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UNIKID FOR NORWEGIAN POWER INDUSTRY

UnikID Guidelines

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Objective:

A UnikID can sound both abstract, difficult and easy at the same time. DIGIN, herein, is now presenting a set of defined guidelines on unique identification process. We recommend these guidelines shall be used by all interested parties for unique identification of power system resources, functions and assets, between energy market actors and systems.

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Table of contents

1 EXECUTIVE SUMMARY

All people in Norway have a unique social security number to be able to communicate who we are in contact with interested parties, like authorities, banks, insurance etc. There are many who have the same name or are born on the same day, so it is not enough to refer to the name and date of birth when an unequivocal identification is needed.

Developments in the power industry are moving towards increasing communication across actors. This is driven by new technology, increased electrification and greater need for real-time coordination, in an efficient and profitable way.

In the existing power systems, different requirements have been made for identification and naming of data elements. This creates problems when data is to be coordinated.

A UnikID can sound both abstract, difficult and easy at the same time. This is one of the fundamental challenges for how we will be able to interact seamlessly in the power system in the future. At the same time, it is important that we approach the task with pragmatism, so that we have a solution that is implementation-friendly and cost-effective for the actors.

Today, each company often operates with its own systems. This has worked fine up until now. But when we exchange ever larger amounts of data and interact more across both web companies, system administrators and governments, we need agreement on what the different data elements represent.

In this project, DNV has performed the work on a work package under the DIGIN program and is now presenting a set of defined guidelines on unique identification process. We recommend these guidelines shall be used by all interested parties for unique identification of power system resources, functions and assets, between power industry actors and systems.

2 INTRODUCTION

Not a day goes by in grid-operations when operators do not hear of identification challenges – this has been plaguing the grid and other respective industries for a period. Misidentification has been present since long, and it still is, even to this day.

Accurate identification of tangible or non-tangible grid elements is of paramount importance – so much so, that it has now been recommended by IEC to assign a unique identifier (UnikID) to the mRID attribute of the IdentifiedObject in the CIM model when modelling grids in the Common Information Model (CIM).

In this project, DNV GL has investigated four different aspects of unique identifiers – a) generation, b) assignment, c) distribution and d) privacy. The methodology of investigation involved stakeholder interviews, analysis of other industries and of the current existing identification schemes in CIM.

The outcome of the investigation has resulted in a set of guidelines that shall act as an initial requirement, which shall be followed by different grid actors to achieve the broader goal of efficient use of unique identifiers.

Five different stakeholders - including system operators, software providers and regulators - were interviewed in order to perform mRID requirement engineering, with the aim of supporting DIGIN in suggesting different alternatives for mRID handling. During the interviews, each stakeholder was challenged to answer a set of questions from a questionnaire developed by DNV.

Four different industries - Health, Defence, Oil & Gas and Construction - have been qualitatively analysed to incorporate their best practices into the guidelines.

3 NORMATIVE REFERENCES

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61970-301:2019, Energy management system application program interface (EMS-API) – Common information model (CIM) base

IEC 61970-501:2006, Energy management system application program interface (EMS-API) - Part 501: Common Information Model Resource Description Framework (CIM RDF) schema

IEC 61970-552:2016, Energy management system application program interface (EMS-API) - Part 552: CIMXML Model exchange format

4 TERMS, DEFINITIONS AND ABBREVIATED TERMS

For the purposes of this document, the following terms and definitions apply.

4.1 Terms and Definitions

4.1.1 profile

agreed-upon subset of derived from a full model. In CIM, a profile is a subset of CIM UML Model.

4.1.2 use case

specification of a set of actions performed by a system, which yields an observable result that is, typically, of value for one or more actors or other stakeholders of the system

4.1.3 unikID

identifier system(s) being used with data and respective activities/processes in grid operations. All the identifiers (e.g., UUID, URN, URIs, DOI, etc.) fully support the activities of identification. However, they have their own pros and cons depending on the use of data and activities. UnikIDs are used to identify, cite, link, and annotate data objects

4.1.4 mRID

mRID is an abbreviation for Master Resource Identifier. It is an *attribute* within the CIM IdentifiedObject Class. Although the CIM standard recommends Universally Unique Identifiers (UUIDs) as a UnikID for mRID as per RFC 4122, currently there are several different identifier systems for mRID in practice such as: URIs/URNs, Version 5 UUIDs and Strings + UUIDs

To be globally unique, we must have an identifier system(s) i.e., a UnikID that ensures global uniqueness, persistence, compatibility, and scalability

4.1.5 cim:IdentifiedObject

An easy way to think about the term “cim:IdentifiedObject (cim:IO)” is that it reflects the simple need for compartmentalizing information in a database that otherwise looks big and confusing. Values in a cim:IO have their own unique IDs, data types, and attributes. In this way, cim:IOs vary across business processes depending on their tangibility and non-tangibility.

A cim:IO is a collection of one or more CIM classes that create meaning. In other words, “object” is an alternate way of saying “this group of data should be thought of as standalone.”

CIM is based on the IdentifiedObject, its relationship, its semantic and its constraint. A cim:IO provides the details of information to be stored as data and is of primary use when the final processes for a business-use-case or the preparation of a functional specification for procurement

4.1.6 data owner

Data owner is a specific organization that can create, edit, modify, share and restrict access to the data associated to CIM:IdentifiedObject. Data ownership also defines the data owner’s ability to assign, share or surrender all these privileges to a third party. The data owner claims the possession and copyrights to such data to ensure their control and ability to take legal action if their ownership is illegitimately breached by an internal or external entity.

There are three primary types of *information models*: 1. Conceptual models (High-level), 2. Logical/Functional models (Mid-level), and Physical asset models (Low-level).

A database consists of many CIM models either compiled into one big table or stored individually. The reason we consider multiple individual CIM models as part of one database is that they relate to each other. If not, they’re just different CIM models in space

4.1.7 information model

information model is a representation of concepts, relationships, constraints, rules, and operations to specify data semantics for a chosen domain of discourse

4.1.8 electricity market

An electricity market is a system enabling electricity as a commodity or services capable of being bought, sold, and traded.

4.1.9 organization

person or group of people that has its own functions with responsibilities, interested parties and relationships to achieve its objectives. The concept of organization includes, but is not limited to sole-trader, company, corporation, firm, enterprise, party, partnership, charity or institution, or part or combination thereof, whether incorporated or not, public or private

4.1.10 interested party (preferred term)
stakeholder (admitted term)
authorities (admitted term)

person or organization (3.01) that can affect, be affected by, or perceive themselves to be affected by a decision or activity

4.1.11 requirement

need or expectation that is stated, generally implied or obligatory

4.1.12 identifier system

A unified method of identification of objects. E.g., UUIDs

4.1.13 asset

Tangible resource of the utility, including power system equipment, various end devices, cabinets, buildings, etc. For electrical network equipment, the role of the asset is defined through PowerSystemResource and its subclasses, defined mainly in the Wires model (refer to IEC61970-301 and model package IEC61970::Wires). Asset description places emphasis on the physical characteristics of the equipment fulfilling that role

4.1.14 power system resource

A power system resource can be an item of equipment such as a switch, an equipment container containing many individual items of equipment such as a substation, or an organisational entity such as sub-control area. Power system resources can have measurements associated

4.1.15 aspect

specified way of viewing an object

4.1.16 function

intended or accomplished purpose or task

4.1.17 functional system

object with characteristics which predominantly represents an overall inherent function

4.1.18 object

entity treated in a process of development, implementation, usage and disposal

4.1.19 product

intended or accomplished result of labour, or of a natural or artificial process

4.1.20 source project

implements or realizes the business process in the cim model - an organization, a system or an interested party which has realized a business process or requirement by one or more use cases and already has implemented the UUID based object identification for the processes

4.1.21 regulatory body

a public organization or government agency that is set up to exercise a regulatory function. This involves imposing requirements, conditions or restrictions, setting the standard for activities, and enforcing in these areas or obtaining compliance. Regulatory bodies cover a wide variety of professions, but not all professions are regulated and may be self-regulated

4.1.22 vendor

a person or company offering something for sale

4.2 Abbreviated Terms

BUC	Business Use Case (Use Case)
CIM	Common Information Model
DNO	Distribution Network Operator
DSO	Distribution System Operator. Generally, a DSO manage a MV/LV network
IEC	International Electrotechnical Commission
RDF	Resource Description Framework
SUC	System Use Case (USE Case)
TSO	Transmission System Operator. Generally, a TSO manage a EHV/HV network
UML	Unified modelling language
UUID	Universally unique identifier
XML	eXtended Markup Language
XSD	XML Schema Definition
mRID	Master Resource Identifier
UnikID	Unique Identifier

5 GUIDELINES

There are various levels at which the exchange of power system data/models is necessary. A pan-European model exchange level covers the territory of all TSOs. Regional model exchanges can be realised between different TSOs in one or more synchronous areas. A model exchange on the national level includes interfaces between TSOs and DSOs, as well as between different DSOs.

The purpose of model exchanges is not only to exchange the data from one party to another but also to satisfy the ultimate goal, namely to perform common studies using the same, relevant and shared data. All parties involved in the process should be able to perform the same types of studies and be able to share project tasks between different parties which are using different power system analysis applications. Indeed, the interoperability between different applications used in the exchange process is therefore crucial in both reaching seamless data exchange and obtaining comparable study results when using this data.

The UnikID guidelines cover the DIGIN and its stakeholder's business processes required unique identification of data and information by defining the following key guidelines valid for all interested parties for unique identification of power system resources, functions and assets, between energy market actors and systems.

The guidelines are grouped into the four aspects to ensure global uniqueness, persistence, compatibility and scalability of UnikIDs.

- *Assignment* - about responsible party for the assignment of a UnikID defining when and why

Table 5-1 Assignment

ID	Guideline
A1	The data owner shall be the assigner of the mRID of the cim:IO. In this case, data owner also owns either a physical asset model or a conceptual model or a functional model for the given business process. For instance, for a physical asset (e.g., transformer) cim:IO is created in database during its procurement or pre-study phase. The same mRID shall be assigned to the asset when it is deployed.
A2	The mRIDs of the existing CIM models (i.e., physical asset model, a conceptual model and a functional model) shall be assigned or updated as UUID and shall not be changed throughout their entire life cycle. The conceptual models shall keep their mRID unless they undergo major local extensions later during execution or implementation.
A3	All assigned mRIDs shall be kept in order to track the history of the cim:IO they correspond to, meaning they shall not be reused. For instance, the mRID of newly commissioned asset shall be different from the respective decommissioned asset. Similarly, the extended CIM conceptual model shall have a different mRID from its parent conceptual model.
A4	In the case of an existing asset, which is typically owned by a party, the asset owner is the data owner and shall be responsible to assign mRIDs to the respective information models of the existing assets. It is recommended that interested party shall provide unique identifiers to the assets independent of their CIM implementation roadmap and strategies.
A5	When identified parties merge unique identifiers, there will be conflicts, e.g., duplication of identification or modelling issue. These conflicts shall be captured transparently, and all the interested parties shall identify each other regarding the changes in the same cim:IO or parts of it. In case of shared and already existing power system resources, e.g., substations, bay and connectivityNodes, If the parties decided to resolve a conflict with the replace action and the mRIDs of the same cim:IOs are different between the two power system resources, it is recommended to replace it with the mRIDs from the source project. If a new object is added to the list of already existing shared power system resources, it is recommended that the party who created the new shared power system resource should assign the mRID and other should follow. This is helpful when creating an object into a profile, so that the user can have full control over the object. Moreover, this is also helpful in automatically merging all other changes, you can more easily resolve the conflicts.

- *Distribution* - about the distribution or sharing of UnikIDs between interested parties to maintain uniqueness and reduce multiple assignments to same power system resource

Table 5-2 Distribution

ID	Guideline
D1	DIGIN's role in ensuring global uniqueness of the mRID is limited to coordination and harmonization of the approaches used in different data exchanges which shall conform to requirements G1-G4
D2	In case of shared CIM model (e.g., a tangible asset which is owned by one interested party in the network but its CIM model is shared by two or more interested parties), the mRIDs shall either be bilaterally assigned or be communicated between the interested parties as soon as possible. The CIM model should practically be owned by the data owner who is responsible for the respective business processes or operations.
D3	mRIDs must be kept persistent for all CIM models and profiles. If exceptions are needed, then interested parties who are involved in exchange of data should have a bilateral agreement defining the exception strategy.
D4	For CIM model exchange, the full CIM model should be stored with interested parties involved, and a differential model should be shared if any involved interested party updates the model (as per IEC 61970-552:2016). All mRIDs involved in it, shall be shared and stored by all interested parties involved and must be kept persistent.

- *Generation* - about the governance the identifier system

Table 5-3 Generation

ID	Guideline
G1	Herein UnikID shall be version 4 UUID/GUID (Universally Unique Identifier) as defined in RFC 4122 (see Appendix C).
G2	cim:IO (CIM:IdentifiedObject) shall be generated in the system as soon as its context is represented digitally. On the other hand, the identifiers of the CIM profiles shall be a case sensitive string which conforms to W3C (ISO 8859/1 8-bit single-byte coded graphic character set known as Latin Alphabet No. 1; http://www.w3.org/MarkUp/html3/specialchars.html) with a maximum character limit of 60 characters.
G3	All cim:IO, which are being exchanged between two or more systems, shall have UnikID as their mRID and this mRID should be exchanged as specified in IEC 61970-552:2016.
G4	All cim:IO shall have a UnikID as an identifier which shall be given to mRID, which is an attribute of the cim:IO. They shall be created independently, and they shall not be serialized or created manually.

- *Storage and Privacy* - about the assurance of quality, privacy and storage

Table 5-4 Storage and Privacy

ID	Guideline
S1	The data owner is responsible for ensuring that the assigned mRID shall be decentralized and stored "locally". If an organization is responsible for a particular operation or business process or a physical asset, then it shall ensure that all existing identifiers to the respective cim:IO are mapped to the same mRID.
S2	For a recipient(s) of cim:IO who is neither a data-owner nor an asset-owner, the data-owner can define how long the mRID can be stored with the recipient, as well as when the recipient(s) shall delete the CIM model, unless it is in conflict with regulations and laws.
S3	No attribute within the cim:IO should be generated by hashing of any sensitive data.
S4	All the expired identifiers shall be stored by the data owner in some form an audit mechanism for traceability. That shall apply for physical asset model and for functional model.

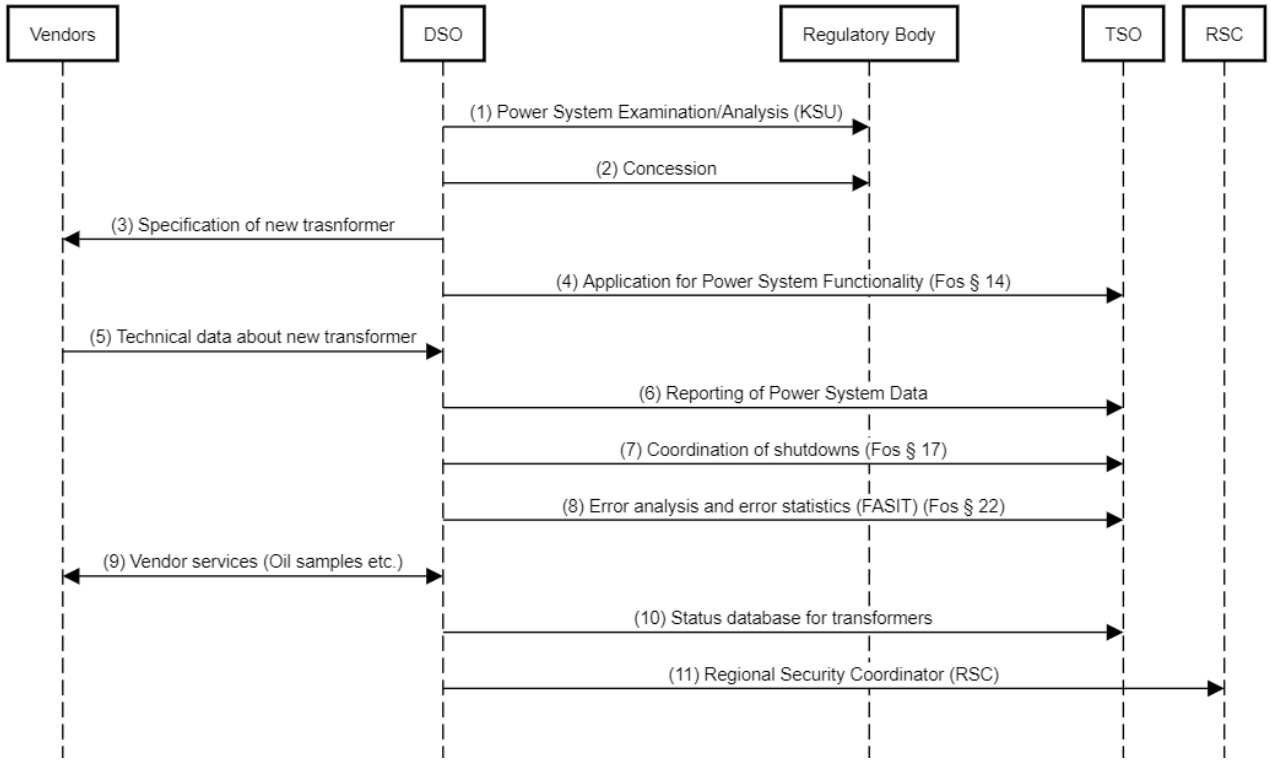
6 USE CASE: TRANSFORMER LIFE CYCLE FROM DSO'S PERSPECTIVE

In this section we follow a transformer life cycle use case from planning to decommissioning, with the aim of clarifying how the UnikID guidelines would be applicable in the various situations that arise throughout the life cycle. The goal here is for the use case to complement the guidelines and show how they would be applied in a practical situation. The use case begins with a DSO who has a need for a new transformer. We follow the DSO's processes from planning stage to procurement and subsequently commissioning and decommissioning. Throughout the life cycle of the transformer the DSO must communicate with external interested parties, and we investigate how the UnikID guidelines should be followed in each step. The actors, roles and responsibilities in the use case are outlined in Table 1 below.

Table 6-1 Roles and responsibilities of different actors in the use case

Actor	Role	Responsibilities
DSO	The DSO is the one who has a need for a new transformer and initiates the planning and procurement processes. Throughout the life cycle of the transformer, they have to communicate with all the other actors.	• Apply for KSU and Concession from Regulator • Communicate with TSO • Coordinate with RSC • Communicate with Vendor
TSO	Since the TSO has an overall responsibility for the grid, they require the DSO to apply to them for power system functionality as well as report about the transformer	• Approve power system functionality for transformer • Gather information about transformer
Regulatory body	The regulatory body requires the DSO to report the plans for the new transformer to them and applies for concession right to the regulatory body	• KSU • Concession
Vendor	The vendor is responsible for manufacturing the transformer according to the DSO's specification, as well as providing services such as checking oil samples from the transformer	• Manufacturing and delivery of transformer • Vendor services (oil samples, etc.)

Figure 1: Transformer Life Cycle Use Case - A diagram showing the different actors in the use case, and the communication between them



The transformer life cycle and the associated communication processes are shown in the diagram in Figure 1. Referring to the numbering in this diagram, we will now describe how the guidelines can be followed in each of the steps.

1. Here the planning of the transformer is placed in a digital context, and information about it is exchanged, hence the transformer functionality shall be assigned mRIDs by the data owner, i.e., the DSO. All cim:IOs in the KSU shall also be given mRIDs. If necessary, the DSO also has the right to determine how long the regulator can store the received mRIDs.

   Guidelines applied: G1-G4, A1, S1-S2

2. The DSO is sending documentation for the planned transformer to the Regulator for concession. The data owner (i.e, DSO) shall ensure the persistence of mRIDs and generates new ones for any possible new cim:IOs.

   Guidelines applied: A1, D3, S2

3. The DSO sends specification about the transformer to vendor(s). The data owner (i.e, DSO) shall ensure the persistence of mRIDs and generates new ones for any possible new cim:IOs. The DSO can limit how long the vendor(s) stores the identifiers.

   Guidelines applied: A1, D3, S2

4. Here the DSO files an application for power system functionality. The mRIDs for transformer functionality shall be persistent and be not altered by any interested party. For any new cim:IOs the DSO should generate and assign the identifiers. The privacy statement S2 applies.

   Guidelines applied: A1, D3, S2

5. In reporting of Power System Data, there is XML being exchanged. If CIM models are being exchanged, the full model should be stored with both interested parties, and updates are sent in differential models. In case of profiles, mRIDs throughout the profile must be persistent with models.

   Guidelines applied: D3-D4, S2

6. The vendor provides data about the transformer to the DSO. For any new cim:IOs created or identified by the vendor, it is the DSO's responsibility to generate and assign them. However, in accordance with guideline D3, if the interested parties can agree that the vendor can do it.

   Guidelines applied: G1-G4, A1, D3

7. In commissioning, the transformer will become a part of power system resource. The cim:IOs for PSR shall be assigned by the DSO and shall be shared with the relevant interested parties if needed. The DSO shall ensure the mRID persistency.

   Guidelines applied: A1, D3, S2

8. Any old mRIDs must be kept persistent. In exchange of CIM models, both interested parties shall store the models, and differential models shall be used for sending updates.

   Guidelines applied: D3-D4, S2

9. A combination of the rules applied in steps 5 and 6 applies.

   Guidelines applied: G1-G4, A1, A5, D3-D4, S2

10. As before, the old mRIDs shall be kept persistent, and the DSO is responsible for mRIDs of any new cim:IOs. The DSO can restrict how long the TSO can store the identifiers.

    Guidelines applied: A1, A5, D3, S2

11. In case, the data owner's (DSO) cim:IOs are being shared with other interested parties. The mRIDs shall kept persistence and the privacy condition applies.

    Guidelines applied: D3, S2

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