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bridge

Data Exchange Reference Architecture (DERA)

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Data Management Working Group

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1 High Level Objectives

Action 2 of the BRIDGE Data Working Group has focused on facilitating the deployment of the BRIDGE DERA 3.1 reference architecture. It has done so on the basis of last year's annual report which drew on the SmartGrid Architecture model.

A new DERA implementation methodology has been proposed aligning with ETSI-CEN-CENELEC practices.This approach enables step-by step-implementation of the platform from use case definition towards the identification of key interfaces and reference models up to the mapping of associated data exchange standards. It can also be used to trigger the definition of consistent data exchange profilesas well as support associated interoperability tests for message exchange validation (as prototyped through the Intnet interoperability tests).

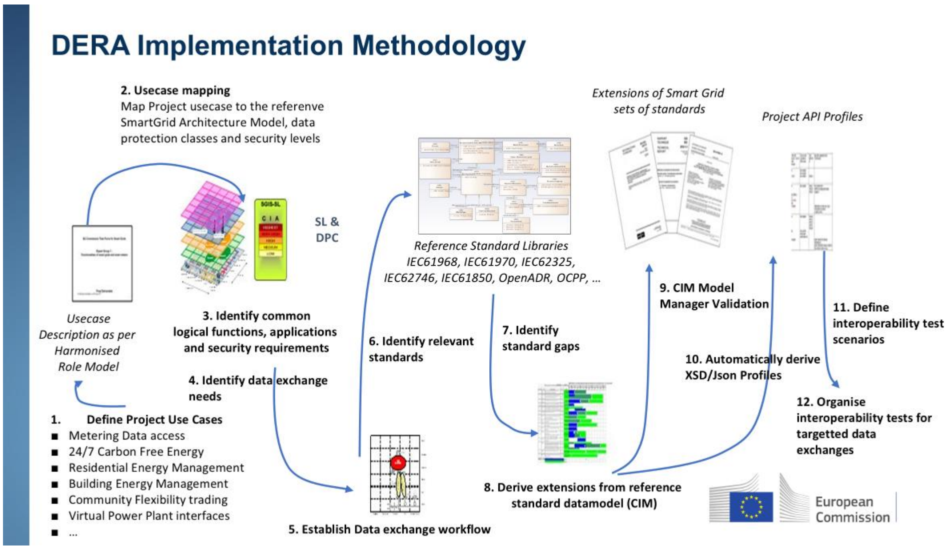

Figure 1 - DERA Implementation Methodology

The action has aimed at developing a new BRIDGE Data Modelling Working Group from the data models and services established through the Onenet project, expanding it from the dataspace project developed through the Intnet project particularly.

The work underwent several phases supported by the EDDIE project particularly and by key representatives from the IEC Technical Committee 57 to align with the underlying data model as used through latest SmartGrid Architecture model.

Figure 2 - Development of new Bridge data modelling

The primary objective of this approach is to define key information exchanges necessary for the support of the DERA3.1 architecture. This involves aligning with existing and emerging regulations, addressing regional interoperability challenges, and meeting the specific needs of BRIDGE demonstrators as discussed through the data modelling coordinating meetings with projects. The work also aims to harmonize the use of existing data model such as the Common Information Model (CIM) and Smart Applications REFerence (SAREF) and build new tools to facilitate key standard mapping through the deployment of the DERA architecture.

The EDDIE project has analyzed the requirements based on current and forthcoming European regulations, specifically EU 2023/1162 and demand response regulations. It has also examined regional interoperability issues in countries like Austria, France and Denmark, and considers the needs of various demonstrators, including hydrogen networks and residential energy management systems.

The proposed approach uses existing standards wherever possible while drawing on the underlying SmartGrid architecture model as used through the DERA architecture. The new BRIDGE modelling environment provides a summary of key data objects relevant to DERA and highlights the mapping with key domain specific standards such as OpenADR and OCPP. It allows to identify gaps between standards to be addressed, often through maintenance requests to enhance standards and can be deployed as open source through the new BRIDGE projects to facilitate their adoption towards the DERA3.1.

Detailed definitions are provided for different types of data exchanges, such as the integration of new permission data, validated historical data, near real-time data, and master data. Additionally, a comprehensive presentation of the change management process for the CIM standard has been made, detailing how changes are proposed, reviewed, and implemented. The EDDIE project deliverable describes how the proposed standards are transformed into working software and provides notes on the deployment and documentation of the EDDIE framework.

This work marks a significant step towards establishing a robust and interoperable data exchange framework for the European energy sector. By harmonizing existing standards and addressing regional and regulatory requirements, the EDDIE project aims to enhance data interoperability, contributing to the overall efficiency and sustainability of energy systems across Europe. This summary provides an overview of the critical aspects and achievements outlined in the EDDIE D2.2 deliverable, setting the stage for subsequent implementation phases and further development within the project.

1.1 Use of CIM through the DERA architecture

The Common Information Model (CIM) was developed by the International Electrotechnical Commission (IEC). While there are many standards already available, CIM seems to be the first choice for many users in Europe. The CIM is an industry-standard model that provides a common language for the exchange of information between system operators (TSOs and DSOs) and market participants in the electricity market. This model has been specifically designed to facilitate the exchange of data and transfer of information necessary for both regional and pan-European grid development studies, as well as future processes related to network codes.

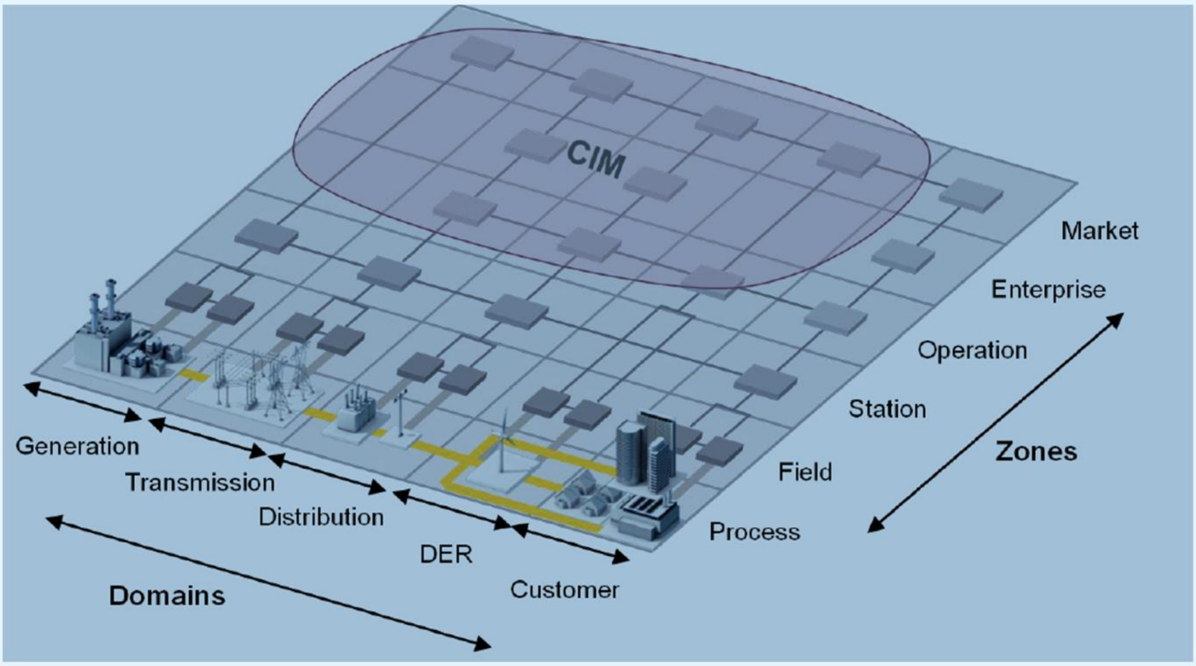

Figure 3 - CIM and the smart grid plane.

The European Network of Transmission System Operators for Electricity (ENTSO-E), publisher of the European style market profile (ESMP), started working on a market profile to enable data exchanges for wholesale market operation and recently expanded their work in a Joint Working Group with the EU DSO entity to cover DSO flexibility markets adding for instance 'Procedures for access to metering and consumption data' and the IEC TC57 WG16 maintenance request on the Permission class.

1.2 Consistent with SAREF data models for behind the meter assets

The Smart Appliance ReFerence (SAREF) model is an ontology originally defined by ETSI for IoT devices to enable interoperability and self-discovery.

SAREF4ENER includes a reference ontology that targets appliance energy efficiency and is in the process of extending into the new demand side flexibility use cases through Horizon Europe projects such as Interconnect.

The core base SAREF ontology model is pictured in Figure 4.

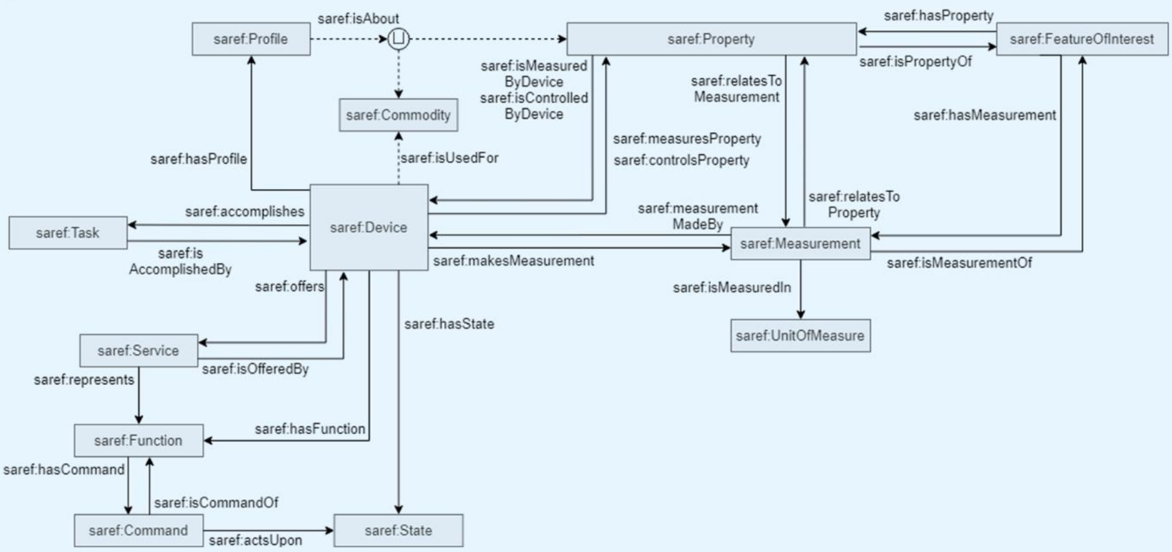

Figure 4 - SAREF base ontology description.

SAREF is well advanced in modelling behind-the-meter devices. For demand response use cases SAREF provides an head start over other ontologies like CIM for device modelling Figure 5.

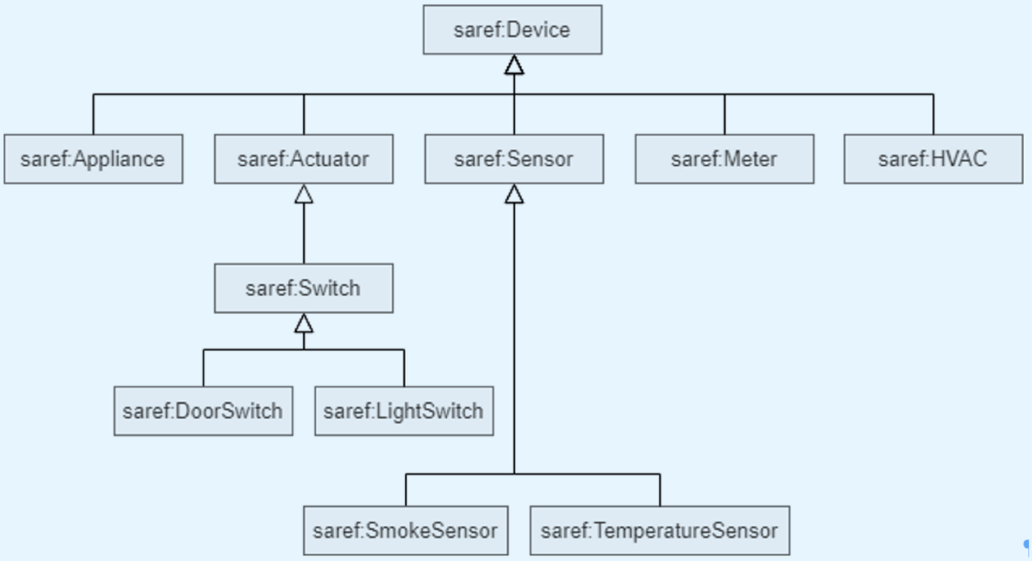

Figure 5 - SAREF DeviceTypes.

The current DERA architecture has implicitly adopted the CIM standard as underlying data exchange pivot model through its underlying SmartGrid architecture model as developped step by steps through Bridge projects such as EUSysflex, Interrface, Onene, Eddie and OmegaX. Associated CIM extensions have recently incorporated near real-time data exchange to support new explicit demand response scenarios which has emerged through Bridge project, which naturally links with SAREF device ontologies. The new dataspace projects coordinated through Int'net have considered using mapping approaches between SAREF and new near real-time CIM based data models.

1.3 Expansion of the DERA architecture towards new electromobility models

The Open Charge Point Protocol (OCPP) originated in 2009 in the Netherlands from the electromobility domain is currently managed by the ElaadNL foundation, a collaboration between Dutch grid operators, charging point operators and suppliers of charging point hardware vendors. The objective of the protocol is to develop an open standard that connects electric vehicles to back-office systems and the grid and so prevent any vendor lock-in from charge point vendors. Developed as a freely available standard, OCPP very quickly became the de facto open standard in this domain, as recent major charging point vendor bankruptcies in the US have illustrated the vulnerability of propriety standards.

The OCCP original deployments are based on OCCP version 1.6 consisting of 5 data exchange message structures to manage simple charging point operation. First energy management messages have recently been introduced to exchange target power curve profiles with charge points (CP) and receive associated charging metering data (one set of data per charging session). This first version of the standard does not support natively ISO 15118-2 Plug & Charge data exchanges, but this has been corrected through OCPP 1.632.

The development of a new OCPP 2.0 started in 2015 with the prime objective to completely redefine protocol profiles based on the experience acquired through first deployments and on future market needs. This new version introduces new data exchange profiles for the better management of remote charging station operation and for the identification of the charging station's hardware and configuration details. It also includes improvements for the management of charging and DER flexibility transactions while introducing new JSON/REST based APIs.

A second OCPP 2.0.1 was released in late 2020, adding improvements discovered through the first OCPP 2.0 deployments. This latest version provides full support to ISO15118-2 (including Plug and Charge and the management of different tariff schedules). OCPP 2.0.1 documents have improved to limit project specific interpretations.

In 2013 the Open Charge Alliance (OCA) was founded, bringing together EV charging hardware, electromobility platform vendors, and charging network operators. Similar to the OpenADR alliance for demand response, OCA's mission is to foster global development adoption, and compliance of the OCPP and related standards through collaboration, education, testing, and certification.

The alliance currently includes 220 members in 43 countries and 5 continents spanning the electromobility business domain. The alliance collaboration model is open with free- rights to use the standard using a pragmatic development approach from experts of EV infrastructure.

The OCPP version 1.6 is the protocol version predominantly deployed through the European markets, raising questions on backward compatibility across versions of OCPP deployment. In parallel to this initiative, the IEC TC69 has launched a new Joint Working Group 11 to develop interoperability across the electromobility and grid domains, which is very active and include over 95 experts from 22 countries.

Currently, the IEC 63110 object model is based on OCPP 2.0 draft 4 model. Additions have been made to introduce some objects or properties that are needed by OCPP 2.01, IEC 63110 or ISO/IEC 15118 use cases requirements. The support for bi-directional EV charging is expected foreseen for OCCP 2.1.

The IEC 63110 standard aims to bring better harmonization with other data exchanges considered through the electromobility domain as shown through the following diagram. In particular, it should offer better consistency with:

- IEC 61850/IEEE2030-5 for Distribution Grid Data Exchanges
- ISO/IEC 15118 with the EV
- IEC 63119 considered for exchange clear Clearing houses and Electromobility Service Providers

First activities have been initiated to derive a CIM based ontology and reference data structure from the IEC 63110 and OCPP work which should serve as a natural basis to initiate first data space deployments for electromobility.

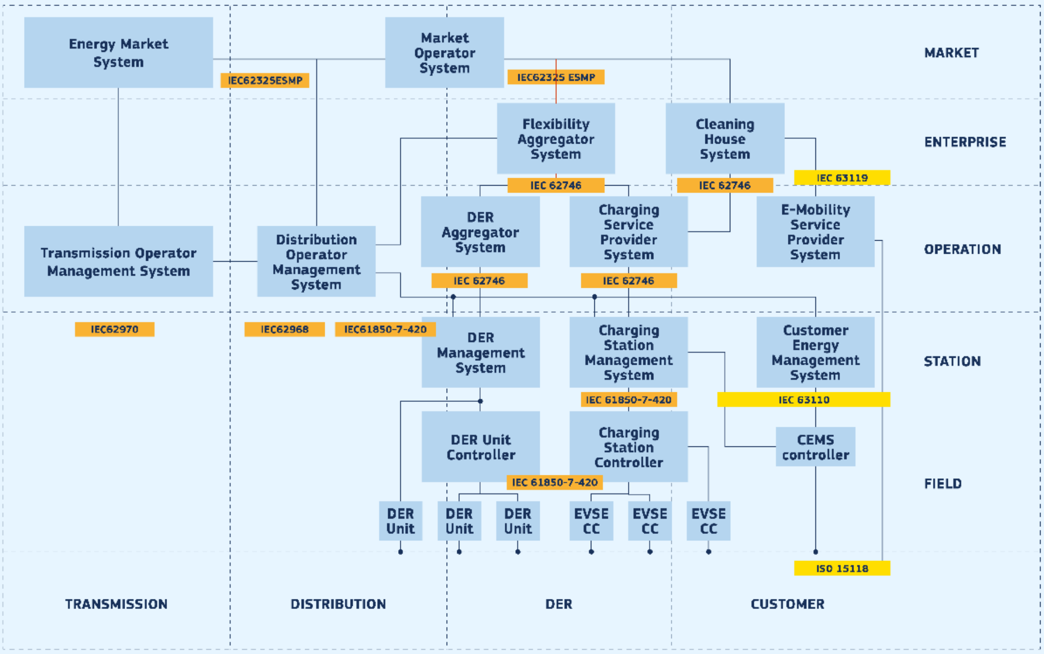

Figure 6 - Smartgrid interfaces with new electromobility domains

The diagram above (see Figure 6) illustrates key SmartGrid data exchange interfaces with the electromobility domain considering the following abreviations

DER = Distributed Energy Resources (PV, stationary battery, wind energy)
EVSE-CC = Electric Vehicle Supply Equipment Charging Controller
CEMS = Customer Energy Management System

1.4 Next steps for DERA architecture standard integration

When designing the DERA information schemas, there are several factors to consider. The most significant design choice is between performance and standardisation. Several BRIDGE projects have historically committed to propose extensions to European data format standards. However, associated project data models have so far not been transparently exchanged with DERA architecture users, which has led several projects to restart very similar standard mapping analysis.

While there are many standards already available, CIM emerges as a first obvious choice for many users in Europe as pivot standard through the DERA architecture. Standards, however, come at a price: performance. Especially in near-real-time data exchange, with potentially 300 million metering points, performance issues cannot be ignored. Within dataspaces projects such as EDDIE the project team have decided to optimise the performance for internal data exchange and to use CIM-based message formats when communicating with external parties. For a smooth transition between internal and external formats, message mapping is designed and documented to make sure no information is lost during processing. Incoming messages from regional connectors (none of them CIM compliant) have been mapped to CIM message format as pivot data model, to make sure all data of relevance can be converted through consistent dataspace dictionaries.

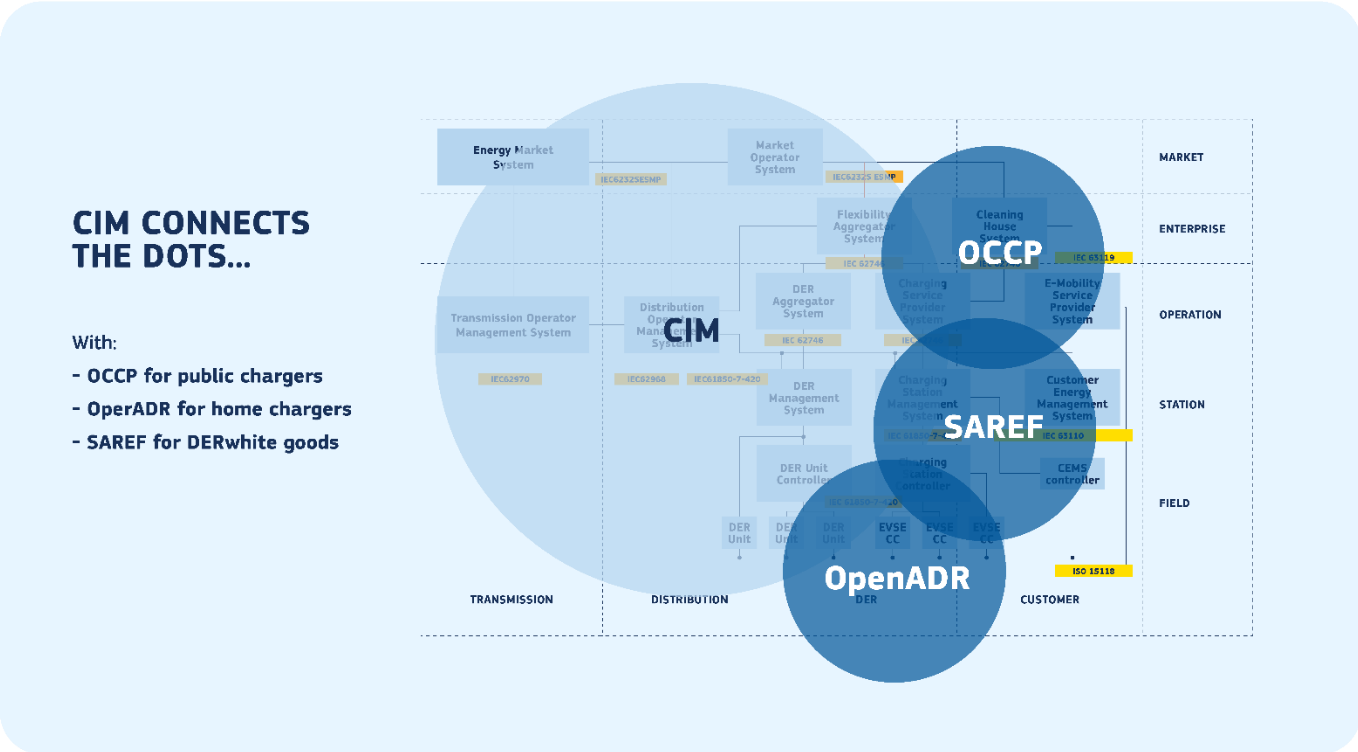

Figure 7 – CIM interface mapping with other domain specific standards

2 Project Development Phases

The proposed project team has adopted the CIM standard update process as a reference to consider evolutions of data exchanges through DERA interfaces considering new releases of IEC CIM standard packages. The approach also allows to identify needed standard updates and propose them to the European ETSI-CEN-CENELEC coordination group maintaining European SmartGrid standards.

Three possible triggers can initiate such evolutions :

1. New usecase needs related to market data exchanges (CIM IEC 62325 ESMP)
2. New usecase needs related to grid data exchanges (CIM IEC 61970)
3. New usecase needs related to the support part of CIM (IEC 61968)

Evolutions for market data exchanges (IEC 62325 ESMP)

In order to start a maintenance request the ENTSO-E template needs to be filled in. It includes the reason for the change, details of the requestor and the proposed change to the CIM model.

This is then put on the agenda of the CIM for Retail Subgroup. Usually, some discussion rounds take place with updated versions of the maintenance request. When fully reviewed, the result is forwarded to the CIM ESMP Workgroup.

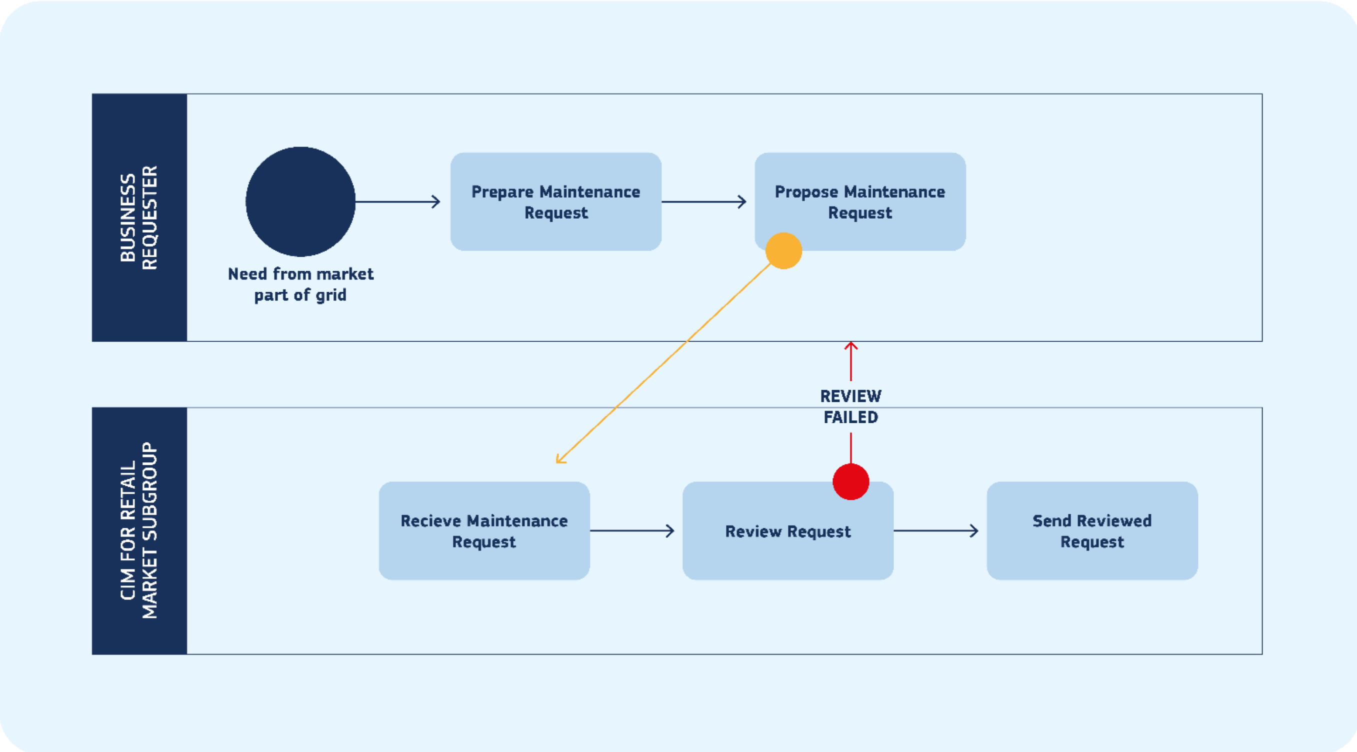

Figure 8 – IEC62325 ESMP Maintenance Request - CIM for Retail Market

The CIM ESMP Workging Group, on receiving the prepared maintenance request, must decide on the approval, taking into account other concurrent requests received. If the request has strategic implications (e.g. on the organisational level), the request is forwarded to the Information and Communication Technical Committee (ICTC). Otherwise it is forwarded to the CIM Working Group (which falls under the ICTC). When not approved, the request is sent back to the CIM for Retail Market subgroup for revision.

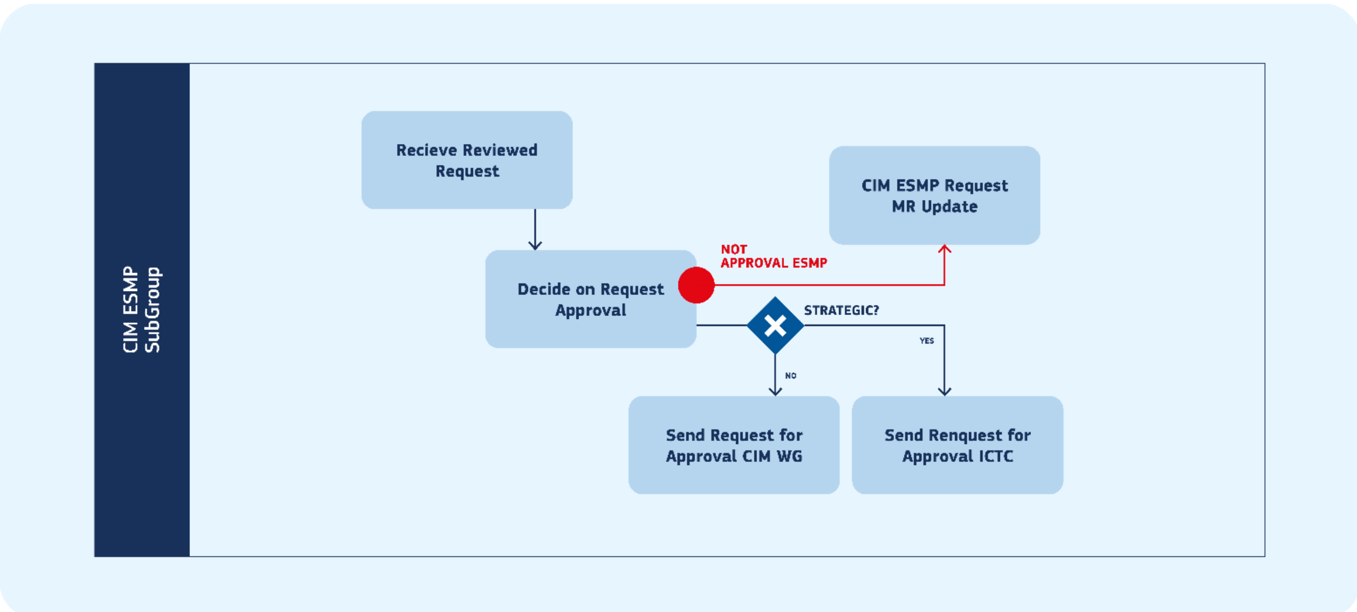

Figure 9 - IEC62325 ESMP Maintenance Request - CIM ESMP Subgroup.

Both the International ICTC core team and the CIM Working Group evaluate the maintenance request and demand a revision (update) in the case of no approval. Both tracks reach the ICTC core team and when the scope is limited to changes in the ESMP (IEC 62325-351) the requested changes are included in the appropriate profile.

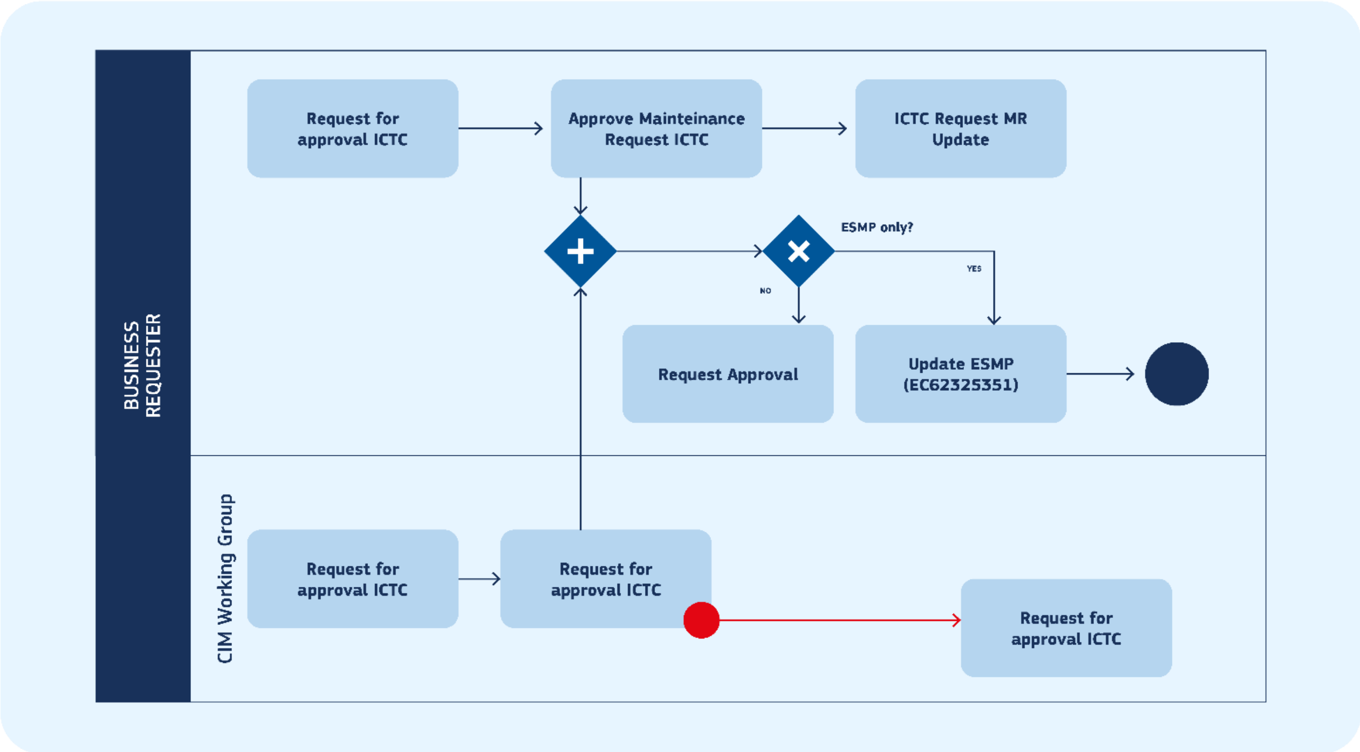

Figure 10 - IEC62325 ESMP Maintenance Request – ICTC

If the scope of the maintenance request exceeds the ESMP domain and requires changes to the grid (IEC 61970) and/or support (IEC61968) profile, the TC57 Taskforce 16 triggers a discussion for a joint approval. If agreed upon, TF 16 will include the changes in the relevant profiles.

Evolutions for grid data exchanges (IEC 61970)

Maintenance requests for the grid profile are handled in the UCA Taskforce 14. When the scope is limited to changes in the ESMP (IEC 61970), the requested changes are included in the appropriate profile. Otherwise, the TC57 Taskforce 16 triggers a discussion for a joint approval.

Evolutions for other parts of the CIM (IEC 61968)

Maintenance requests for the support profile are handled in the UCA Taskforce 13. When the scope is limited to changes in the ESMP (IEC 61968), the requested changes are included in the appropriate profile. Otherwise the TC57 Taskforce 16 triggers a discussion for a joined approval.

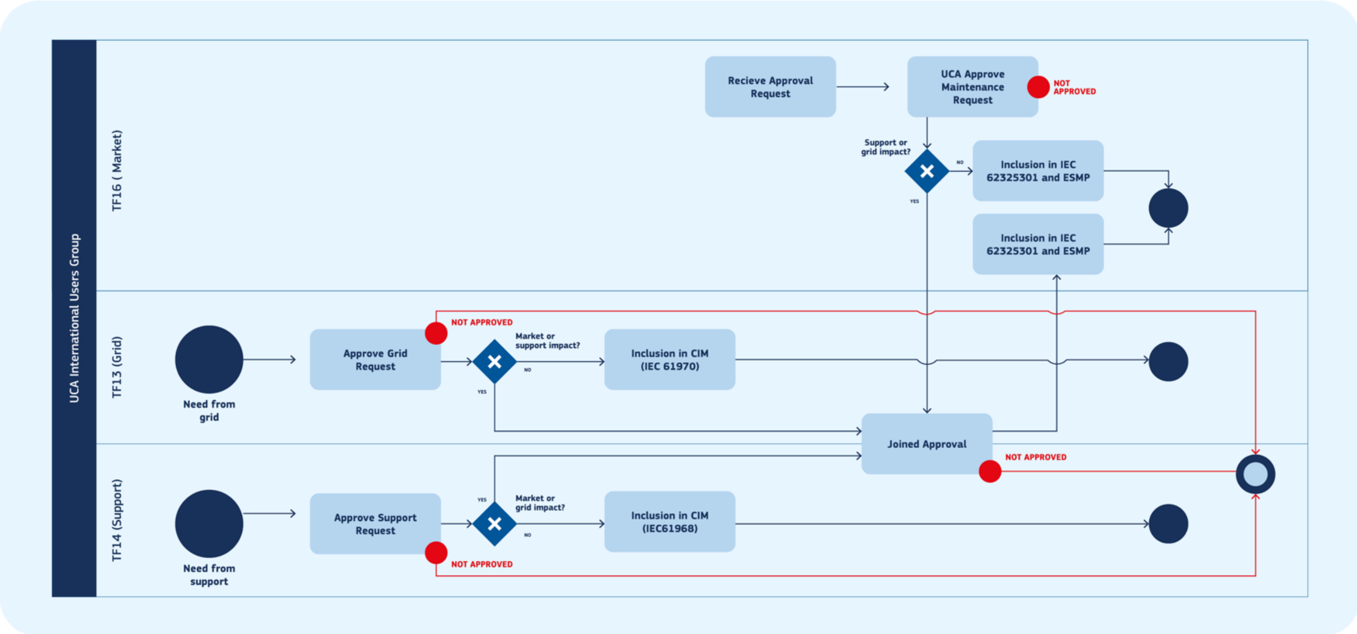

Figure 11 - Maintenance Request – UCA

Once every 3rd or 4th year, a new edition of the standard is implemented by the IEC CIM TC57 Working Group. They decide which part of all approved maintenance requests will make it into the official standard.

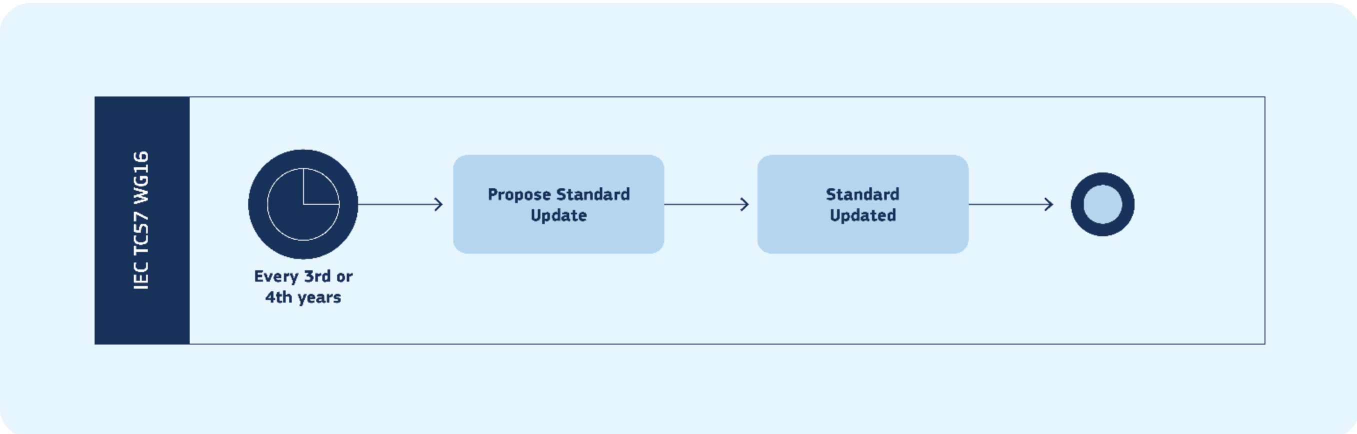

Figure 12 - CIM Maintenance Request procedure overview

To decouple the BRIDGE DERA architecture extension needs from the CIM core standard developments, the following approach has been proposed by the EDDIE project:

1. ENTSO-E is contacted to discuss the hosting of the EDDIE data needs in a future version. Such requests will in the future evolve towards the joint working group of ENTSO-E and the EU DSO entity working on the implementing act for flexibility data interoperability.
2. A CIM compliant message is generated from the CIM library extensions using different CIM generation tools
3. A copy made of the above message, with the addition of missing entities or enhanced datatypes/enumerations.
4. A version of the message is created which does not link to the existing central ENTSO-E code lists, but instead refers to a localised version with the needed additions. This results in a *CIM-compatible message*.
5. A maintenance request is issued to ENTSO-E to incorporate the missing data needs in the official CIM standard.

When the data needs are part of a newly released CIM standard, step two is repeated and will produce a *fully compliant CIM message*.

2.1 Kick-start phase

The initiative was started by the Onenet project and continued through EDDIE from January 2023. The latter immediately took over the responsibility to support the BRIDGE data modelling activities in coordination with other projects.

Among the first extensions was the specification of new messages exchange profiles beyond the one established for energy market data exchange through the IEC62325 – 751 European Style market exchanges. These new messages are adding new data exchange profiles for smart metering validated historical data and management of permission requests for consent management. As EDDIE was established on the basis of the IEC European standards as core dataspace pivot model, the challenge was to propose extensions to the existing Common Information Model building blocks to cover BRIDGE projects' specific needs. These extensions are based on the European Style Market Profile (ESMP) of IEC62325 as a starting base as tested and validated through Onenet message exchanges.

As part of that exercise the Corporate Systems Department of the Faculty of Computer Science of the University of Vienna (one of the EDDIE project’s consortium partners) has lead the development of a low entry-level introduction to the whole CIM ontology to facilitate reuse of the data model through new BRIDGE projects..

2.2 Coordination phase with other interested BRIDGE project

As the proposed data modelling approach is complex for projects having limited familiarity with CIM data models, the BRIDGE modelling team has decided not to conduct any widespread project questionnaires but instead actively search bi-lateral contacts with other interested projects having similar modelling expectations – particularly those leveraging new dataspace developments as federated through the Intnet project.

The first lessons learned from past projects such as EUSysflex, Interrface or OneNet have provided first inputs as starting point as they faced similar difficulties leveraging existing standards. Several coordination sessions were organised to discuss modelling environments and methods for new message profile developments derived from the same basis as the European Style Market profile and incorporating new data models derived from IEC 62746-4 as well as the DLSM/COSEM translated into CIM as pivot data exchange. The EDDIE project demonstrated the feasibility and replicability of the approach through the creation of 2 key new message profiles i.e. the EnergyCurve NearRealTime data document and the Near Real Time document as used through the EDDIE framework.

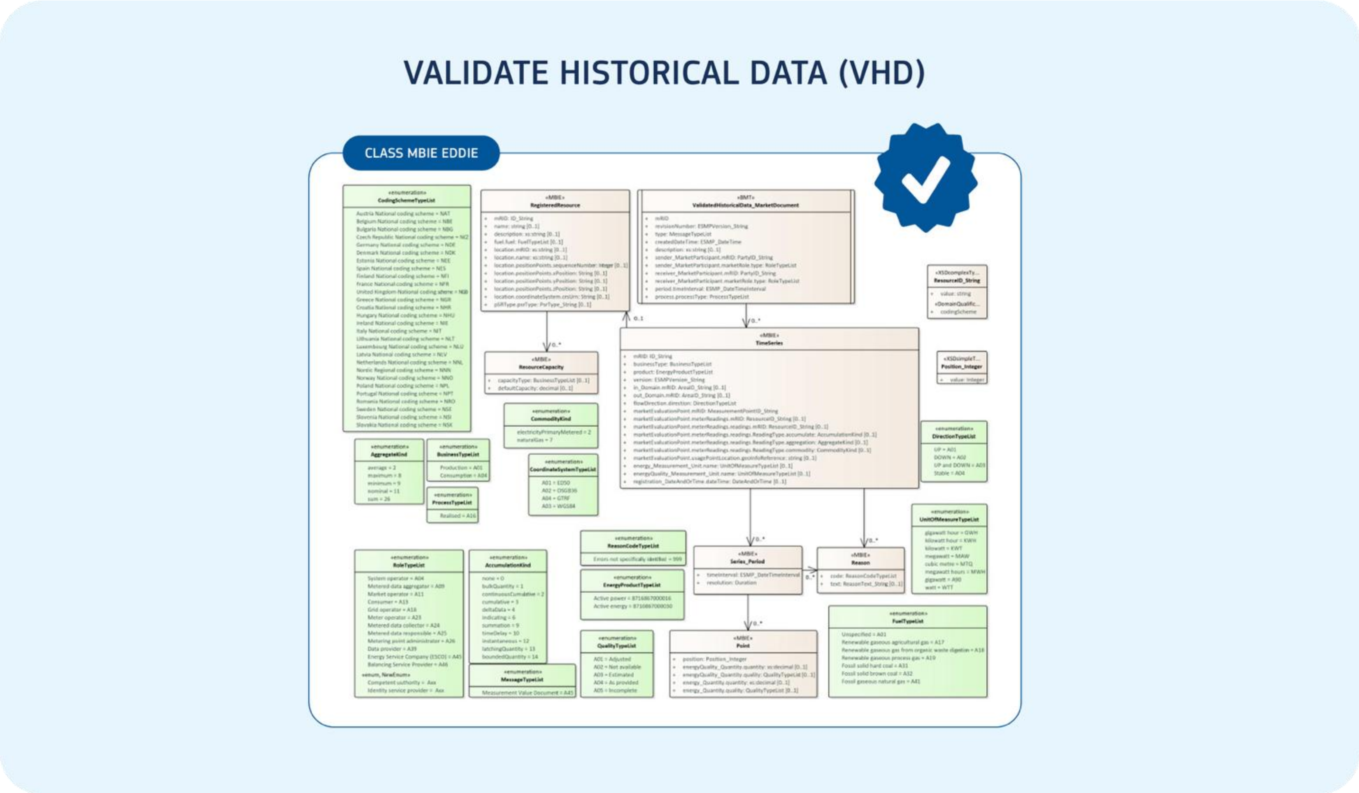

Figure 13 - EDDIE VHD message based on IEC62325-351 ED. 3profile

These messages have been used to support Intnet interoperability tests demonstrating interoperability between EDDIE and OmegaX dataspace infrastructures. This was particularly relevant to discuss different implementation options and test associated message syntax.

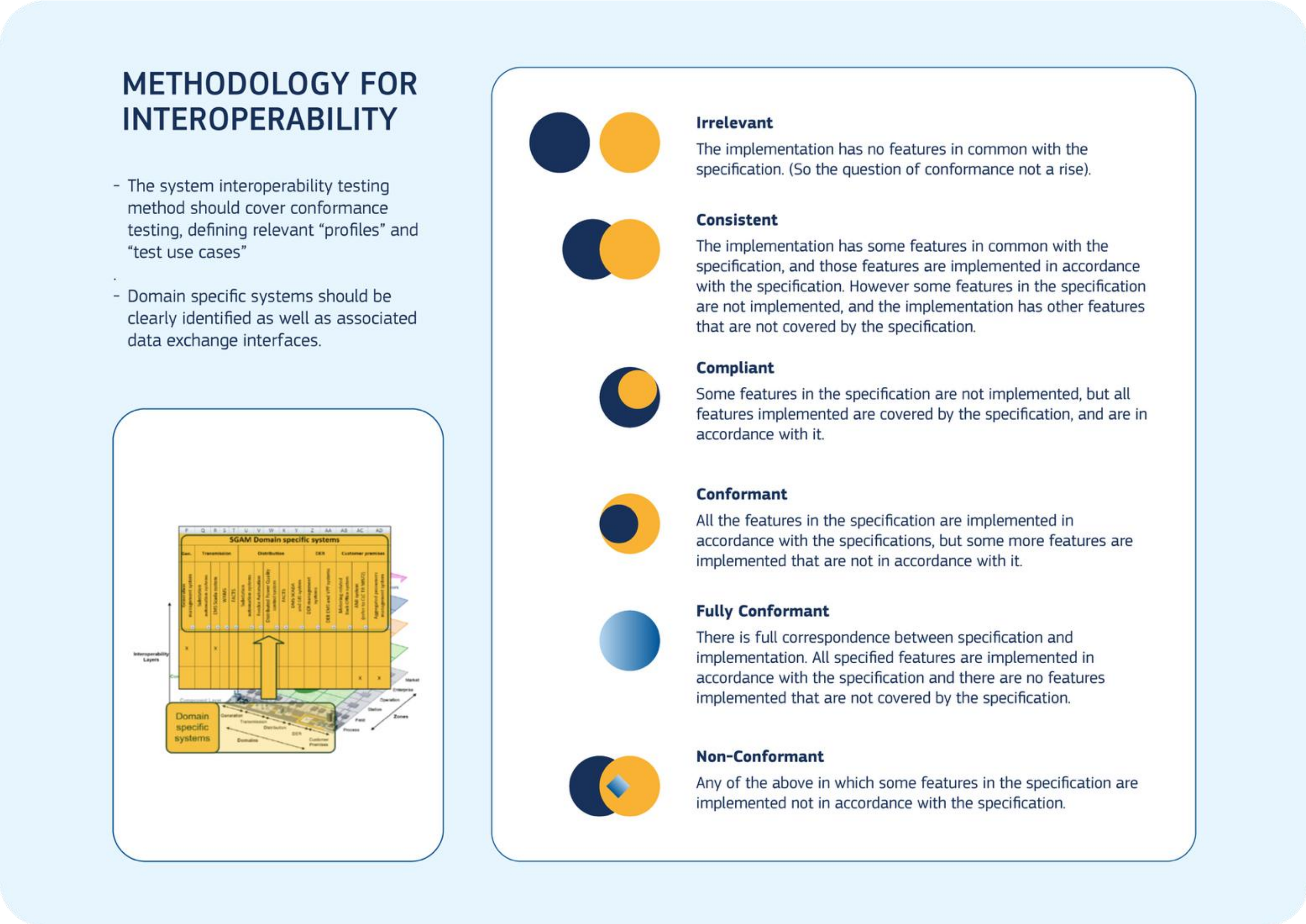

Figure 14 - EDDIE interoperability test objectives

Once the first implementation was demonstrated as feasible, the BRIDGE data modelling team efforts focused on other data space data exchanges as implemented through the EDDIE demonstrators. This has led to the creation of new DERA Master data models as illustrated on the following diagram for account points.

ACCOUNTING POINT MASTERDATA

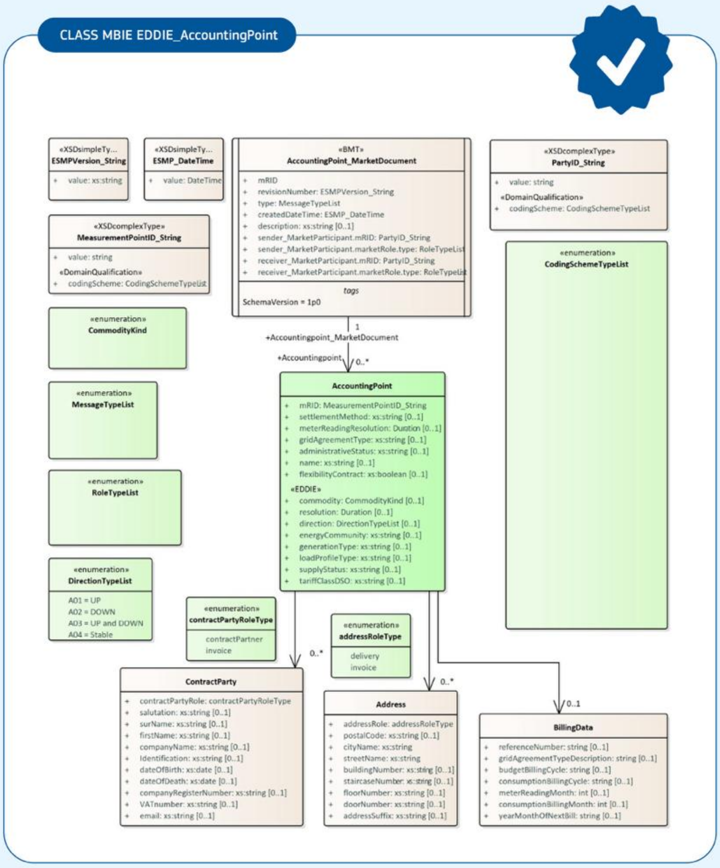

Figure 15 –New CIM Masterdata proposed by Eddie for Accounting Points

Metadata has been discussed through the CIM community for years, but no agreement has so far been reached, nor is it currently on the agenda. To get this into the existing CIM messages, the BRIDGE modelling team established contacts through the open-source community with key developers who have long-standing relations with both ENTSO-E and the CIM community in supporting building extensions to the CIM standard. This approach has led to the definition of an open-source data modelling environment leveraging streamlined processes as established by ENTSO-E while using open-source tooling (CIMConteXtor and CIMSyntaxGen) for engineering the necessary meta information extensions. During these collaborative modelling sessions, extensive scripts were made to simplify the use of associated tools for deploying it through a broader BRIDGE opensource community.

To avoid a too strong adherence to CIM standards, some research was conducted as part of the EDDIE project to maintain alignments with other key standards i.e. SAREF4ENER, OCPP 2.0.1 and OPENADR 3.0 standards. Necessary liaison has been set up so that alignment initiatives can continue while the DERA architecture develops.

2.3 Longer dissemination phase

In Q4 2024 the modelling team established a BRIDGE open Github repository to enable both tooling improvements and the sharing of the key underlying data models derived from DERA3.1 (for more details refer to https://github.com/Digital4Grids/Bridge_energy_schemas.)

The objective of the Github is to foster open-source collaboration through these models and facilitate European project adoption of new DERA3.1 pivot data models and benefits from best practices established through first dataspace projects coordinated through Intnet.

A new ‘Quick Startup Guide’ to using the CimContextor and CimSyntaxGen has been published on the Github to facilitate project adoption, with ‘the Pragmatician’s guide to CIM extensibility’ in progress. The source code of both the CimContextor and CimSyntaxGen tooling will become available shortly through the same Github to ensure relevant tooling is more widely spread. Recorded Webinars are planned and regular DERA modelling sessions are planned to be open to external audiences leveraging the IEC CIM and the BRIDGE community together.

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