes, and *subjective scores* based on perception and unmeasurable attributes.

c) **Clause 6** discusses and defines the mathematical formulas used for calculating reputation based on actual performance with focus on the duration historical events have effect on current reputation score. Such as everlasting, linear decay and logarithmic decay.

d) **Clause 7** discusses GDPR aspects of reputation and the way to ensure compliance with such requirements.

The present document is a Group Specification and as such each of the clauses includes requirements (mandatory, recommended, optional) that need to be fulfilled for an ETSI compliant PDL reputation to be defined and managed.

# 1 Scope

The present document discusses and specifies:

a) The meaning of reputation.

b) Representation of reputation and the use of a normalized score.

c) Types of reputation with specific focus on:

   i) Reputation based on technical performance and adherence to service level commitments.

   ii) Reputation based on behaviour and conformance with standards and regulations.

d) The use of reputation when conducting PDL related activities.

# 2 References

## 2.1 Normative 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.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference/.

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 necessary for the application of the present document.

Not applicable.



## 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] Cambridge Dictionary definition of the term "reputation".

NOTE: Available at https://dictionary.cambridge.org/dictionary/english/reputation.

[i.2] Merriam-Webster Dictionary definition of the term "reputation".

NOTE: Available at https://www.merriam-webster.com/dictionary/reputation.

[i.3] "Reputation and its risks", Robert G. Eccles, Scott C. Newquist, and Roland Schatz, Harvard Business review, February 2007.

NOTE: Available at https://hbr.org/search?search_type=search-all&term=reputation+and+its+risks.

[i.4] Recommendation ITU-T G.107 (June 2015): "The E-model: a computational model for use in transmission planning".

# 3 Definition of terms, symbols and abbreviations

## 3.1 Terms

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

**object:** device, an entity or a functionality that can be identified and defined

## 3.2 Symbols

Void.

## 3.3 Abbreviations

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

| | |
|---|---|
| API | Application Programming Interface |
| CA | Certification Authority |
| D&B | Dun & Bradstreet ™ |
| CIBIL | Credit Information Bureau (India) Limited |
| CQE | Conversational Quality Estimation |
| DLT | Distributed Ledger Technology |
| ETSI | European Telecommunications Standards Institute |
| EWMA | Exponential Weighted Moving Average |
| GDPR | General Data Protection Regulation |
| GoB | Good or Better |
| ISG | Industry Specification Group |
| ITU | International Telecommunication Union |
| MOS | Mean Opinion Score |
| PDL | Permissioned Distributed Ledger |
| PoW | Poor or Worse |
| SLA | Service Level Agreement |
| SLS | Service Level Specifications |
| SP | Service Provider |
| VoIP | Voice over IP |
| WMA | Weighted Moving Average |
| ZKP | Zero Knowledge Proof |



# 4 Definition of Reputation

## 4.1 Introduction

In most PDL ecosystems quantifiable and verifiable reputation represents significant economic and operational value to the ecosystem participants/members or their delegates. While in human interactions a person would have more trust in another person or an entity with higher reputation, when it comes to digital systems such trust needs to be represented in a manner readable and usable by a machine so an algorithm of some sort can use such representation when making reputation-related decisions. Such decisions may include selection of vendors (where the algorithm may prefer a vendor with higher reputation or may consider reputation as one of multiple weighted factors such as price, delivery timelines, SLA, etc.). Reputation may be presented as a single metric but may also represent different metrics. E.g. an object may be assessed by its SLA reputation, financial stability reputation and trustworthiness reputation where each may have a certain effect on the final score calculated by an algorithm.

Certain entities offer reputation scores of various types. Banks typically define credit scores to their customers. Other companies provide scores to entities such as commercia companies and even countries. One of the main drawbacks of scores issued by such entities is the lack of transparency into the algorithms used to derive the score, and uncertainty about the motives or trustworthiness of the issuer of such scores.

PDL-based reputation scores offer a way to overcome both the issue of transparency and the uncertainty related to trust. PDL based algorithms are transparent and trust is embedded in PDL.

## 4.2 Etymology

### 4.2.1 Definition of Reputation

The Cambridge Dictionary defines reputation as *"the opinion that people in general have about someone or something, or how much respect or admiration someone or something receives, based on past behaviour or character"* [i.1].

The Meriam-Webster dictionary [i.2] gives the term Reputation three similar meanings with slightly different contexts:

a) overall quality or character as seen or judged by people in general;

b) recognition by other people of some characteristic or ability;

c) a place in public esteem or regard: good name.

Combining both sources reputation can be described as: Judgement of the behaviour of an object (object A) by another object (object B) which may affect decisions made by object B with regards to object A.



### 4.2.2 Branding and Reputation

Discussion of the difference between Reputation and Branding. A brand may have a reputation, meaning reputation is one of the attributes describing a brand. It is not uncommon that companies re-brand themselves and as a result their reputation may or may not follow to the new brand. e.g. an ill-repute brand may re-brand itself in an attempt to get rid of its poor reputation and start off with a clean slate. Another example could be two brands that merge into one and choose to retain the brand that has the better reputation. It is also not uncommon to see a company offering different brands in different geographies based on the reputation such brands have established in said geographies.

## 4.3 The value of reputation

In most PDL ecosystems quantifiable and verifiable reputation represents significant economic and operational value to the ecosystem participants/members or their delegates. The present document defines how ETSI ISG PDL manages a quantifiable and verifiable reputation framework.

**[O1]** The reputation of an ETSI ISG PDL entity **MAY** reflect:

a) The quality of its products and services.

b) Its trustworthiness as business/operational entity.

c) Its level of engagement in the PDL operations.

d) Additional factors not listed above.

There may be relationships among these different types of reputations, but there are important distinctions that determine how they are to be derived and used. As an example, an object (such as a node or a user) may be trustworthy when it comes to fraudulent activities, but perform poorly when it comes to its ability to process data on a timely manner. As such it will have a low Quality of Service score and a high Trustworthiness score. However – there may be scenarios where an object's slow performance or communication errors may cause it to appear as if it is injecting errors on purpose and that may also reduce its Trustworthiness score.

By leveraging the data integrity and time linearization properties of PDLs, it is possible to automate the collection, organization, and use of certain reputation information. This, in turn, can be used to make the PDL platform operations more transparent and reward those participants who offer a high-quality service and conduct their business fairly and according to governance rules.

In the context of a PDL platform the perception or opinion discussed in clause 4.1 is not necessarily held by people but may rather be held by systems or machines. The past behaviour or character is then measured against specific criteria and is expressed in comparable and readable numerical terms. The present document discusses both the methods by which such behaviour and character can be defined and measured, as well as possible ways to represent reputation in a normalized and comparable format.

The use of reputation as a measurable attribute of an object or an entity that can then determine actions related to such object or entity is the core value of reputation in a PDL platform.

Robert G. Eccles, Scott C. Newquist, and Roland Schatz discuss reputation in an article in the Harvard Business review [i.3] stating that "… *strong positive reputations attract better people. … perceived as providing more value.... organizations are especially vulnerable to anything that damages their reputations*". Leading to a conclusion that a good reputation may be an indicator of both the ability to perform well as well as the ability to sustain such performance over time. On the other hand, it also leads to the conclusion that damage to reputation not only indicates that an entity or object does not perform well, but it may also restrict such object or entity from being included in certain activities.

The resulting conclusion is that reputation offers value to both the objects or entities being measured and the objects or entities using those measurements in order to take decisions or actions.

## 4.4 Assignment of reputation to objects in a PDL platform

### 4.4.1 Assignment of Reputation to a PDL node



#### 4.4.1.1 Service Level related reputation

A PDL node can be assigned a reputation score representing certain Service Level related attributes which measure its adherence with defined/expected operational behaviour. Examples would be:



a) Uptime of the node.

b) Responsiveness of the node (e.g. time of data processing calculations and sending a response).

c) Additional attributes defined in a service level agreement defined by the governance.

These are discussed in detail in clause 5.1.2 herewith.

#### 4.4.1.2 Trustworthiness related reputation

A PDL node can be assigned a reputation score based on its trustworthiness within the context of PDL consensus operations and general calculations. Examples would be:

a) Involvement of the node in fraudulent activity.

b) Ability of the node to maintain proper security measures against external fraudulent activity.

These are discussed in detail in clause 5.1.3 herewith.

#### 4.4.1.3 Commercial reputation

A PDL node can be assigned a reputation score representing its payment and financial stability and behaviour. Such score may be linked to external credit score rating entities.

In the context of PDL payment and financial stability are related to:

a) Cryptographic transactions performed using a blockchain based crypto-currency.

b) Token based fiat transactions where certain details of the transaction are recorded on-chain.

These are discussed in detail in clause 5.1.4 herewith.

### 4.4.2 Assignment of Reputation to entities

Entities, in the context of a PDL platform, could be node operators, external storage providers, virtual or physical hosts and others. Such entities may operate one or more device that is involved directly or indirectly in PDL operations.

Assignment of reputation to such entities can be broken down in a similar manner to that of nodes: Service Level related and Trustworthiness related. The main difference is that entities may operate more than one device and the reputation of an entity affects all devices/nodes it operates, or all objects included in it.

### 4.4.3 The significance of reputation of objects

As per the etymological definition of reputation earlier in this clause, reputation may impact the opinion and behaviour of certain objects towards other objects. As a result, reputation may impact the likelihood of specific objects to be used/selected for certain tasks. Examples could be:

a) A node with poor trustworthiness reputation may be banned from taking part in certain consensus operations.

b) An entity with poor commercial reputation may be less likely to receive orders from potential customers who may consider them as a financial risk.

## 4.5 Disengagement of Reputation from Commercial/Monetary value



### 4.5.1 Representation of reputation as a metric



Measuring reputation should preferably yield a score with a numerical value. Even in environments with a binary behaviour (e.g. "Operational" vs. "Non-operational") a reputation score can be achieved over time by comparing the number or duration of the binary options thus yielding a score of "290 out of 300 samples were operational". In other environments, for example temperature-controlled environments, a score can represent the average temperature and the number of times or duration the temperature exceeded the min/max thresholds.



### 4.5.2 Binary Reputation vs. Score-based reputation

In a binary reputation scenario, an object can be tagged as "reputable" or "irreputable" and will then be considered for inclusion in or exclusion from key operations (consensus votes, hash calculations, etc.).

In a score-based reputation scenario an object has a reputation which is somewhere between a minimum and a maximum value and may then be considered for inclusion or exclusion from key operations based on its score. E.g. in the case of a platform with, say, 8 nodes and a governance rule stating that a minimum of 5 nodes is required for a vote to be valid, the governance may select the 5 nodes with the highest reputation score.

Typically, a lower score represents lower reputation, and a higher score represents a higher reputation. However, the governance has the prerogative to define the opposite. This is useful when the score, as a numerical value, is used for calculations related to the eligibility of an object to participate in key activities.

**[D1]** In a Score Based reputation scenario the governance **SHOULD** define the lower limit and the upper limit of the reputation score and the meaning of such limits related to the use of the score.