

ETSI GS PDL 022 V1.1.1 (2024-03)



Permissioned Distributed Ledgers (PDL); PDL in Wholesale Supply Chain Management

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Foreword

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

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**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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Executive summary

The present document defines and describes the use of PDL in the lifecycle of goods and/or services delivered through a supply chain. It defines the types of supply chains, the types and roles of entities in a supply chain, and the lifecycle phases and processes executed by the different entities along the supply chain. The present document also describes the architectural concepts of the PDLs used in supply chains as well as the data stored on the chain during the lifecycle processes.

Introduction

The delivery of goods and/or services through a supply chain involves operational and commercial activities across a chain of entities. Such goods and/or services traverse a series of phases that are bound into a lifecycle that may include initial inquiry/research, quoting, ordering, delivery, quality assurance, usage measurement, fault repair, financial settlement and change management.

A supply chain is built from pairs of Buyers and Sellers where on one side there is an ultimate Buyer procuring the goods and/or services, and down the chain there are entities that serve as both Sellers and Buyers. They sell to the upstream Buyer and buy from downstream Sellers. Some of those downstream entities simply pass the goods and/or services from the downstream Seller to the upstream Buyer (commonly referred to as "wholesaler") and some also contribute certain elements to the final product sold to the ultimate Customer. An example of a wholesaler would be a vegetable grocer that buys from the farmers by the tons and sells to the consumers by the kilo, while another example could be of a data centre operator that rents office space from one entity, buys 19" racks from another entity, computers from another entity, software licenses from yet another entity, integrates and assembles them all and sells computation capacity or storage space to ICT consumers.

The processes that occur at each participant in such supply chain differ depending on the lifecycle stage and the role that the participant plays in such chain.

Many entities participating in supply chains have developed their own processes, nomenclature and data models to define their internal operations. Integrating, coordinating and synchronizing such processes across operational boundaries creates misalignment in process steps, data models and inter-entity communications, often resulting in failure to automate the inter-entity operations thus reverting to slow and inefficient manual processes.

The present document defines the stages, processes, and high-level requirements each player has to abide by for the proper operation of a supply chain. The main intention is to allow automation of such supply chains, minimizing manual activities that are expensive, slow and prone to errors.

Clause 4 of the present document defines the types of supply chains, the entities taking part in a supply chain, the types of transaction occurring in a supply chain and the types of, and requirements from, the PDLs in use in a supply chain.

Clause 5 of the present document lists the lifecycle stages and defines the required process flow for each of those stages in a supply chain environment.

Annex A describes a potential use case of PDL in management of lifecycle of a network slice in a supply chain of mobile operators. This annex is descriptive and does not include specifications or requirements.

1 Scope

1.1 Definition

The present document defines and describes the use of PDL in the lifecycle of goods and/or services delivered through a supply chain.

1.2 In scope

- a) Definition of types of supply chains.
- b) Definition of the types and roles of entities in a supply chain.
- c) Definition of the lifecycle phases and processes executed by the different entities along the supply chain.
- d) Definition of the types of transaction occurring in a supply chain.
- e) Definition of the types of, and requirements from, PDLs in use in a supply chain.
- f) Definition of the lifecycle stages.
- g) Definition of the required process flow for each of lifecycle stage in a supply chain environment.

1.3 Out of Scope

- a) Detailed data models for specific goods and/or services.
- b) Settlement of usage-based services.

2 References

2.1 Normative references

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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] MEF 74 (December 2018): "Commercial Affecting Attributes".
- [i.2] Journal of Object Technology: "Cloud Computing; Today and Tomorrow", Vol. 8, No. 1, January-February 2009.
- [i.3] University of Cambridge (August 2018): "Cambridge Judge Business School - Defining DLT".
- [i.4] Recommendation ITU-T M.3400 (02/2000): "TMN management functions".
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- [i.13] Diego Ongaro and John Ousterhout: "Stanford University, In Search of an Understandable Consensus Algorithm", June 2014.

3 Definition of terms, symbols and abbreviations

3.1 Terms

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

bilateral agreement: business relationship between two Participants

NOTE: The business relationship between these Participants is always direct, private and bilateral.

bilateral business process: various business processes that are part of the Bilateral Agreement

NOTE: The bilateral business process includes Pre-Order, Order, Service Delivery, SOAM, Billing and Change Management.

bilateral PDL: ledger shared between exactly two parties

billing: commercial process of invoicing, reconciliation and settlement of amounts due by Buyer, Seller or bidirectional trading partners

NOTE: See MEF 74 [i.1].

Buyer: entity that buys a service from a Seller of which it is an immediate upstream neighbour in the Supply Chain

change management: changes made to in-operation service instances

cloud: non-geographically specific environment offering data services such as compute, storage and connectivity

NOTE: Journal of Object Technology [i.2].

commercial agreement: agreement between two parties allowing for buying services, selling services between them or both

commercial framework: framework that facilitates the generation of commercial value through wholesale trading of data services

compute: act of manipulating data or acting based on data using a computing resource

connectivity: act of transporting data through space

data service: service that combines one or more of the following:

- Connectivity service
- Compute service
- Storage service

data-on-demand service: data-on-demand services are expected to be activated, operated, billed, and settled with immediate effect

NOTE: This expectation is based on pre-existing and pre-on-boarded facilities and interconnects.

Distributed Ledger Technology (DLT): digital system for recording information so it is recorded in multiple places at the same time

NOTE: Defining DLT, University of Cambridge [i.3].

DLT Abstraction Layer: architectural abstraction between applications using the DLT and the DLT itself

ecosystem: federated and collaborative platform that enables establishment of data services through a Supply Chain

ecosystem-wide PDL: PDL that includes exactly one node from each participant in an Ecosystem

NOTE: It may also include a validation node.

fault management: process of identifying and rectifying faults in services

NOTE: Recommendation ITU-T M.3400 [i.4].

inquiry: first part of the process 'Inquiry and Quote'

NOTE: It includes request by Buyer from Seller confirmation of ability to Quote followed by a Quote for service as described in the Inquiry. Service details may include: Locations, Bandwidth, QoS, VNF details (CPU, OS, RAM, Storage, etc.).

Interface Reference Point (IRP): See MEF 55.1 [i.5].

internal PDL: repository that contains information that is used internally by an entity and that does not need to be shared with any external entity

invoicing: process in which the Seller generates and sends an invoice to the Buyer for the amount stipulated by the Bilateral Agreement and based on utilization information and SLA or other credits as applicable based on agreement

Lifecycle Service Orchestration (LSO): open and interoperable automation of management operations over the entire lifecycle of Layer 1, Layer 2 and Layer 3 Data Services

NOTE: This includes fulfilment, control, performance, assurance, usage, security, analytics and policy capabilities, over all the network domains that require coordinated management and control in order to deliver the service (see MEF 55.1 [i.5]).

LSO Reference Architecture: layered abstraction architecture that characterizes the management and control domains and entities, and the interfaces among them, to enable cooperative orchestration of Data Services

NOTE: See MEF 55.1 [i.5].

LSO Sonata IRP: IRP through which a Buyer and Seller exchange commercial and operational information pertaining to services

NOTE: See MEF 55.1 [i.5].

order: request from Buyer to Seller for service based on Quote provided by Seller

ordering: service lifecycle phase in which a Buyer places an order for a service with a Seller based on a quote received from the Seller either through an inquiry/quote phase or based on a valid rate sheet

provisioning: phase in the lifecycle of a data-on-demand service during which an order is fulfilled and implemented on the respective network components

quote: price for a service offered by a Seller to a Buyer

raft: consensus algorithm

NOTE: See Stanford [i.13].

reconciliation: process of reaching agreement in case of a dispute

NOTE: See MEF 74 [i.1].

Seller: entity that sells goods or a service to a Buyer of which it is an immediate downstream neighbour in the Supply Chain

service chaining: process of configuring and integrating multiple Service Elements to become a single composite service referred to as a Service Chain

NOTE: See IETF RFC 7665 [i.6].

service delivery: process of integrating different Service Elements and delivering them as complete service to the Buyer

service element: component of a service

EXAMPLE: Include VM, Access E-Line, combination of the two, etc.

settlement: transfer of monetary funds between parties based on billing and reconciliation

NOTE 1: The process of analysing the amount a Buyer is invoiced by the Seller, comparing the resource usage and the monetary amounts associated with use of the resource as per commercial agreement, identifying the differences between the Seller's records and calculations to those of the Buyer. The differences may be settled either automatically or manually through algorithms.

NOTE 2: See MEF 74 [i.1].

Service Level Agreement (SLA): contract between the Subscriber and Service Provider specifying the service level commitments and related business agreements for a service

NOTE: See MEF 10.4 [i.7].

service lifecycle: sequence of phases in the life of a service including Inquiry, Quote, Order, Billing and Change Management

SLA Reputation: metric representing the on-going performance of a network compared to its Service-Level commitments

NOTE 1: The reputation is a score based on a moving average.

NOTE 2: See also ETSI GS PDL 015 [i.8].

Service Operations, Administration, and Maintenance (SOAM): See MEF 17 [i.9].

storage: act of transporting data through time

supply chain: collection of entities that in combination deliver one or more goods or end-to-end services through bilateral agreements

Virtual Machine (VM): See Computer [i.10].

3.2 Symbols

Void.

3.3 Abbreviations

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

| | |
|-------|---|
| BPMN | Business Process Modelling Notation |
| DLT | Distributed Ledger Technology |
| eBOM | electronic Bill Of Materials |
| ETSI | European Telecommunications Standards Institute |
| EV | Electrical Vehicle |
| GDPR | General Data Protection Regulation |
| GUI | Graphical User Interface |
| HR | Human Resources |
| ID | Identification/Identity Document |
| InP | Infrastructure Provider |
| IoT | Internet of Things |
| ISG | Industry Specification Group |
| IT | Information Technology |
| MEF | MEF Forum |
| NOTE: | Formerly known as Metro Ethernet Forum. |

| | |
|------|------------------------------------|
| MVNO | Mobile Virtual Network Operator |
| PDL | Permissioned Distributed Ledger |
| PoW | Proof of Work |
| QA | Quality Assurance |
| RAM | Random Access Memory |
| RAN | Radio Access Network |
| SLA | Service Level Agreement |
| SOAM | Service Operations and Maintenance |
| SP | Service Provider |
| TV | Television |
| UTC | Universal Coordinated Time |
| VOD | Video On Demand |
| ZKP | Zero Knowledge Proof |

4 Supply chains

4.1 Preface

Supply chains are groups of two or more entities involved in the production or delivery of goods or services. They exist in many scenarios that cover multiple aspects of life. In practical terms when an entity delivering goods or services to another entity requires some goods or services provided by an additional entity to deliver those good or services a supply chain is formed. There are multiple types of supply chains and multiple roles within a supply chain. Considering an entity within a supply chain as "a link in a chain" - some "links" are only reSellers who pass goods and services between two entities while other "links" may contribute certain elements of the goods and services delivered downstream to the final "link" - the consuming entity.

NOTE: The term "Link" used in the paragraph above represents a physical link in a physical chain. Not to be confused with the same term used to describe a connection or a relationship between entities as commonly used in relationship diagrams and graphs and in other places in the present document.

The present document discusses the types of supply chains, the roles within a supply chain, the types of transactions occurring between the entities the supply chain consists of as well as the roles PDL can play in a supply chain.

4.2 Definition of a supply chain

4.2.1 Functions

4.2.1.1 Introduction

4.2.1.1.1 Definition of a function

A function is a type of activity/role performed by an entity.

An entity may have a single function (role) or multiple functions.

EXAMPLE: A grocer may be both a Seller of groceries to its customers and a Buyer of groceries from a distributor.

The architecture depicted in Figure 1 shows the different functions of an entity within a supply chain.

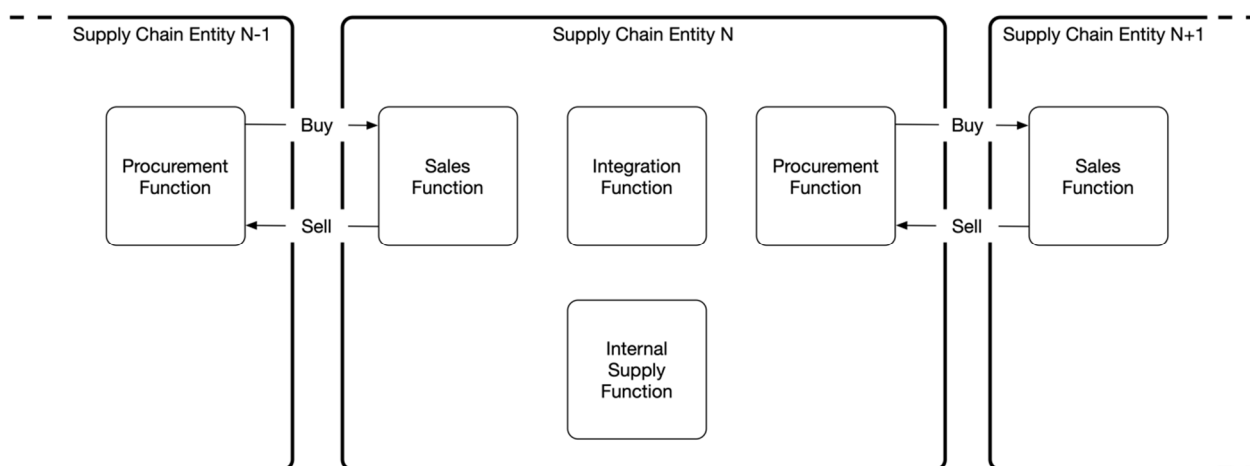


Figure 1: Architecture of an entity in a supply chain

Some functions are optional and thus may not exist at all in a specific entity. Other functions may be mandatory depending on the type of entity.