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ETSI GR PDL-002 CDPR V0.0.1 (2019-02)

**Group REPORT**

Title;

Permissioned Distributed Ledger;

PDL Applicability and compliance to data processing requirements for connected machines

Release 1

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# Foreword *(style H1)*

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

[*ETSI Drafting Rules* (*EDRs)*](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx)*,* clause *2.7.*

# Introduction *(style H1)*

Member States in Europe are responsible for ensuring the health and safety on their territory of workers, consumers, animals and goods in relation to the risks arising out of the use of machinery.

This document captures the impact that the use of connected machinery has upon health and safety compliance. The introduction of connectivity allows the remote reading of a machine’s state: both static properties (e.g. manufacturer, equipment identifier etc.) fixed for the lifespan of the machine, and dynamic properties (e.g. operating temperature, last service date, firmware version etc.) of varying lifespans~~. The value of a given property may trigger the remote writing of updates or instructions to the machine in order to meet compliance (e.g. out-of-date firmware).~~

The owner of a machine must be properly identified and verifiable, and data shared to and from the machine would require verification to show it has not been corrupted or hacked in transit. Such verifications may need to persist over time (for example for an audit later), and to be shared across national boundaries in the case of machine roaming. Hence, this document also describes the use of PDL technologies to assert the health and safety compliance of connected machines, and how to verify these assertions to meet applicable data-processing requirements.

The "Introduction" clause may be used to give specific information or commentary about the technical content of the ETSI deliverable, and about the reasons prompting its preparation.

*[ETSI Drafting Rules](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx)* [(](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx)*[EDRs)](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx),* clause 2.8.

Clause numbering starts hereafter.

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See clause 2.12.1.1 and 6.9.2 of the ETSI Drafting Rules ([*EDRs*](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx)).

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# 1 Scope *(style H1)*

This document will analyse the essential data processing requirements in terms of trust, security and effective conformity assessment, and make recommendations on how PDL can be used by organisations, operations, deployment, hardware, and software to be trusted.

The report will reference use-cases work by other standards-developing organisations and material in the public domain. The essential requirements for the PDL technology to ensure compliance to existing regulatory aspects will also be analysed.

*This clause* **shall start on a new page**.

The "Scope" clause defines without ambiguity the subject of the ETSI deliverable and the aspect(s) covered, thereby indicating the limits of applicability of the ETSI deliverable or particular parts of it.

Forms of expression such as the following should be used:

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# 2 References *(style H1)*

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The following text block applies.

## 2.1 Normative references *(style H2)*

As the ETSI Group Report (GR) is entirely informative it shall not list any normative references.

Normative references are not applicable in the present document.

## 2.2 Informative references *(style H2)*

Clause 2.2 *shall provide a numbered list of all informative references in an ETSI deliverable.* It is preferable that informative references are publicly available. Current practice is that the Secretariat need not check the public availability of 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.

* Use the **EX** style, add the letter "i" (for informative) before the number (which shall be in square brackets) and separate this from the title with a tab (you may use sequence fields for automatically numbering references, see clause 6.9.2 of [EDRs](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx))) (see example).

EXAMPLE:

[i.1]*[tab]* *<*Standard Organization acronym*> <*document number*> <*V#*>: "<*Title*>".* *(style EX)*

[i.2]*[tab]* ETSI TR 102 469: "Digital Video Broadcasting (DVB); IP Datacast over DVB-H: Architecture". *(style EX)*

# 3 Definition of terms, symbols and abbreviations *(style H1)*

*[ETSI Drafting Rules](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx)* [(](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx)*[EDRs)](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx),* clause 2.11.

*Definitions and abbreviations extracted from ETSI deliverables can be useful when drafting documents and can be consulted via the* ***Terms and Definitions Interactive Database (TEDDI)*** *(*[*https://webapp.etsi.org/Teddi/*](https://webapp.etsi.org/Teddi/)*).*

## 3.1 Terms *(style H2)*

The terms shall:

* not take the form of, or contain, a requirement.
* be presented in alphabetical order
* *have a definition that* can replace the terms in context. Additional information shall be given only in the form of examples or notes. *I**f there are several notes or examples for the same term,* *the notes and examples shall be numbered. (See examples below).*.

The following text block applies. If there are no terms to be listed, replace the text block by "Void".

For the purposes of the present document, the [following] terms [given in ... and the following] apply:

* Use the **Normal** style.
* The term shall be in **bold**, and shall start with a lower case letter (unless it is always rendered with a leading capital) followed by a colon, one space, and the definition of term starting with a lower case letter and no ending full‑stop.

*<***term***>***:** *<*definition of term*>*

*EXAMPLE 1:*

**communal site:** location at which there is more than one fixed transmitter *(style Normal)*

NOTE: There are two types of communal site; one having separate equipment and antennas but housed in a common equipment room, and the other having an engineered system employing common antenna working where the isolation between equipment is determined by the filter system.  
At all communal sites equipment installed on the site meet the limits as specified in the relevant standards. *(style NO)*

*EXAMPLE 2:*

**fast channel:** channel with low latency but higher BER in comparison to the slow channel *(style Normal)*

EXAMPLE: In contrast to the slow channel, the fast channel is not interleaved. *(style EX)*

## 3.2 Symbols *(style H2)*

The symbols list shall:

* contain the symbols and their corresponding explanations.
* be presented in alphabetical order.
* have entries not numbered.

The following text block applies. If there are no symbols to be listed, replace the text block by "Void".

For the purposes of the present document, the [following] symbols [given in ... and the following] apply:

* Use the **EW** style and separate this from the definition with a tab. Use the **EX** style for the last term.

*<*1st symbol*>* *[tab]<*1st Definition of symbol*>* *(style EW)*

*<*2nd symbol*>* *[tab]<*2nd Definition of symbol*>* *(style EX)*

*EXAMPLE:*

dB decibel *(style EW)*

DDI Direct Dialling-In, or direct dialling-in *(style EX)*

## 3.3 Abbreviations *(style H2)*

The abbreviations list shall:

* contain the abbreviations and their corresponding full form.
* be presented in alphabetical order.
* have entries not numbered.

The following text block applies. If there are no abbreviations to be listed, replace the text block by "Void".

For the purposes of the present document, the [following] abbreviations [given in ... and the following] apply:

* Use the **EW** style and separate this from the definition with a tab. Use the **EX** style for the last term.

*<*1st ABBREVIATION*>* *[tab]<*Definition of abbreviation*>* *(style EW)*

*<*2nd ABBREVIATION*>* *[tab]<*Definition of abbreviation*>* *(style EX)*

*EXAMPLE:*

DPC Dynamic Power Control *(style EW)*

CCI Co-Channel Interference *(style EX)*

# 4 User defined clause(s) from here onwards *(style H1)*

## 4.1 GENERAL PRINCIPLES

The present document provides the data processing requirements relevant to trust, security, and safety set out in light of the general principles listed as below:

The data processing must ensure that a risk assessment is carried out in order to determine the trust, security, and safety requirements, which apply to the device equipped with sensors. The device should then be designed and calibrated taking into account the results of the risk assessment.

By the iterative process of risk assessment and risk reduction referred to above, the device supplier should:

— determine the limits of the trusted environment, which include the intended use and any reasonably foreseeable misuse thereof,

— identify the risks that can be generated going through all the layers constituting the distributed ledger and the associated unreliable situations,

— estimate the lack of trust, considering the value that you can have in the data, that the end-user will use through organisations, operations, hardware, and software,

— evaluate the risks, with a view to determining whether risk reduction is required, in accordance with the objective of the actuation of the device base on the data generated or received.

— eliminate the risk of corruption or reduce the risks associated with a distributed database by application of protective measures

## 4.2 ASSESSMENTS

The communication layer in PDL is supposed to give the unconditional trust in the safety, security. However, there is a need to assess the safety and security to access sensor data in a way that is not dependent on a single third party. Access to the communication is based on Internet Service Providers who act as a central hub for connected machineries. If there is no communication possible, then the essential health and safety requirements have still to be insured. The distributed ledger allows peer to peer connection allowing this decentralized communication in the blockchain ecosystem as a backup in case of unconnected areas where the machinery is used. The PDL could be used not only as a service but also as a decentralization of the services covering at the same time privacy, safety, and security without central hub for the sensor management.

Steps toward placing a connected machinery on the EU Market or putting a connected machinery into service in the EU would require implementing the following assessments:

**STEP 1:** Identify relevant Essential Health and Safety Requirements for the connected machinery.

**STEP 2:** Apply technical standards to the connected machinery.

**STEP 3:** Assemble the technical assessment/certification file.

**STEP 4:** Certify conformance to the certification scheme.

**STEP 5:** Create the EC Declaration of Conformity.

**STEP 6:** Place the CE mark on the machinery.

Compliance to the standards means that the design meets or exceeds the requirements of all relevant and applicable Essential Health and Safety Requirements.

The following model for the layers would allow the implementation of security, safety, and privacy

|  |
| --- |
| **Application Layer** |
| Machinery parameters |
| **Management Layer** |
| Data management |
| **PDL Layer** |
| consensus management |
| **Network Layer** |
| LAN, WAN, Routers, |
| **IoT Layer** |
| Security, safety at the sensor level |
| **Physical Object** |
| Analog data |

This will provide immutably and securely data, which allows auditability, integrity, and transparency of the data and parameters associated with the machinery.

### Mobility

Machinery presenting hazards due to its connectivity must meet all the essential health and safety requirements

#### General requirements on the model posed by the machinery world

(a) ‘Connected machinery presenting hazards due to its mobility’ means:

— machinery which requires either remote control for the mobility while working, or continuous or semi-continuous remote-control movement between a succession of fixed working locations, or

— machinery which is operated without being moved, but which may be equipped with sensors as to enable it to move more easily from one place to another.

(b) ‘Driverless’ means remote operator responsible for the movement of a machine. The remote operator may be connected to the machinery through the six layers supporting the transfer of the order to the connected machinery by remote control.

( c ) Data:

The generation, storage, processing and evaluation of data are integral components of the work activity of the machinery and are essential for sustainable management. The data are characteristic of the machinery management and have a direct influence on the safety of the work activity (operator and environmental safety). Therefore, they require special measures to protect against unauthorised access.

In the case of data that do not allow conclusions to be drawn concerning persons or individual machinery operations, transparency with respect to data collection and use must be ensured (e.g. via statements in the machinery operating instructions concerning which data are used for what purpose).

Personal and operational data shall be subject to legal provisions (e.g. the EU General Data Protection Regulation).

(d) Liability

Those who are particularly involved in the use of automated machinery are the manufacturer, the owner/employer, the operator and the provider of telecommunications services; all must fulfil their respective roles and responsibilities.

In order for machinery owners and operators to be able to fulfil their responsibilities, appropriate information must be available to them (e.g. information concerning the intended use & limits of the machinery, training/instruction of operators, etc.).

Legal provisions concerning the manufacturer’s product liability (e.g. relating to product defects, information defects, etc.) shall remain unaffected.

( e ) Operations

-- In order for the employer/operator to be able to fulfil his responsibility, the manufacturer must clearly define and communicate the application possibilities and limits for partially and fully automated machine use (e.g. sales literature, operator’s manual).

-- Operators – on the machinery or at a control station – must have the possibility of “overruling”, so as to be able to fulfil their responsibility for the use of the machinery at all times.

-- It must be clearly apparent at all times whether the system or the operator has direct control over the use of the machinery; the operating condition and thus the responsibility for the machine operation must be traceable; the (re)transfer of control from the system to the operator must not occur abruptly; i.e. the operator must have the opportunity to react.

-- Restriction of the automated use of machinery to particular use cases can be an option for avoiding situations that are not completely controllable (e.g. use in the immediate vicinity of residential areas).

-- System safety and protection against manipulation must be designed so that the safety of machinery utilisation is ensured under normal conditions; targeted attacks on systems cannot always be avoided due to complexity, open interfaces (data transmission from / to machinery to / from PC / mobile equipment / cloud) and the large number of parties involved (manufacturers of hardware and software, owners/operators, telecommunications service providers); but targeted attacks must not lead to a destruction of confidence in technology.

-- The communication between system and operator must be adapted to the capabilities of the person who is authorised to operate the machinery.

-- Self-learning systems are permissible if they increase the sustainability of processes, and if the operator retains the power to make decisions (overrule).

-- In emergency situations the machinery must automatically enter a safe state (e.g. shutdown of the power/energy supply, retransfer of control to the operator, etc.).

-- Fully automated machines must be able to detect and respond to 'obstacles' (persons, animals, objects) in the driving and working area of the machine. The performance of detection systems must be equivalent to that of an average operator under normal operating conditions.

Example:

A braking, a steering system, or the detection of bystanders are critical for the proper operation of a mobile machinery in safe conditions. The example given has the purpose to offer presumption of conformity based on the real status of the safety component, which has been previously qualified against safety assessments.

The purpose of braking, steering, bystander detection performances is to establish defined levels of security for use in the development of other specific safety standards for connected functions of machinery. Due to the potential number of different safety functions of machinery, it is necessary to establish at a high level, the primary management of the safety functions, where the presumption of conformity. It resides on the status of the component and/or perception systems for the specific safety functions. The mitigation of risk of injury to operator and bystander is the primary focus of safety standards. Defining the presumption of conformity in the environment of a Permissioned Distributed Ledger will guide for the development of specific function safety standards.

The status of the machinery is calculated based on the accumulated data received from the IoT device installed in the mobile machinery. This can be described with the safety component and the status associated with:

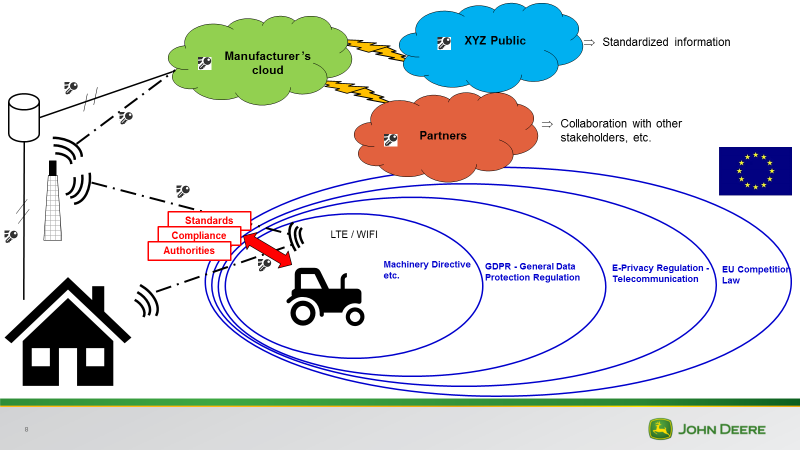
The integration of the PDL into the overall eco-system of the machinery should help to address the challenges raised by the regulatory environment and the manufacturer infrastructure. This integration shall provide a safe environment, reliable, and secure data exchange between multiple enterprise applications.

This approach should handle the challenges raised by:

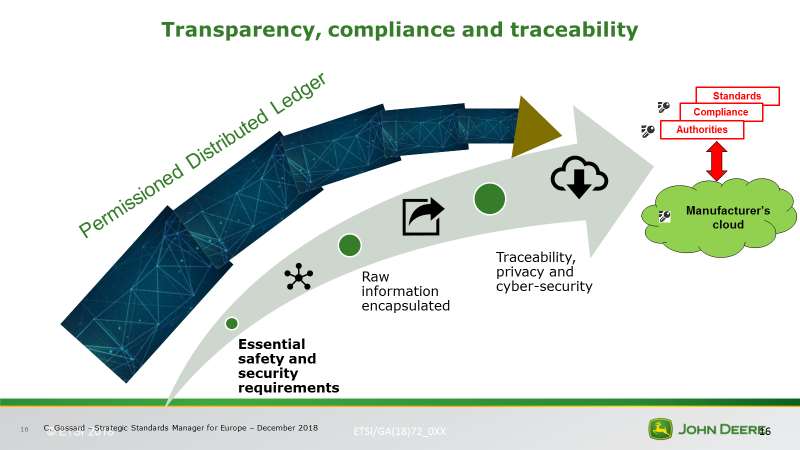
* Controlled access to (machinery) data
* Design of interfaces (for communication / data access)
* Provide input for additional or revision of current legislations and third-party certification
* Revision / modification of basic legal requirements (product safety, product liability, …)

The various clouds provided by the Original Equipment Manufacturers or other platforms can provide such infrastructures where the PDL will be the catalyst for the link with the protocols, infrastructure, applications, status.

IoT is about connecting devices and applications. One of its key benefits is automation, but also about new compliance to conformity achieved through enabling applications, services and compliance related data.



The technical specifications to be accepted by all the OEMs as standards would allow off-the shelf connections with standardized APIs. This would include integrated safety and security requirements, which can be then integrated into any blockchain networks.



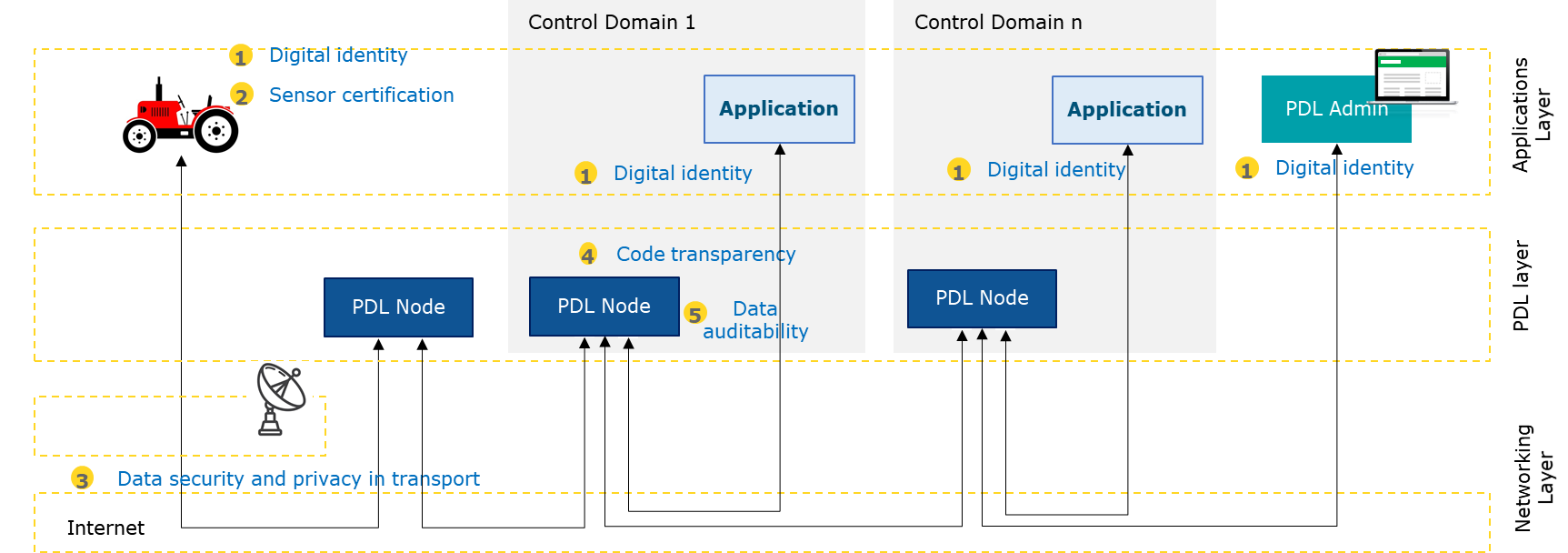
The ledger to ledger connectivity will be provided by the standardization process in the different standard bodies in a secured and high performant manner.

You keep the presumption of conformity based on the status provided back to the OEM platform where you preserve compliance to privacy, etc. and enables at the same time integration partner public of private. We have convergence of the constraints, which can be solved through the the PDL. However, we need to fill the gap regarding the transfer of data between the sensor and the Electronic Control Unit, which is the first element of the IoT backbone for the transfer of data to this IoT infrastructure.

(LB: FIRST DRAFT)

### 5 Interaction scenario

A simplified interaction scenario for the machinery domain is presented below:



The schema only shows a single PDL, while multiple connected PDLs may be in place in more complex settings. TDB

The networking layer falls outside the scope of this document. It covers 3. data privacy and security in transport, using well known technologies and standards.

The PDL layer forms the core of the architecture, granting features like

* 5. Data integrity and auditability
* 4. Code transparency (when distributed code is required, in the form of smart contracts/chain code)

Note: Both 4. and 5. are native features of PDL.

The applications layer follows traditional security practices. It is however affected in that:

* 1. There is need to establish with certainty the identity of the application acting on the data
* Possibly, application code may be certified (code review) and signed (code signing)

The devices are affected in that:

* 1. There is need to certify the digital identity of the machinery and/or of the individual micro-sensors
* 2. There is need for sensor factory tuning and certification.

### 6 Identity

#### 6.1 Identity of sensors/devices

While this is largely independent from the communication infrastructure (networking/PDL), the presence of a PDL is only justified when there is a proper mean for identifying the authors of the transactions. Having accurate and persistent audit logs for transactions created by uncertain actors would provide little value.

Identity for devices and micro-devices is largely in the scope of IOT standardization initiatives; it is however essential to include them in an overall model of applicability to remote machinery.

Traditional Identity systems leverage on PKI (Private Key Infrastructure) models. They have been widely used in the last 30 years for the secure identification of people and devices (web server using TLS certificates).

Current ongoing effort for the identification of devices follow some main lines:

* Extension of the PKI paradigm to a wider IoT setting (e.g. in the energy domain, IEC 62351-9). It includes the simplification of the enrolment process (e.g, through Simple Certificate Enrollment Protocol - SCEP) and a more complex key lifecycle process (see e.g <https://ec.europa.eu/transport/sites/transport/files/c-its_certificate_policy-v1.1.pdf>).
* New lightweight key management models (OMA, <https://www.omaspecworks.org/what-is-oma-specworks/iot/lightweight-m2m-lwm2m/>, TBD)
* Distributed PKI (e.g. Iota? <https://www.iota.org/> TBD)

A major issue to be considered for device identity is the possible impact of quantum attacks. Considering that the replacement of keys on the filed may be problematic or even unfeasible, it may be necessary to endow them with crypto material which is resistant for a long-time window (10-15 years or more), by when it is expected that quantum attacks will be a reality. Quantum-safe cryptographic schema may be advised.

#### 6.2 Identity of applications

Application identities are less controversial , since traditional PKI schemas fits appropriately.

(TBD)

#### 6.3 Identity of operators/administrators

Human identities are less controversial , since traditional PKI schemas fits appropriately.

(TBD)

### 7 PDL

#### 7.1 PDL support for identity

When a PDL is used in a machinery scenario, it needs to deal with human/application/device identities associated to transactions. Different approaches have been used:

* Native identities on the PDL – this is the case e.g. for Ethereum (in permissioned mode)
* Hook for an external identity system – this is, e.g. the case for Hyperledger Fabric
* …TBD

#### 7.2 Multiple PDLs

TBD

### 8 Certifications

#### 8.1 Sensor/device certification

#### 8.2. Application certification

From clause 4, the technical content of the ETSI deliverable shall be inserted. Each clause **shall have a title** For numbered clauses the title shall be placed after its number

A clause can have numbered subdivisions, e.g. 5.1, 5.2, 5.1.1, 5.1.2, etc. This process of subdivisions may be continued as far as the sixth heading level (e.g. 6.5.4.3.2.1).

For numbering issues, see clause 2.12.1 of the [*EDRs*](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx).

* Use the **Heading** style appropriate to its level (see ETSI styles" table in [*editHelp!*](https://portal.etsi.org/Services/editHelp!/Standardsdevelopment/Drafting/Styles/Styleslistingtable.aspx)website).
* Separate the number of the heading and the text of the heading with a tab.
* Treat clause titles as normal text (i.e. **no additional capitalization**), **but** no full stop.

Notes and examples

Notes and examples integrated in the text shall only be used for giving additional information intended to assist the understanding or use of the ETSI deliverable. Notes and examples shall not contain requirements. For more details see clauses 5.5 and 2.12.1 of the [EDRs](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx)).

A single note in a clause shall be preceded by "NOTE" in upper case. When several notes occur within the same element (e.g. clause, figure or table), they shall be designated "NOTE 1:", "NOTE 2:", "NOTE 3:", etc.

Use the **NO** style.

Separate NOTE: from the text of the note with a tab.

EXAMPLE:

NOTE 1: Text formatted with the **NO** style will be formatted **with** a space after the paragraph. (Style NO)

NOTE 2: This is the second note contained in a clause. *(Style NO)*

A single example in a clause shall be preceded by "EXAMPLE:" in upper case. When several examples occur within the same element (e.g. clause, figure or table), they shall be designated "EXAMPLE 1:", "EXAMPLE 2:", "EXAMPLE 3:", etc.

When there is a danger that it may not be clear where the example ends and the normal text continues, then the end of the example may be designated by "END of EXAMPLE".

Use **EX** style.

Separate EXAMPLE: from the text of the example with a tab.

EXAMPLE:

EXAMPLE 1: This is the first example of the clause. *(Style EX)*

EXAMPLE 2: This is the second example of the clause. *(Style EX)*

END of EXAMPLE

Figures

Figures shall be prepared in accordance to clauses 5.1 and/or 7.2 of the [*EDRs*](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx). Details concerning "[Supported file formats](https://portal.etsi.org/Services/editHelp!/Howtostart/Supportedfileformats.aspx)" and "How to copy a figure" are available in[*editHelp!*](https://portal.etsi.org/edithelp/Files/other/Graphics_editHelp!.pdf) website. For an easy application of the ETSI styles download "The ETSI styles toolbar" from [*editHelp!*](https://portal.etsi.org/Services/editHelp!/Standardsdevelopment/Drafting/Styles.aspx) website.

* The figure number and title shall be below the figure. An explicit figure title is optional.
* *Notes to figures* ***shall*** *be treated independently from notes integrated in the text,* see clause 5.1.5 of the [*EDRs*](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx) *for more details.*
* *To generate a list of figures see clause 2.3.2 of the* [*EDRs*](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx)*.*
* Use **TF** style for the figure number and title.
* Use **FL** style on the paragraph which contains the figure itself.
* Use **NF** style for the notes to figures. Separate "NOTE:" from the text of the note with a tab.
* If applicable, the figure number is followed by a colon, a space and the table title.
* Maximum width for figures is 17 cm and maximum height is 22 cm.
* For automatic figure numbering see clause 6.9.2 of the [EDRs](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx).

Figure numbering

Figures may be numbered sequentially throughout the ETSI deliverable without regard to the clause numbering, e.g. first figure is figure 1 and the twentieth figure is figure 20.

Figures may also be numbered taking account of clause numbering.

EXAMPLE 1: First figure in clause 5 is figure 5.1, second figure in clause 5.1.1 is figure 5.2, third figure in clause 5.2.3 is figure 5.3.

EXAMPLE 2: First figure in clause 7.3.2 is figure 7.3.2.1, fifth figure in clause 7.3.2 is figure 7.3.2.5.

One level of subdivision only is permitted (e.g. table 1 may be subdivided as 1 a), 1 b), 1 c), etc.). See also clause 2.12.1.0 of the [*EDRs*](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx)*.*

Figures of an annex shall be preceded by the letter designating that annex followed by a full-stop (e.g. figure B.1, figure C.4.1.1). The numbering shall start afresh with each annex.

Layout of a figure

EXAMPLE:

Figure *(style FL)*

NOTE: This is a note to figure 1. *(style NF)*

Figure 1: Details of apparatus *(style TF)*

Tables

Tables shall be prepared in accordance to clauses 5.2 of the [*EDRs*](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx). For an easy application of the ETSI styles download "the ETSI styles toolbar" from[*editHelp!*](https://portal.etsi.org/Services/editHelp!/Standardsdevelopment/Drafting/Styles.aspx) website*.*

* The figure number and title shall be above the table itself. An explicit table title is optional.
* *If the table continues over more than one page, the column headings* ***shall*** *be repeated on all pages after the first.*
* *Notes to figures* ***shall*** *be treated independently from notes integrated in the text,* see clause 5.1.5 of the [*EDRs*](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx) *for more details.*
* *To generate a list of figures see clause 2.3.2 of the* [*EDRs*](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx)*.*
* *For numbering issues see clause 5.1.3* of the [*EDRs*](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx)*.*

Details concerning "ETSI Styles" for tables are available on the[*editHelp!*](https://portal.etsi.org/Services/editHelp!/Standardsdevelopment/Drafting/Styles/Styleslistingtable.aspx) website.

|  |
| --- |
| * Use the following styles: * **TH** for the table number and title. * **TAH** for table headings * **TAL** for text left aligned * **TAC** for text centred * **TAR** for text right aligned * **TAN** for the note to table. Separate NOTE: from the text of the note with a "Ctrl" + "→" (tab). Include notes to a table within its borders in one cell, at the bottom. * **TB1** for the list of level 1 * **TB2** for the list of level 2 * If applicable, the table number is followed by a colon, a space and the table title. * To repeat the column heading on all pages, use the table headings tool (**Table, Heading Rows Repeat**). * For automatic figure numbering see clause 6.9.2 of the [EDRs](http://portal.etsi.org/Help/editHelp!/Howtostart/ETSIDraftingRules.aspx)). |

Centre tables horizontally.

The "space between columns" is 0,1 pt or 0,05 cm (default cell margins Left 0,05 pt & Right 0,19 pt).

Maximum width for tables in portrait orientation: 17 cm and for landscape orientation: 22 cm.

Set table columns widths in centimetres (not inches).

Use borders to separate the rows and columns of tables, as appropriate; the precise format will depend on the structure of each table, but be consistent throughout a deliverable (or series of related deliverables). Borders should be ¾ pt single line.

Each table shall be followed by an empty "Normal" style paragraph (↵ "Enter" key).

Table numbering

Tables may be numbered sequentially throughout the ETSI deliverable without regard to the clause numbering, e.g. the first table is table 1 and the twentieth table is table 20.

Tables may also be numbered taking account of clause numbering.

EXAMPLE 1: First table in clause 5 is table 5.1, second table in clause 5.1.1 is table 5.2, third table in clause 5.2.3 is table 5.3.

EXAMPLE 2: First table in clause 7.3.2 is table 7.3.2.1, fifth table in clause 7.3.2 is table 7.3.2.5.

One level of subdivision only is permitted (e.g. table 1 may be subdivided as 1 a), 1 b), 1 c), etc.). See also clause 2.12.1.0 *of the* [*EDRs*](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx)*.*

Tables of an annex shall be preceded by the letter designating that annex followed by a full-stop (e.g. table B.1, table C.4.1.1). The numbering shall start afresh with each annex.

Layout of a table

The title shall be above the table. An explicit table title is optional. See the following examples. The first word in the heading of each column shall begin with a capital letter. The units used in a given column shall generally be indicated within the column heading.

EXAMPLE:

Table 1: Electrical properties *(style TH)*

|  |  |  |  |
| --- | --- | --- | --- |
| **Type** *(style TAH)* | **Linear density (kg/m)** *(style TAH)* | **Inside diameter (mm)** *(style TAH)* | **Outside diameter (mm)** *(style TAH)* |
| Text*(style TAL)* | Text *(style TAC)* | Text *(style TAR)* |  |
| NOTE 1: This is a note to table. *(style TAN)*  NOTE 2: This is a merged cell. *(style TAN)* | | | |

Mathematical formulae

Mathematical formulae shall be prepared in accordance to clause 5.3 of the [*EDRs*](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx)*.* Details concerning tools that shall be used for editing "Mathematical formulae" are available on the *[editHelp!](https://portal.etsi.org/Services/editHelp!/Tohelpyouinyourwork/Furtherresources/Mathematicalformulae.aspx)* website.

For an easy application of the ETSI styles download "the ETSI styles toolbar" from *[editHelp!](https://portal.etsi.org/Services/editHelp!/Standardsdevelopment/Drafting/Styles.aspx)* website.

* Use **EQ** style.
* Insert one tab before the equation to centre it.
* For automatic equation numbering see clause 6.9.2 of the [EDRs](http://portal.etsi.org/Help/editHelp!/Howtostart/ETSIDraftingRules.aspx).

Equation numbering

If it is necessary to number some or all of the formulae in an ETSI deliverable in order to facilitate cross‑referencing, Arabic numbers in parentheses shall be used, beginning with 1:

EXAMPLE 1:

x2 + y2 < z2 (style EQ) (1)

Equations may be numbered sequentially throughout the ETSI deliverable without regard to the clause numbering, e.g. first equation is equation 1 and the twentieth equation is equation 20.

Equations may also be numbered taking account of clause numbering.

EXAMPLE 2: First equation in clause 5 is equation 5.1, second equation in clause 5.1.1 is equation 5.2, third equation in clause 5.2.3 is equation 5.3.

EXAMPLE 3: First equation in clause 7.3.2 is equation 7.3.2.1, fifth equation in clause 7.3.2 is equation 7.3.2.5.

Equations of an annex shall be preceded by the letter designating that annex followed by a full-stop (e.g. table B.1, table C.4.1.1). The numbering shall start afresh with each annex.

## 4.1 User defined subdivisions of clause(s) from here onwards *(style H2)*

<Text>.

Annexes

Each annex **shall:**

* start on a new page (insert a page break between annexes A and B, annexes B and C, etc.).
* be designated by a heading comprising the word "Annex" followed by a capital letter designating its serial order, beginning with "A".
* have its heading followed by the indication "(normative):" or "(informative):", and by the title on the next line.

*[ETSI Drafting Rules](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx)* [(](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx)*[EDRs)](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx),* clause 2.13.

*Numbers given to the clauses, tables, figures and mathematical formulae of an annex shall be preceded by the letter designating that annex followed by a full-stop. The numbering* ***shall start afresh with each annex****. A single annex shall be designated "Annex A".*

Clauses in annex A shall be designated "A.1", "A.2", "A.3", etc. (further details in clause 2.12.1 of the [*EDRs*](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx)).

* Use the **Heading 9** style. Insert a line break ("shift" + ↵ "enter") between the colon and the title.
* For all annex clause headings use the appropriate Heading styles, starting from **Heading 1,** e.g. for clause A.1 use **Heading 1**, for clause A.1.1 use **Heading 2**. ("ETSI Styles" are available on the[*editHelp!*](https://portal.etsi.org/Services/editHelp!/Standardsdevelopment/Drafting/Styles/Styleslistingtable.aspx) website ).

EXAMPLE:

<PAGE BREAK>

Annex A:  
Title of annex *(style H9)*

<Text>.

<PAGE BREAK>

Annex B:  
Title of annex *(style H9)*

# B.1 First clause of the annex

## B.1.1 First subdivided clause of the annex

<Text>.

<PAGE BREAK>

Annex <L>:  
Authors & contributors *(style H9)*

The annex entitled "Authors & contributors" is optional. When present it describes the list of persons and companies that contributed to the elaboration of the present Group Report.

The following people have contributed to the present document:

**Rapporteur**:  
Title, Firstname, Lastname, company

**Other contributors**:Title, Firstname, Lastname, company

<PAGE BREAK>

Annex <L+1>:  
Bibliography *(style H9)*

The "Bibliography" annex identifies additional reading material not mentioned anywhere in an ETSI deliverable including annexes. These publications might or might not be publicly available (no check is made by the Secretariat).

The Bibliography **shall include** list of standards, books, articles, or other sources on a particular subject which are not cited anywhere in an ETSI deliverable including annexes.

The Bibliography **shall not include** *documents listed in clauses 2.1 and 2.2.*

*[ETSI Drafting Rules](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx)* [(](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx)*[EDRs)](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx),* clause 2.14.

* Use **Heading 9** style for the "Bibliography" annex, see clause 2.13 of the [EDRs](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx) for examples.
* For the listed material use the **Normal** style or bulleted lists (e.g. **B1+**), do not use numbered references.

*EXAMPLE 1:*

*<*Publication*>*:"*<*Title*>".<*Edition*>*. *<*Year*>*, *<*Issue designation*>*, *<*Page location*>*. *(style Normal)*

WEAVER, William. "Command performances". December 1985, vol. 42, n° 12, p. 126-133). *(style Normal)*

*EXAMPLE 2:*

* <Publication>: "<Title>". *(style B1+)*
* ETSI EN 300 066: "ElectroMagnetic Compatibility and Radio Spectrum Matters (ERM); Float-free maritime satellite Emergency Position Indicating Radio Beacons (EPIRBs) operating in the 406,0 MHz to 406,1 MHz frequency band; Technical characteristics and methods of measurement". *(style B1+)*

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Annex <L+2>:  
Change History *(style H9)*

*The "Change history/Change request (history)" is an optional informative element.*

*The "Change history/Change request (history)" annex, if present, describes the list of changes implemented in a new version of the ETSI deliverable. It shall be presented as a table.*

"ETSI styles" for tables are available in[*editHelp!*](https://portal.etsi.org/Services/editHelp!/Standardsdevelopment/Drafting/Styles/Styleslistingtable.aspx) website.

| Date | Version | Information about changes |
| --- | --- | --- |
| October 2011 | 1.1.1 | First publication after approval (30 September - 2 October 2011; Prague) |
| February 2012 | 1.2.1 | Implemented Change Requests:  Error message information clarifications  update of figure 3 clause 9.2  These CRs were approved by <ISG shortname> (3 - 5 February 2012; Sophia)  Version 1.2.1 prepared by the Rapporteur |

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# History *(style H1)*

*The "History" clause shall start on a new page and be the final unnumbered clause of an ETSI deliverable.*

*History shall be prepared in accordance to clause 2.16 of the* [*EDRs*](https://portal.etsi.org/Services/editHelp!/Howtostart/ETSIDraftingRules.aspx)*.*

Use **Heading 1** style for the title.

|  |  |  |
| --- | --- | --- |
| **Document history** | | |
| <Version> | <Date> | <Milestone> |
| 005 | 22/05/2019 | Consolidated input covering PDL and Machinery requirements |
|  |  |  |
|  |  |  |
|  |  |  |

A few examples:

|  |  |  |
| --- | --- | --- |
| **Document history** | | |
| V1.1.1 | April 2018 | Publication |
| V1.2.2 | June 2017 | Pre-Processing done before TB approval e-mail: <mailto:edithelp@etsi.org> |
| V1.3.0 | July 2018 | Clean-up done by ***editHelp!*** e-mail: <mailto:edithelp@etsi.org> |
|  |  |  |
|  |  |  |

*Latest changes made on 2019-01-08*