Importance of Common Information Model (CIM)

- a basis for interoperability and the role of conformance testing

cigre
For power system expertise

Harish Krishnappa
Senior Consultant & Service Lead (CIMbion)
DNV Energy Systems

DNV

A global assurance and risk management company

GL Group
DNV
GARRAD HASSAN
NOBLE DENTON
KEMA
ADVANTICA

Ship and offshore classification and advisory

Energy advisory, certification, verification and monitoring

Software and digital solutions

Management system certification, supply chain and product assurance

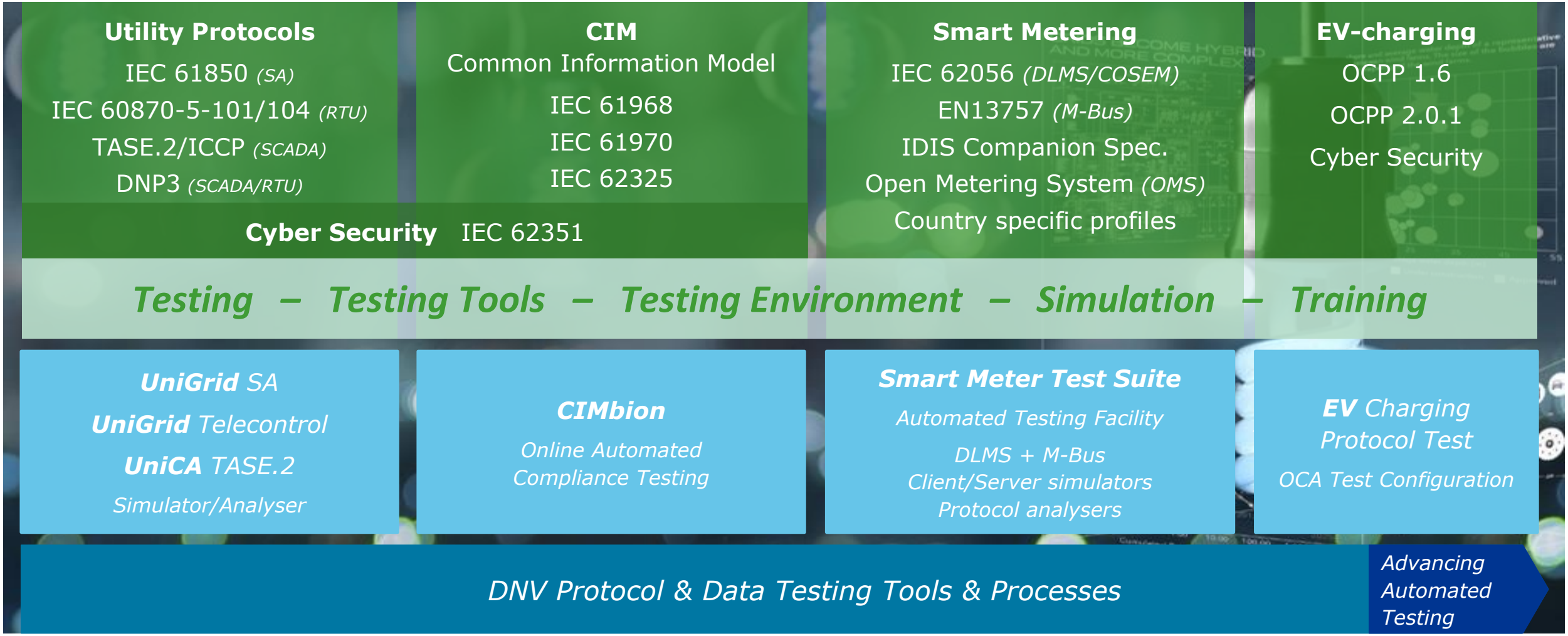
156	12,000	100,000	100+	5% R&D
years	employees	customers	countries	of annual revenue

DNV

Testing Compliance to Utility Standards

Interoperability – Testing – Tools – Training

DNV Utility Protocol Testing Tools



Common Information Model (CIM)

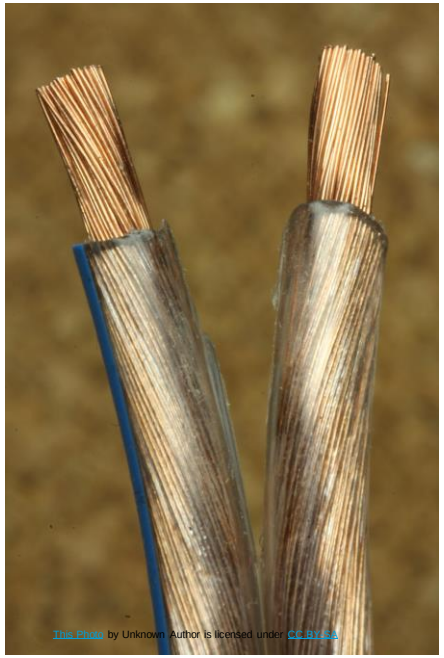
Information modelling is a language used to define not unique naming into a standardised concept allowing an integrated view

Syntactically valid

#1: The conductor is wearing a cool jacket!

Semantically valid

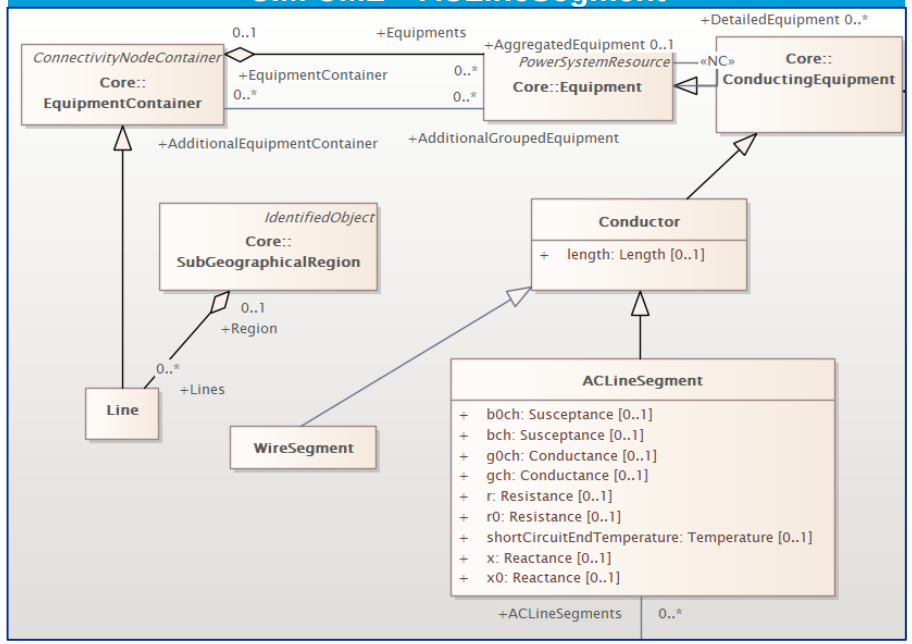
#2: Conductor 23AC50 has a ratedCurrent of 50A



Common information Model

- is an Information Model for the utility industry
- is an abstract representation of real-world objects *(has a consistent representation of power)*
  - gives unique names, definitions and meaning to each object and attributes to avoid confusion
  - describes relationships between objects
  - is not tied to a particular application's view of the world
- Is large *(consists more than 2000 classes)*
- is described in UML and maintained within Sparx Enterprise Architect (EA) and published under Apache license by UCAiug
- provides a standardized way of data representation, data exchanges between proprietary applications/systems and enable integration using a single data format

CIM UML – ACLineSegment




```
<cim:ACLineSegment rdf:ID="_7dfc7fd8-c857-4845-8e4b-ce592f9e8cc2">
  <cim:ACLineSegment.bch>0</cim:ACLineSegment.bch>
  <cim:ACLineSegment.gch>0</cim:ACLineSegment.gch>
  <cim:ACLineSegment.r>4.1956</cim:ACLineSegment.r>
  <cim:ACLineSegment.x>12.73</cim:ACLineSegment.x>
  <cim:ConductingEquipment.BaseVoltage rdf:resource="#_74945c22-508b-4361-9d03-5ce7474f56e7" />
  <cim:Equipment.EquipmentContainer rdf:resource="#_e38a38db-37d1-bb4b-88d4-3617d9c71f9b" />
  <cim:IdentifiedObject.mRID>7dfc7fd8-c857-4845-8e4b-ce592f9e8cc2</cim:IdentifiedObject.mRID>
  <cim:IdentifiedObject.name>FNOD041  FNOD021  2</cim:IdentifiedObject.name>
</cim:ACLineSegment>
```

Summarised history of CIM

1992 Unified Information turned over a EPRI data model to a Task Force with the understanding it would be turned into an industry standard model.

1993 - 1996 The task force expanded the data model with a primary goal of enabling use of plug-compatible applications to help protect utility investment in applications.

1996 The CIM was turned over to IEC TC57, WG13, where it is advancing through the standards process. Now also WG 14, 16 and 19 are involved.

1998 Move to UML

2000 First IOP, annual IOPs, NERC mandate CIM

2005 First edition of IEC 61970-301 CIM base document

2009 NIST identifies CIM as a Smart Grid standard

2010 First ENTSO-E IOP tests for grid model exchange. Five IOPs have been organized to date.

2012 First ENTSO-E IOP test on CIM for energy market (European market style). Six IOPs have been organised to date.

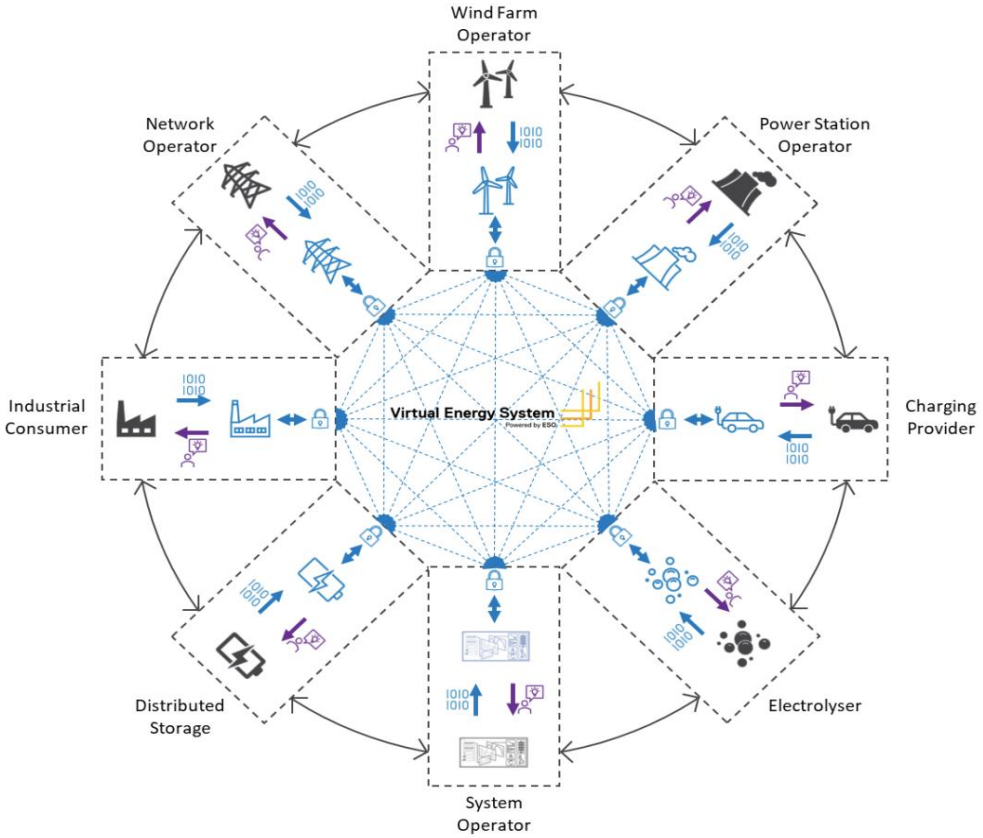
Since then, CIM developments are many.

Ecosystem of connected digital twins

- Aligning models and taxonomies *(one of the identified key priority factors necessary for VirtualES)*
  - broad range of terminologies for the energy sector
  - common ontologies need to be defined and specified that can enable alignment of models

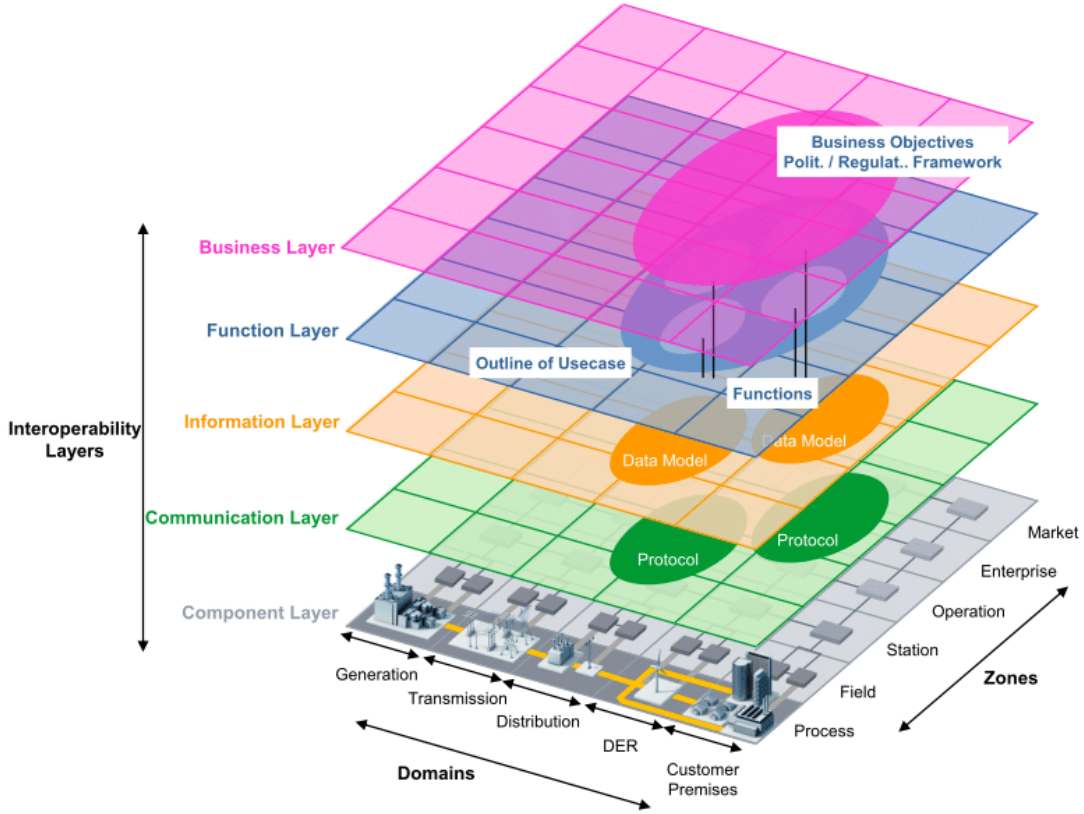
- Creating an interoperable technology stack *(one of the identified key priority factors necessary for VirtualES)*
  - enable smooth communication between organisations and systems
  - enable the exchange of standardised data across the sector in a reliable, secure and governed way

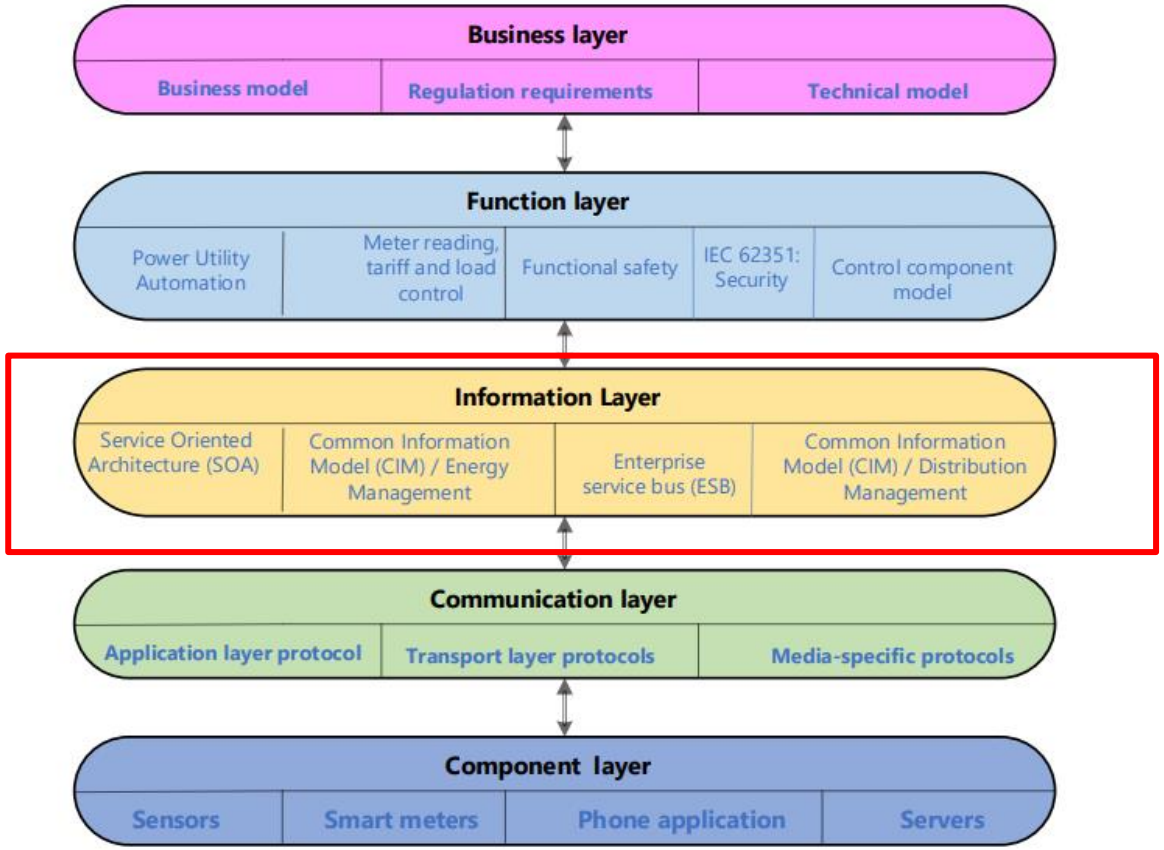
*The ambition of the Virtual Energy System (VirtualES) programme is to enable the creation of an ecosystem of connected digital twins of the entire energy system of Great Britain.



*Virtual Energy System - Priority technical factors

The “Smart Grid Architecture Model” (SGAM)* defines data management and data exchange as vital architecture components





*IEC SRD 63200 – SGAM basics
https://syc-se.iec.ch/wp-content/uploads/2019/10/SGCG_Methodology_SGAMUserManual.pdf

Conformity and Interoperability

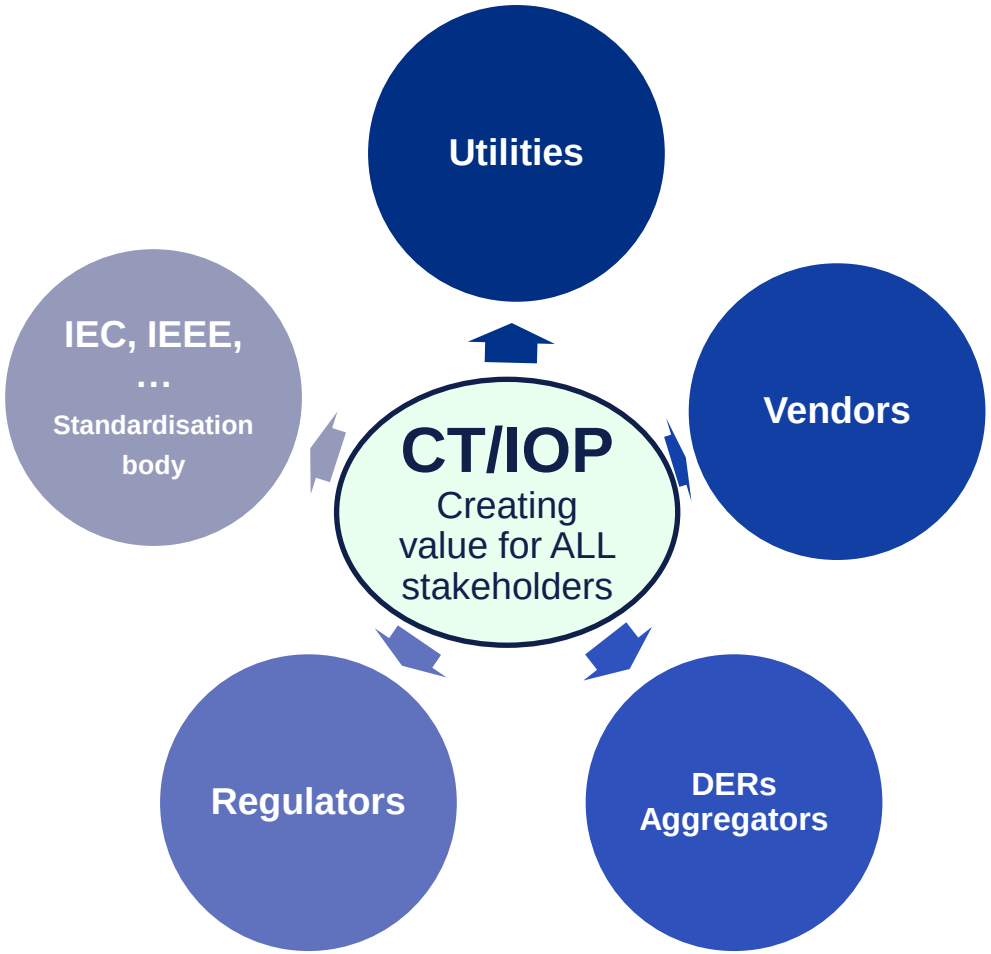
Conformance/Compliance Vs Interoperability

- **CONFORMANCE TEST (CT):** Provides assurance that an implementation complies to a standard or parts of a standard. Provides an audited environment of accredited test laboratories and certification of results for both positive and negative exchange cases. Conformance does not provide an assurance that different implementations can exchange information.
- **INTEROPERABILITY TEST (IOP):** Tests the ability to have implementation exchange information. Typically, tests are positive tests and are witnessed. Interoperability testing does not indicate conformance to the standard.

To be successful, the implementation should undergo both the Conformance and Interoperability testing

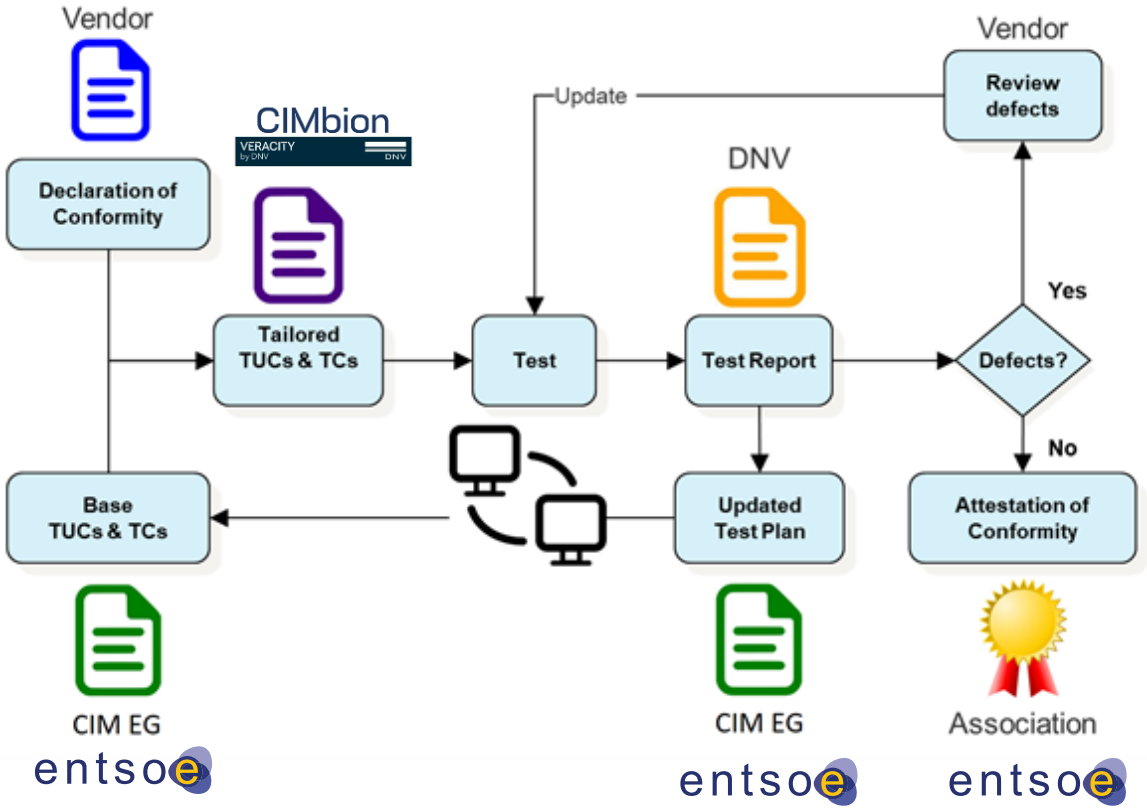
Added Value of CT and IOP

- **Application vendors:** Optimise the quality of product portfolio to **reduce** customer integration and testing **efforts, increasing market share**
- **Utilities, DERs, Aggregators:** purchase well tested, cost effective and **interoperable tools** and ability to be certified for business processes in **compliance with legislation** (network codes)
- **Regulator:** Developing policies and legislation with clear guidance to **enable energy transition**
- **IEC, IEEE, …: Wide and continuous use of standards** supported by a certification process and evolvement of standard



DNV Conformance Testing Services and Process (*CGMES v3.0)

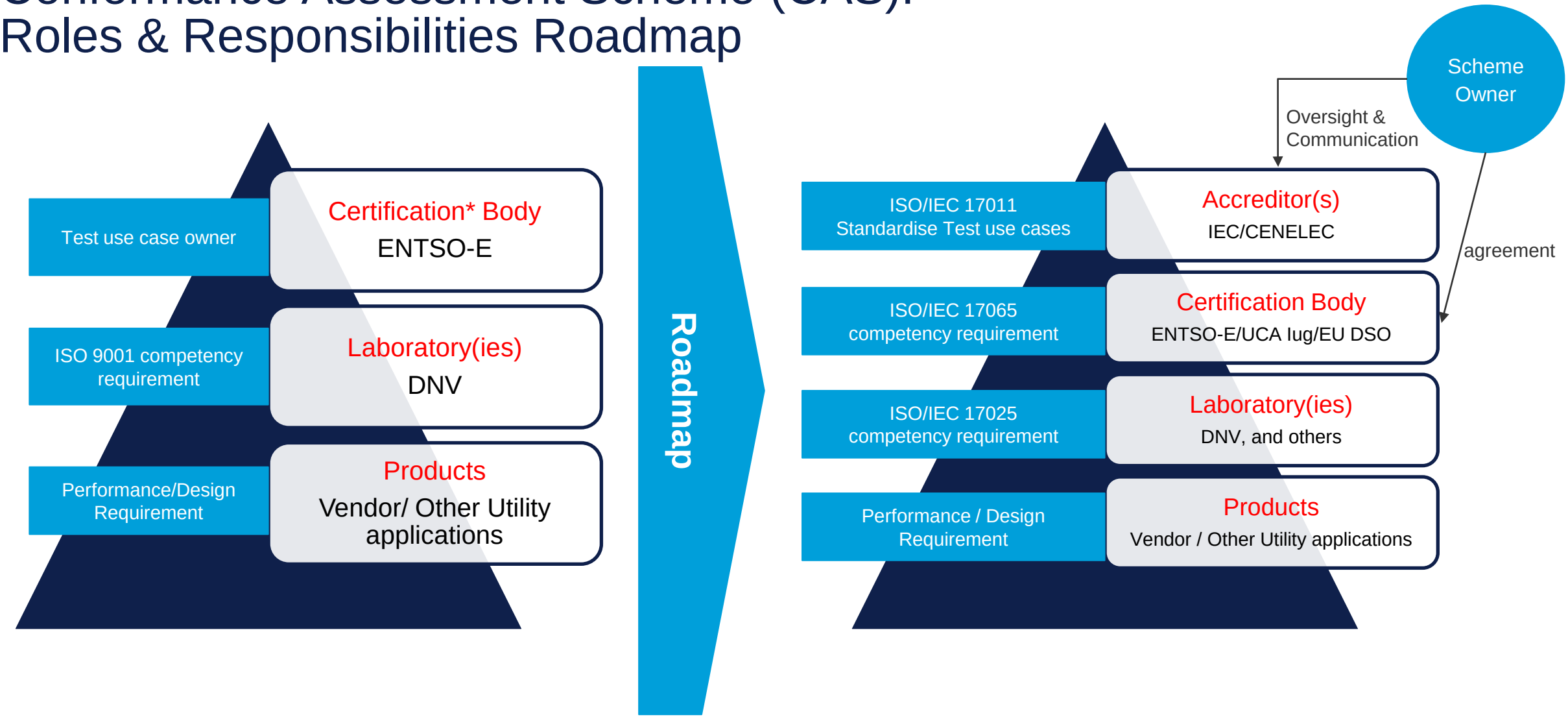
SERVICES	PARTIES
Subscription (self-assessment)	Vendor Utilities
Pre-conformance test	Vendor DNV
Conformance Test [FAT] (Test Data)	Vendor DNV
Site Acceptance Test [SAT] (Utility Data)	Utilities DNV
Business Process Testing	Utilities DNV



TUCs – Test Use Cases
TCs – Test Configurations
CIM EG – CIM Expert Group (ENTSO-E)
Utilities – TSOs and DSOs

*Common Grid Model Exchange Standard (CGMES)
https://www.entsoe.eu/data/cim/cim-for-grid-models-exchange/

Conformance Assessment Scheme (CAS): Roles & Responsibilities Roadmap



*ENTSO-E is not certified as an IEC Certification body, ENTSO-E provides the role of opinion body and schema owner

Automated *(CIM)* testing tool

- Cloud hosted tool
- Reduces Integration & Testing efforts
- Predefined Test Use Cases are available
- Enables Continuous Use & Improvement of the CIM standard

CIMbion
VERACITY by DNV

Free Demo	Basic Import/Export	Incremental Import/Export	Advanced Functionalities
Features	**Features**	**Features**	**Features**
✓ Import/Export Inclusive & Individual	✓ Import/Export Inclusive & Individual	✓ Import/Export Inclusive & Individual	✓ Import/Export Inclusive & Individual
✗ Access to Pre-Test & Conformity Testing	✓ Access to Pre-Test & Conformity Testing	✓ Access to Pre-Test & Conformity Testing	✓ Access to Pre-Test & Conformity Testing
✗ Import/Export Difference	✗ Import/Export Difference	✓ Import/Export Difference	✓ Import/Export Difference
✗ Update and Repository	✗ Update and Repository	✗ Update and Repository	✓ Update and Repository
✗ Diagram & Geographical Layout	✗ Diagram & Geographical Layout	✗ Diagram & Geographical Layout	✓ Diagram & Geographical Layout
✗ Topology Processing	✗ Topology Processing	✗ Topology Processing	✓ Topology Processing
✗ Power Flow, Short circuit & Dynamics	✗ Power Flow, Short circuit & Dynamics	✗ Power Flow, Short circuit & Dynamics	✓ Power Flow, Short circuit & Dynamics

cigre Netherlands | Next Generation Network

Thank you

cimbion@dnv.com

cigre
For power system expertise

Harish Krishnappa
Senior Consultant & Service Lead (CIMbion)
DNV Energy Systems

DNV