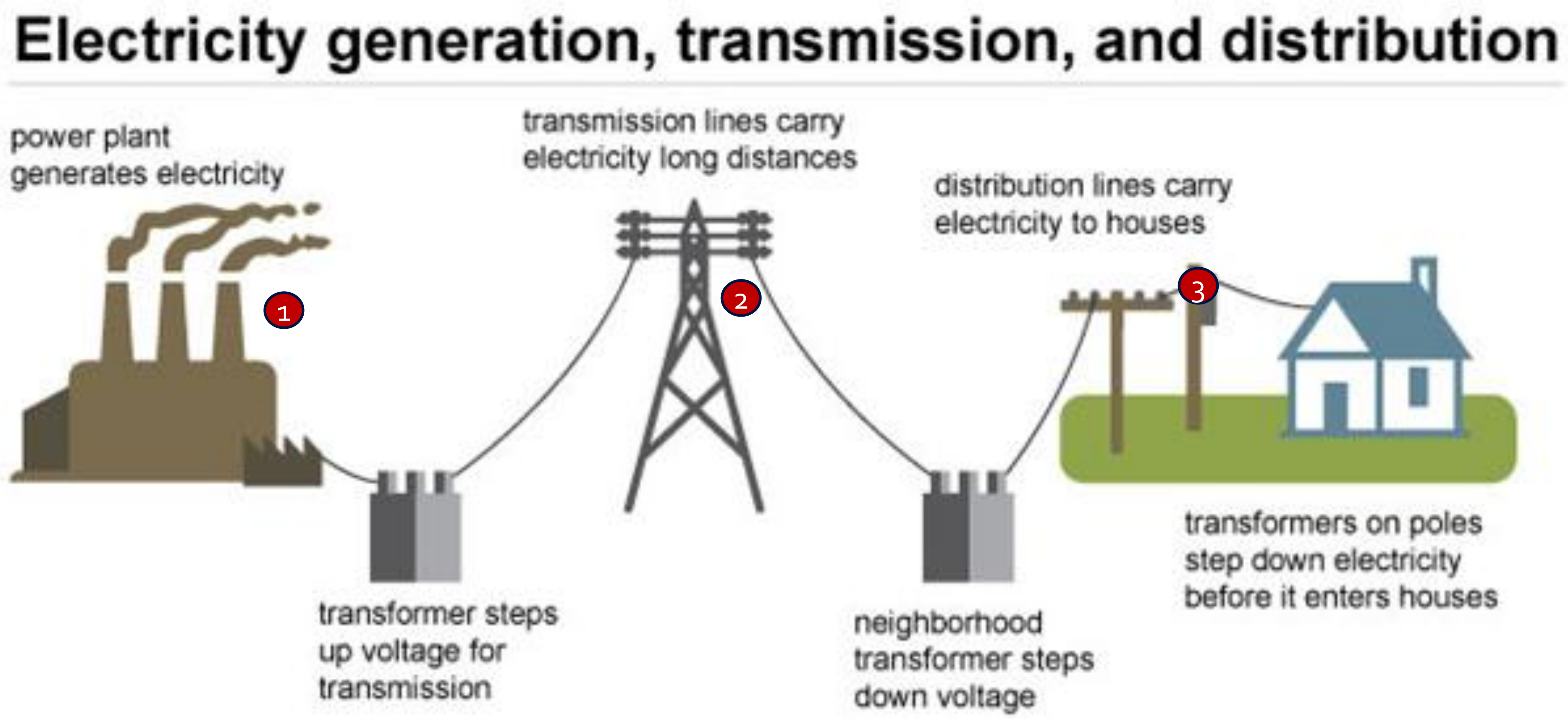
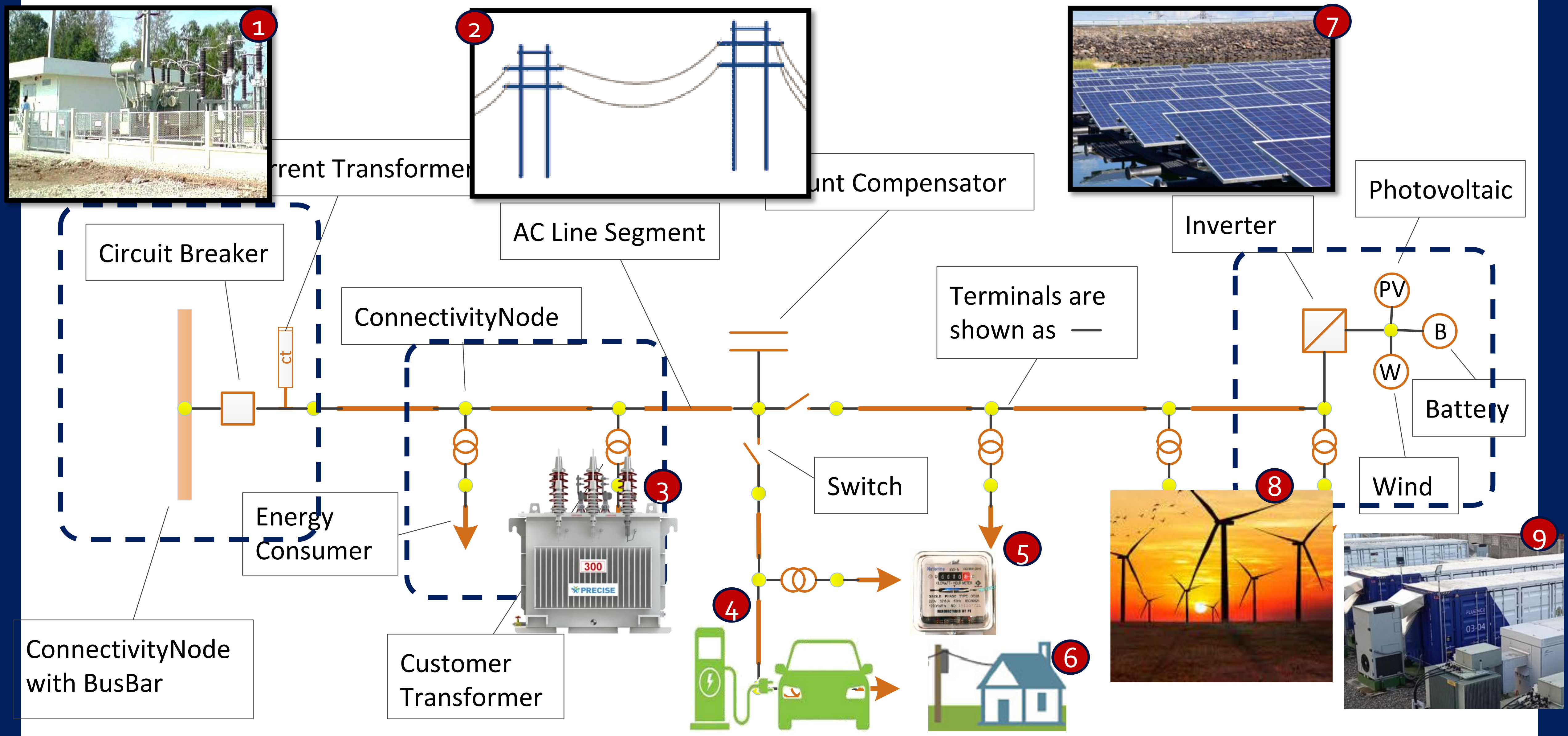
CIM EXAMPLE

ระบบผลิตกระแสไฟฟ้า ระบบส่งกระแสไฟฟ้า ระบบจำหน่ายกระแสไฟฟ้า



Power System became more complicated



Grid Model in Substations

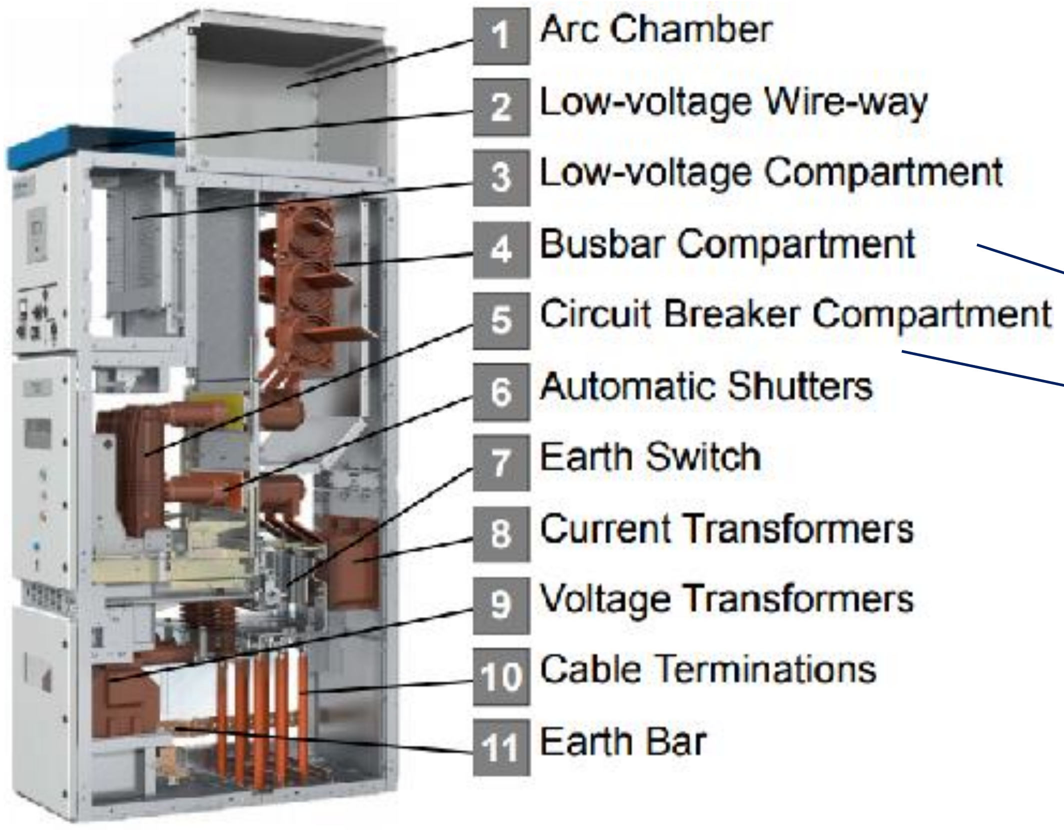
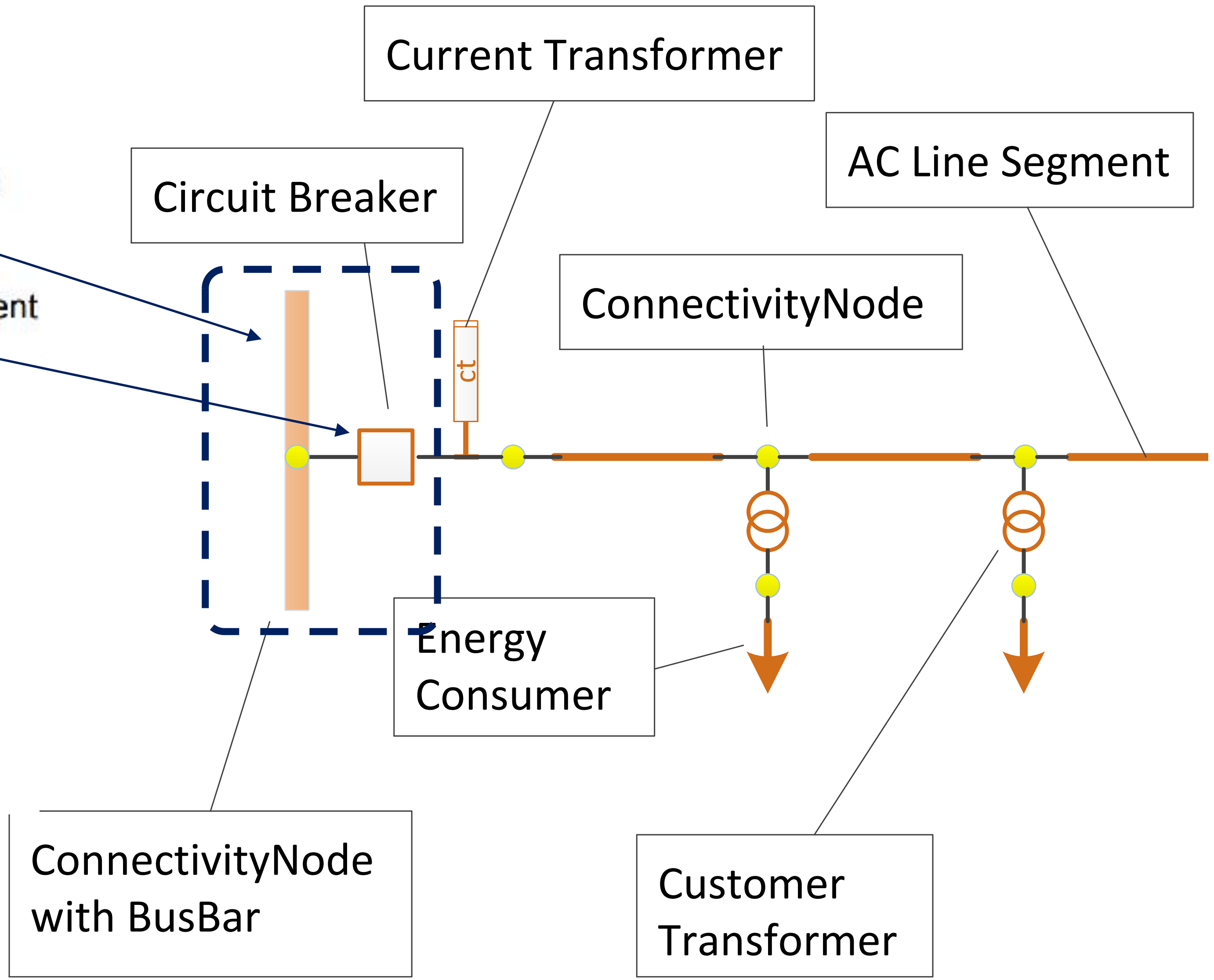
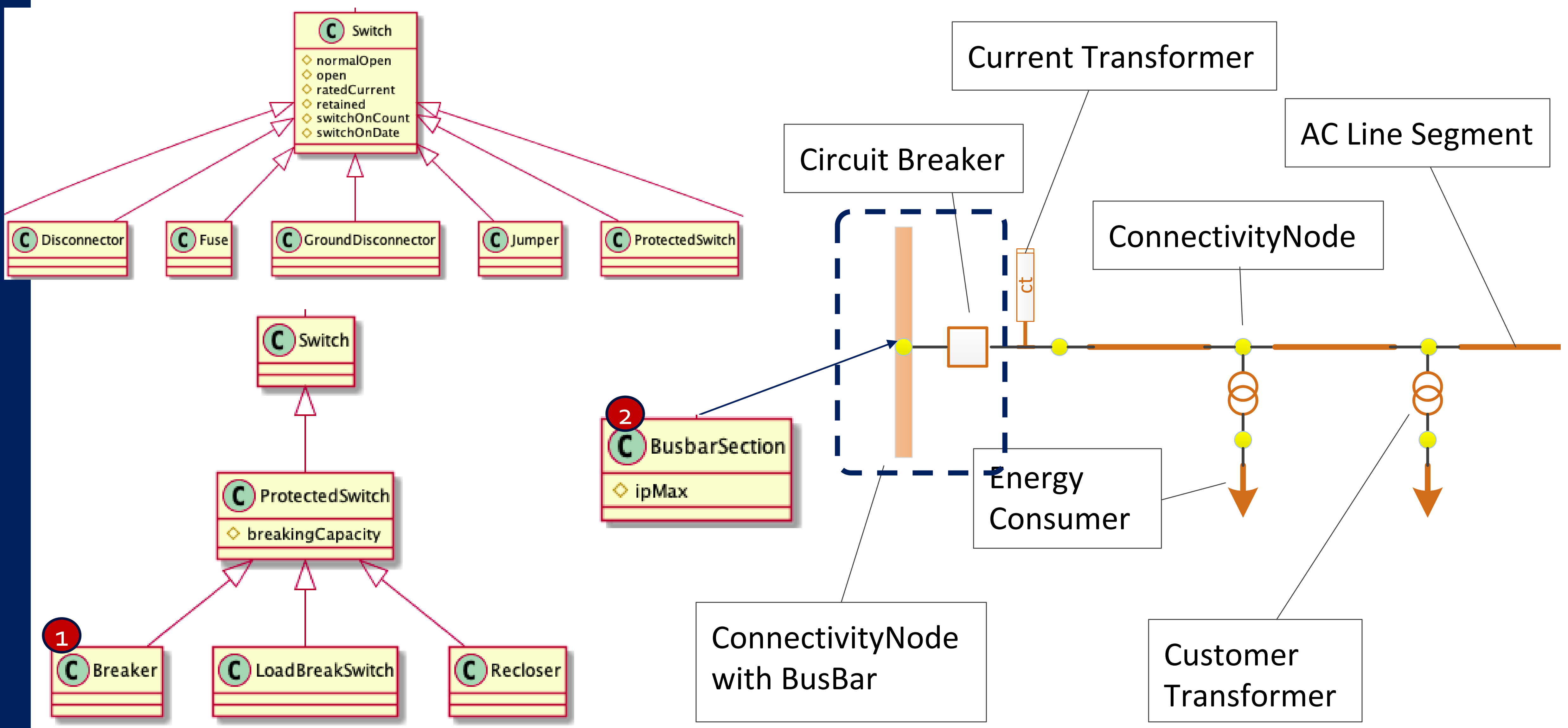


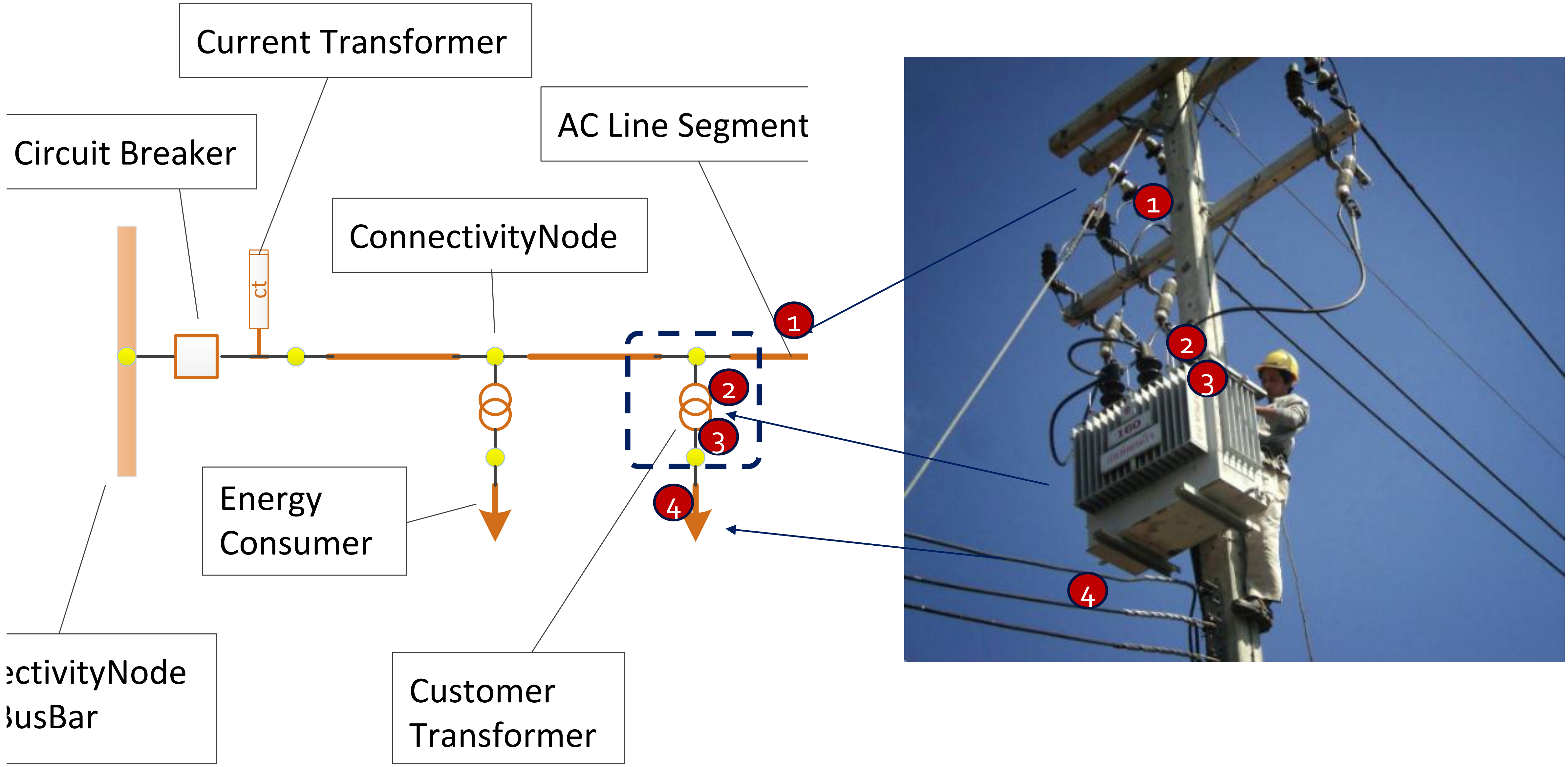
Figure 1. Construction parts of MV switchgear



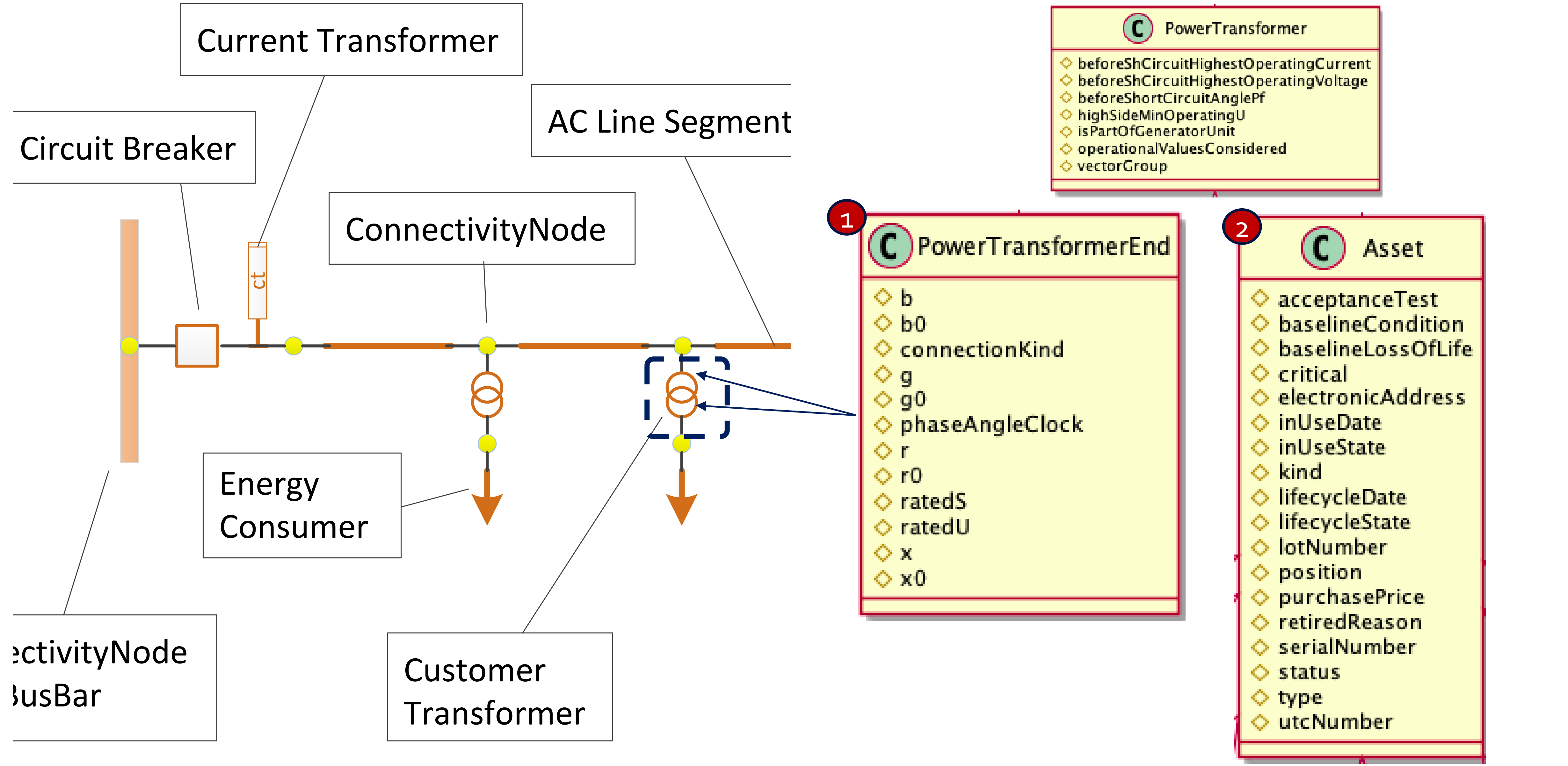
CIM examples : busbar and breaker



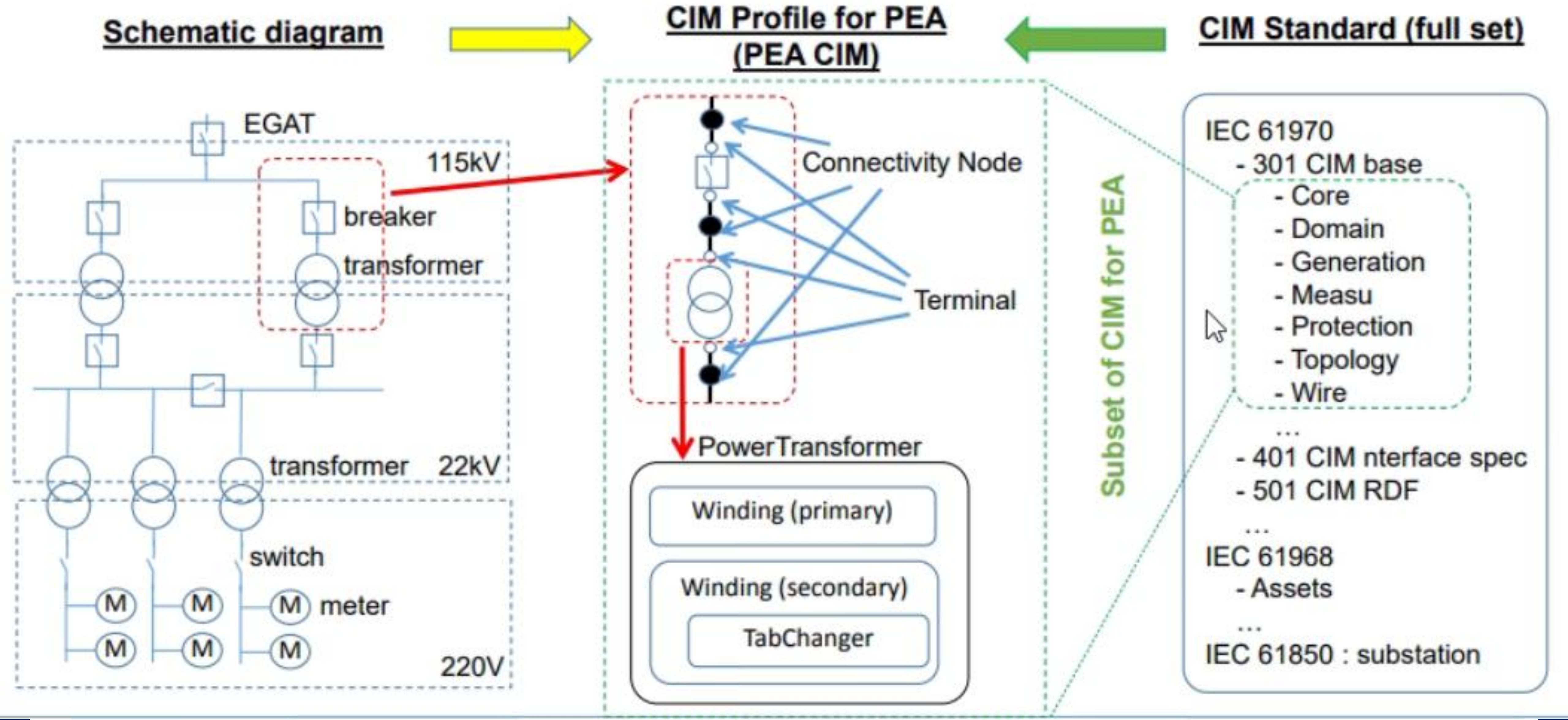
Grid Model in Distribution System



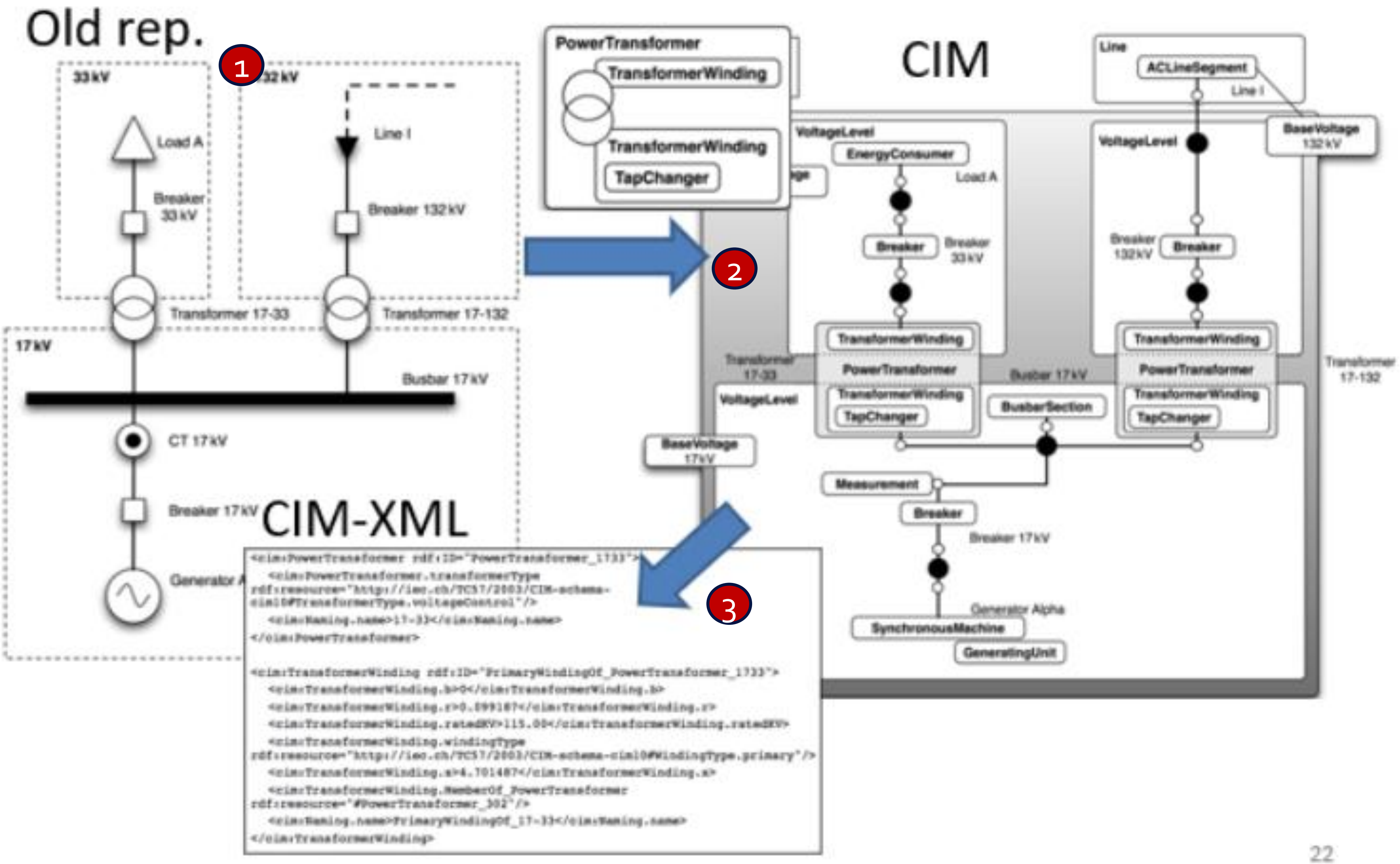
PowerTransformer as Equipment and Asset

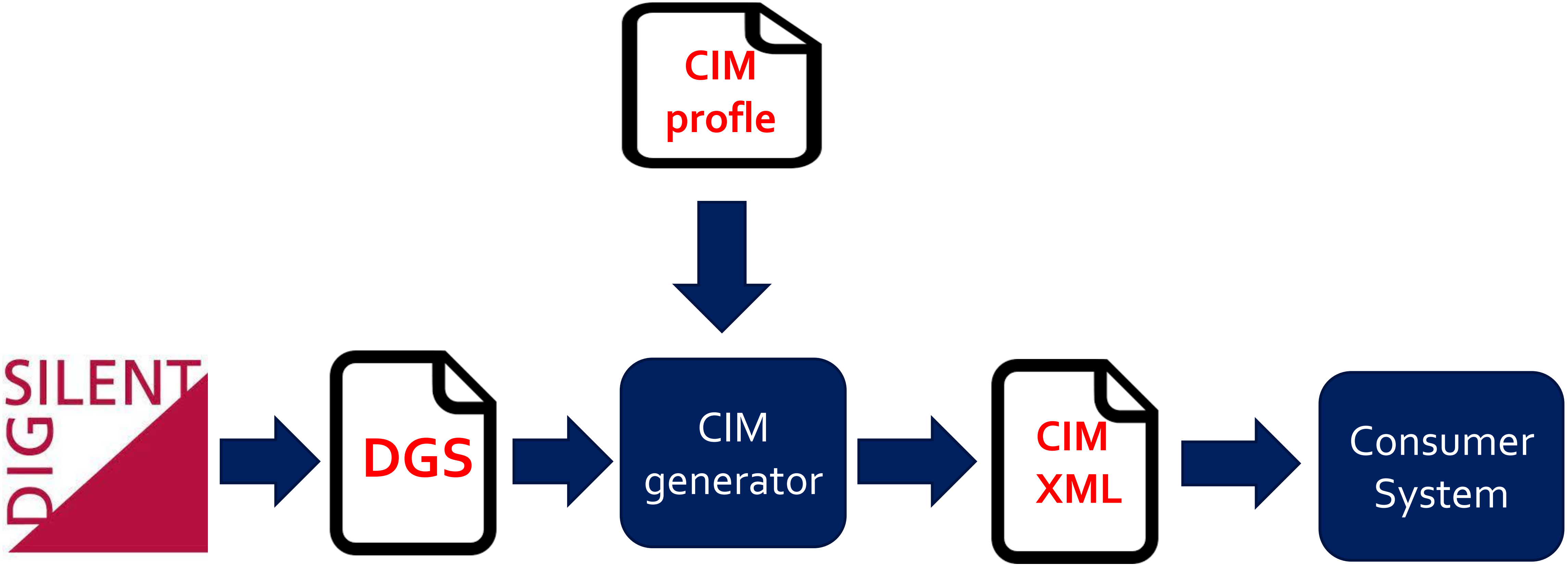


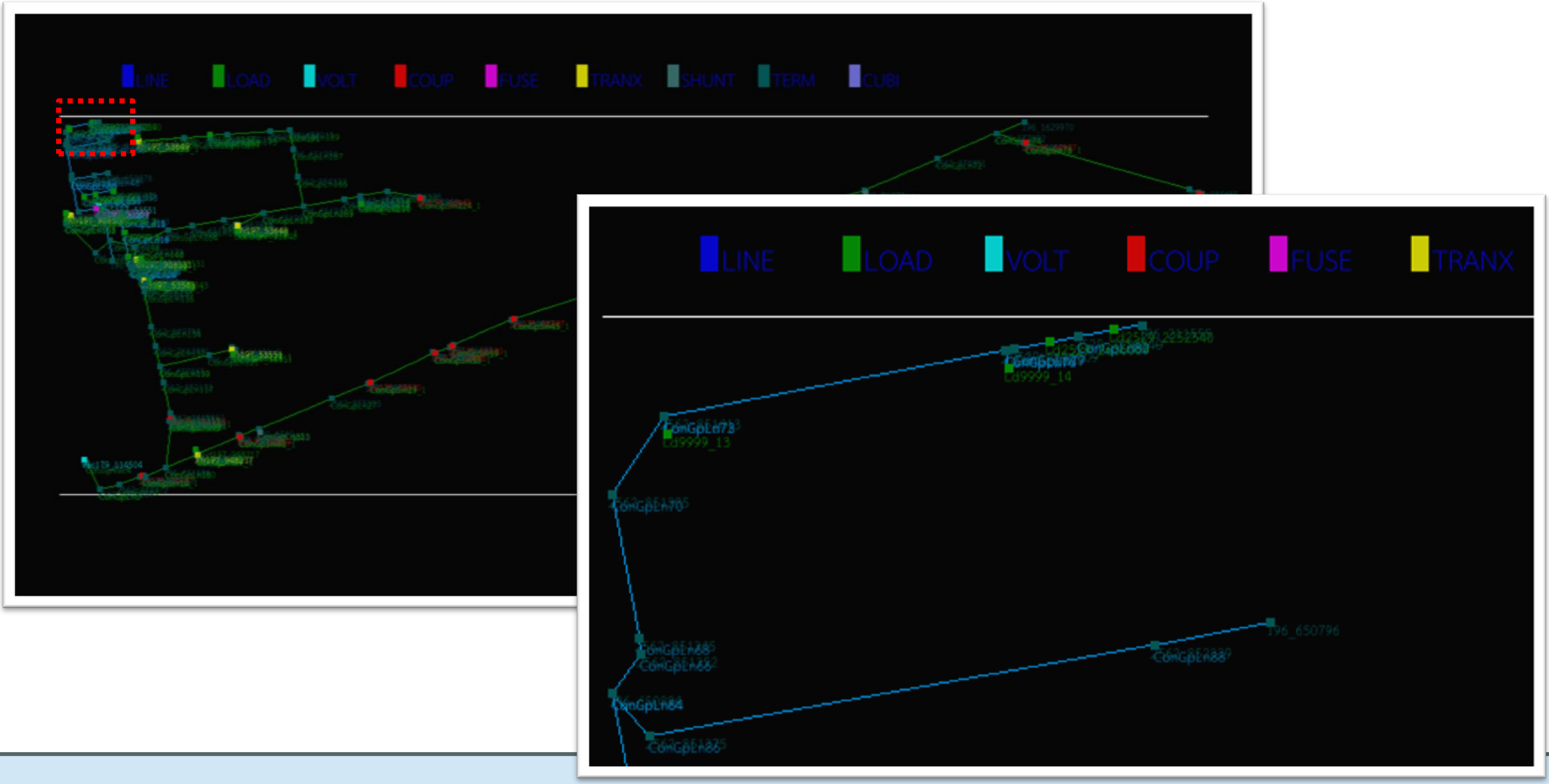
CIM Profile : subset of CIM

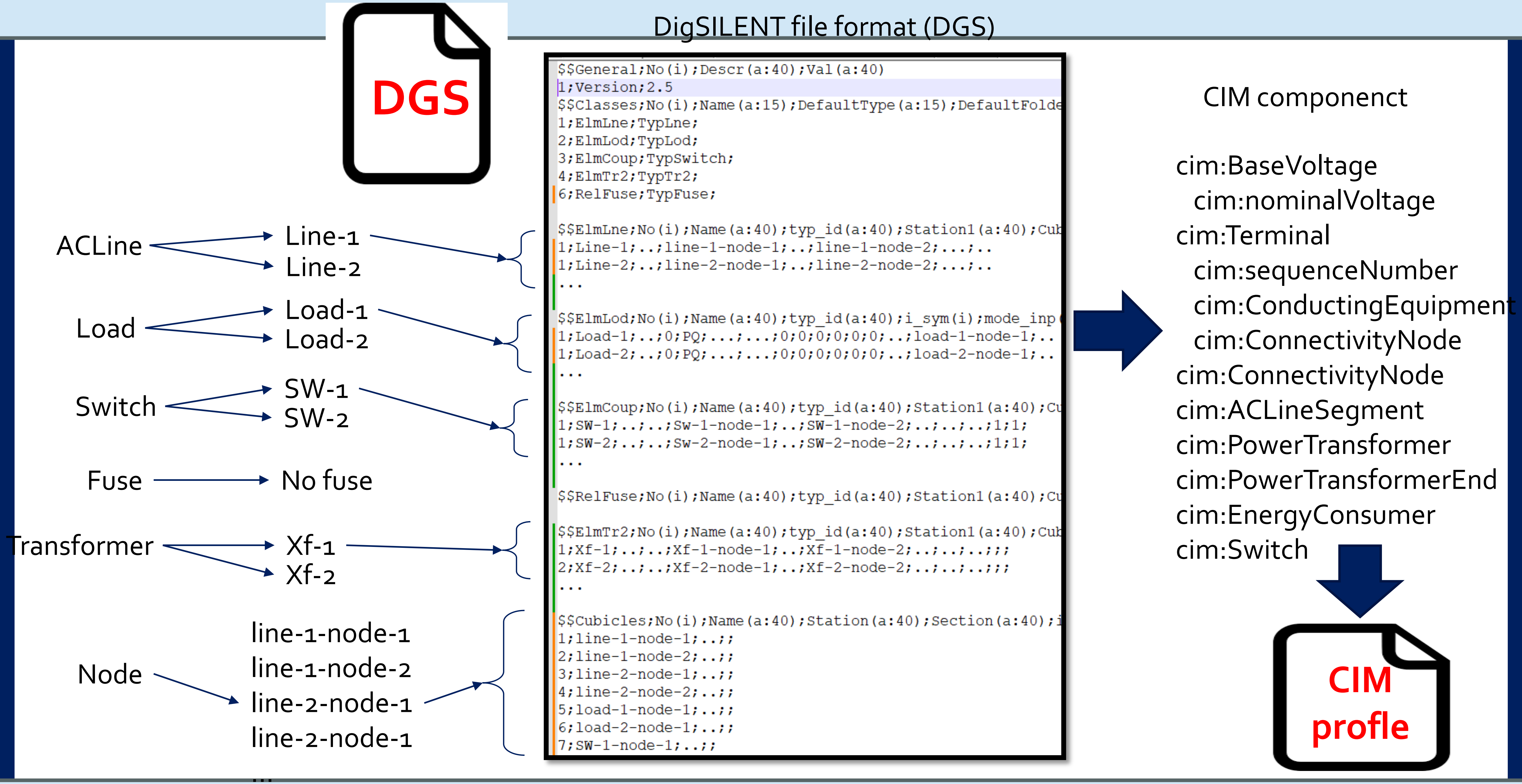


มาตรฐานข้อมูลกลาง : CIM Standard




CIM
profle
SILENT
DIG
DGS
CIM
generator
CIM
XML
Consumer
System


LINE
LOAD
VOLT
COUP
FUSE
TRANX
SHUNT
TERM
CUBI
LINE
LOAD
VOLT
COUP
FUSE
TRANX
ConGpLd73
Ld9999_13
Ld9999_14
ConGpLn70
ConGpLn84
196_650796


DigSILENT file format (DGS)
DGS
ACLine
Line-1
Line-2
Load
Load-1
Load-2
Switch
SW-1
SW-2
Fuse
No fuse
Transformer
Xf-1
Xf-2
Node
line-1-node-1
line-1-node-2
line-2-node-1
line-2-node-1
...
$$General;No(i);Descr(a:40);Val(a:40)
1;Version;2.5
$$Classes;No(i);Name(a:15);DefaultType(a:15);DefaultFolde
1;ElmLne;TypLne;
2;ElmLod;TypLod;
3;ElmCoup;TypSwitch;
4;ElmTr2;TypTr2;
6;RelFuse;TypFuse;
$$ElmLne;No(i);Name(a:40);typ_id(a:40);Station1(a:40);Cub
1;Line-1;..;line-1-node-1;..;line-1-node-2;...;..
1;Line-2;..;line-2-node-1;..;line-2-node-2;...;..
...
$$ElmLod;No(i);Name(a:40);typ_id(a:40);i_sym(i);mode_inp
1;Load-1;..;0;PQ;...;...;0;0;0;0;0;0;..;load-1-node-1;..
1;Load-2;..;0;PQ;...;...;0;0;0;0;0;0;..;load-2-node-1;..
...
$$ElmCoup;No(i);Name(a:40);typ_id(a:40);Station1(a:40);Cu
1;SW-1;..;..;Sw-1-node-1;..;SW-1-node-2;..;..;..;1;1;
1;SW-2;..;..;Sw-2-node-1;..;SW-2-node-2;..;..;..;1;1;
...
$$RelFuse;No(i);Name(a:40);typ_id(a:40);Station1(a:40);Cu
$$ElmTr2;No(i);Name(a:40);typ_id(a:40);Station1(a:40);Cub
1;Xf-1;..;..;Xf-1-node-1;..;Xf-1-node-2;..;..;..;;;
2;Xf-2;..;..;Xf-2-node-1;..;Xf-2-node-2;..;..;..;;;
...
$$Cubicles;No(i);Name(a:40);Station(a:40);Section(a:40);i
1;line-1-node-1;..;;
2;line-1-node-2;..;;
3;line-2-node-1;..;;
4;line-2-node-2;..;;
5;load-1-node-1;..;;
6;load-2-node-1;..;;
7;SW-1-node-1;..;;
CIM componenct
cim:BaseVoltage
cim:nominalVoltage
cim:Terminal
cim:sequenceNumber
cim:ConductingEquipment
cim:ConnectivityNode
cim:ConnectivityNode
cim:ACLineSegment
cim:PowerTransformer
cim:PowerTransformerEnd
cim:EnergyConsumer
cim:Switch
CIM
profle

CIM profile format (IEC61970-501)

cim:BaseVoltage
  cim:nominalVoltage
cim:Terminal
  cim:sequenceNumber
  cim:ConductingEquipment
  cim:ConnectivityNode
cim:ConnectivityNode
cim:ACLineSegment
cim:PowerTransformer
cim:PowerTransformerEnd
cim:EnergyConsumer
cim:Switch

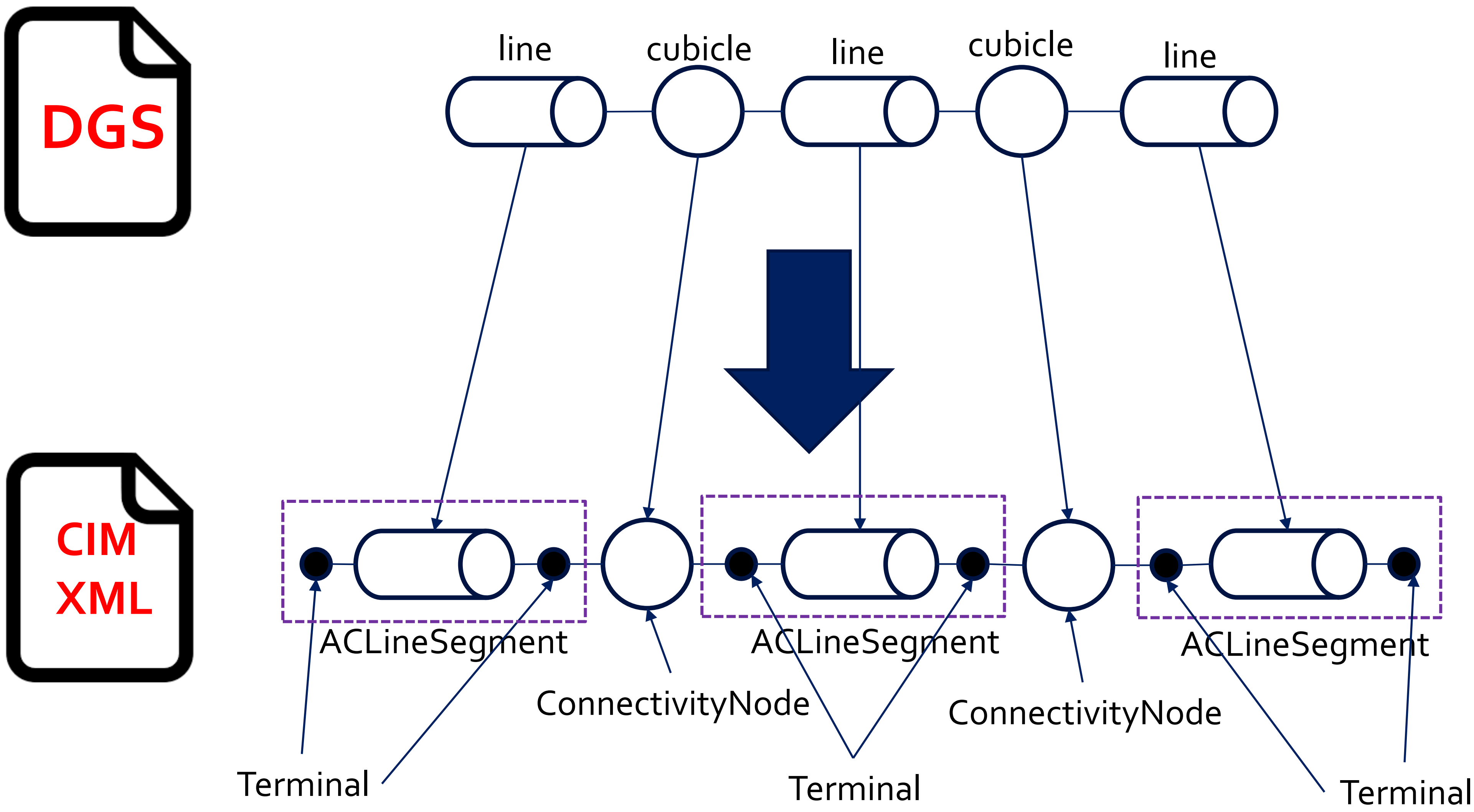
```
<rdf:RDF
    xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
    xmlns:rdfs="http://www.w3.org/TR/1999/PR-rdf-schema-19990303#"
    xmlns:cim="http://iec.ch/TC57/2016/CIM-schema-cim17#"
    xmlns:prf="http://utility.co.th/profile-1/#">

    <rdfs:Class rdf:ID="prf:BaseVoltage">
        <rdfs:subClassOf rdf:resource="cim:BaseVoltage"/>
    </rdfs:Class>
    <rdf:Property rdf:ID="prf:BaseVoltage.nominalVoltage">
        <cim:multiplicity rdf:resource="http://iec.ch/TC57/1999/rdfschema-extensions-19990926#M:0..1"/>
    </rdf:Property>

    <rdfs:Class rdf:ID="prf:Terminal">
        <rdfs:subClassOf rdf:resource="cim:Terminal"/>
    </rdfs:Class>
    <rdf:Property rdf:ID="prf:ACDCTerminal.sequenceNumber">
        <cim:multiplicity rdf:resource="http://iec.ch/TC57/1999/rdfschema-extensions-19990926#M:0..1"/>
    </rdf:Property>
    <rdf:Property rdf:ID="prf:Terminal.phases">
        <cim:multiplicity rdf:resource="http://iec.ch/TC57/1999/rdfschema-extensions-19990926#M:0..1"/>
    </rdf:Property>
    <rdf:Property rdf:ID="prf:Terminal.ConductingEquipment">
        <cim:multiplicity rdf:resource="http://iec.ch/TC57/1999/rdfschema-extensions-19990926#M:0..1"/>
    </rdf:Property>
    <rdf:Property rdf:ID="prf:Terminal.ConnectivityNode">
        <cim:multiplicity rdf:resource="http://iec.ch/TC57/1999/rdfschema-extensions-19990926#M:0..1"/>
    </rdf:Property>

    <rdfs:Class rdf:ID="prf:ACLineSegment">
        <rdfs:subClassOf rdf:resource="cim:ACLineSegment"/>
    </rdfs:Class>
    <rdf:Property rdf:ID="prf:ConductingEquipment.BaseVoltage">
        <cim:multiplicity rdf:resource="http://iec.ch/TC57/1999/rdfschema-extensions-19990926#M:0..1"/>
    </rdf:Property>

    <rdfs:Class rdf:ID="prf:PowerTransformer">
```


DGS
line
cubicle
line
cubicle
line
CIM
XML
ACLineSegment
ACLineSegment
ACLineSegment
ConnectivityNode
ConnectivityNode
Terminal
Terminal
Terminal

CIM data format (IEC61970-552)


```xml
<rdf:RDF
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    xmlns:rdfs="http://www.w3.org/TR/1999/PR-rdf-schema-19990303#"
    xmlns:cim="http://iec.ch/TC57/2016/CIM-schema-cim17#"
    xmlns:md="http://iec.ch/TC57/61970-552/ModelDescription/1#"
    xml:base="urn:uuid:">
    <md:FullModel rdf:about="#_26cc8d71-3b7
        <md:Model.created>2022-10-24</md:Mo
        <md:Model.version>V1</md:Model.vers
        <md:Model.modelingAuthoritySet>http
        <md:Model.description>CIM Unit Auth
        <md:Model.profile>http://utility.th
    </md:FullModel>

    <!-- Base Voltage -->
    <cim:BaseVoltage rdf:ID="_c2356069-e9d1
        <cim:BaseVoltage.nominalVoltage>24<
        <cim:IdentifiedObject.description>B
        <cim:IdentifiedObject.name>24 kV</c
    </cim:BaseVoltage>
    <cim:BaseVoltage rdf:ID="_36790ecd-55c2
        <cim:BaseVoltage.nominalVoltage>220
        <cim:IdentifiedObject.description>B
        <cim:IdentifiedObject.name>220 V</c
    </cim:BaseVoltage>


    <!-- ACLineSegment -->");
```
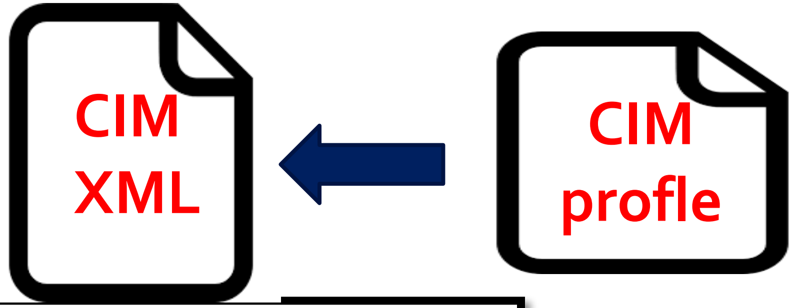

```xml
<!-- ACLineSegment -->");

<cim:ACLineSegment rdf:ID="_498319bc-6c9e-c95a-32f3-5854b574caf0">
    <cim:IdentifiedObject.name>Ln175_579050</cim:IdentifiedObject.name>
    <cim:ConductingEquipment.BaseVoltage
</cim:ACLineSegment>
<cim:Terminal rdf:ID="_0ccaa26c-ac7a-ea
    <cim:IdentifiedObject.name>Ln175_57
    <cim:ACDCTerminal.sequenceNumber>1</
    <cim:Terminal.phases rdf:resource="
    <cim:Terminal.ConductingEquipment r
    <cim:Terminal.ConnectivityNode rdf:
</cim:Terminal>
<cim:Terminal rdf:ID="_2e2d5164-a80f-79
    <cim:IdentifiedObject.name>Ln175_57
    <cim:ACDCTerminal.sequenceNumber>2</
    <cim:Terminal.phases rdf:resource="
    <cim:Terminal.ConductingEquipment r
    <cim:Terminal.ConnectivityNode rdf:
</cim:Terminal>
```

```xml
<cim:PowerTransformer rdf:ID="_54316ce3-c122-a063-2131-72e042597083">
    <cim:IdentifiedObject.name>Xfr197_776418</cim:IdentifiedObject.name>
</cim:PowerTransformer>
<cim:Terminal rdf:ID="_631513b8-83e9-6e4e-3a36-20566ffc03da">
    <cim:IdentifiedObject.name>Xfr197_776418-197_776418_C-197_776418</cim:IdentifiedObject.name>
    <cim:ACDCTerminal.sequenceNumber>1</cim:ACDCTerminal.sequenceNumber>
    <cim:Terminal.phases rdf:resource="http://iec.ch/TC57/2013/CIM-schema-cim16#PhaseCode.ABC"/>
    <cim:Terminal.ConductingEquipment rdf:resource="#_54316ce3-c122-a063-2131-72e042597083"/>
    <cim:Terminal.ConnectivityNode rdf:resource="#_4d1c9631-a93f-bf6c-af8c-60f3ba60a073"/>
</cim:Terminal>
<cim:Terminal rdf:ID="_a5631b74-04bb-172a-c2a1-105f0b2cfbfe">
    <cim:IdentifiedObject.name>Xfr197_776418-197_776418-197_776418</cim:IdentifiedObject.name>
    <cim:ACDCTerminal.sequenceNumber>2</cim:ACDCTerminal.sequenceNumber>
    <cim:Terminal.phases rdf:resource="http://iec.ch/TC57/2013/CIM-schema-cim16#PhaseCode.ABC"/>
    <cim:Terminal.ConductingEquipment rdf:resource="#_54316ce3-c122-a063-2131-72e042597083"/>
    <cim:Terminal.ConnectivityNode rdf:resource="#_29a84cbd-18bb-0d9b-9aa7-76096b86efb3"/>
</cim:Terminal>
<cim:PowerTransformerEnd rdf:ID="_631513b8-83e9-6e4e-3a36-20566ffc03da">
    <cim:IdentifiedObject.name>Xfr197_776418-197_776418_C-197_776418</cim:IdentifiedObject.name>
    <cim:TransformerEnd.endNumber>1</cim:TransformerEnd.endNumber>
    <cim:TransformerEnd.BaseVoltage rdf:resource="#_c2356069-e9d1-e79c-a924-378153cfbbfb"/>
    <cim:PowerTransformerEnd.PowerTransformer rdf:resource="#_54316ce3-c122-a063-2131-72e042597083"/>
    <cim:TransformerEnd.Terminal rdf:resource="#_631513b8-83e9-6e4e-3a36-20566ffc03da"/>
</cim:PowerTransformerEnd>
<cim:PowerTransformerEnd rdf:ID="_a5631b74-04bb-172a-c2a1-105f0b2cfbfe">
    <cim:IdentifiedObject.name>Xfr197_776418-197_776418-197_776418</cim:IdentifiedObject.name>
    <cim:TransformerEnd.endNumber>2</cim:TransformerEnd.endNumber>
    <cim:TransformerEnd.BaseVoltage rdf:resource="#_36790ecd-55c2-030d-c553-685bef719df6"/>
    <cim:PowerTransformerEnd.PowerTransformer rdf:resource="#_54316ce3-c122-a063-2131-72e042597083"/>
    <cim:TransformerEnd.Terminal rdf:resource="#_a5631b74-04bb-172a-c2a1-105f0b2cfbfe"/>
</cim:PowerTransformerEnd>
```

2019 Modern Electric Power Systems (MEPS) in IEEE

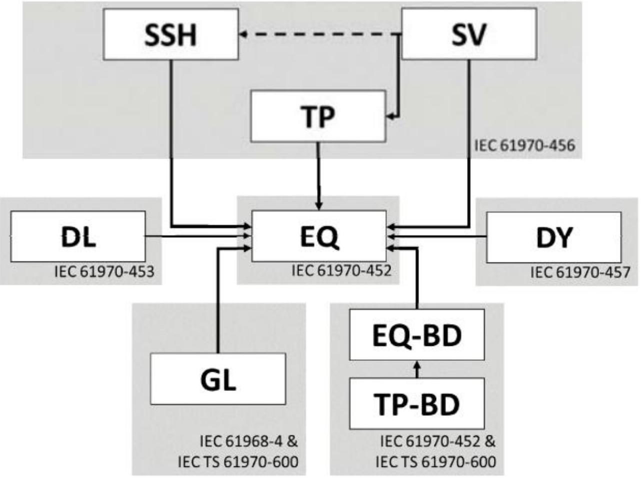


Fig. 2 CGMES 2.4.15 dependencies.

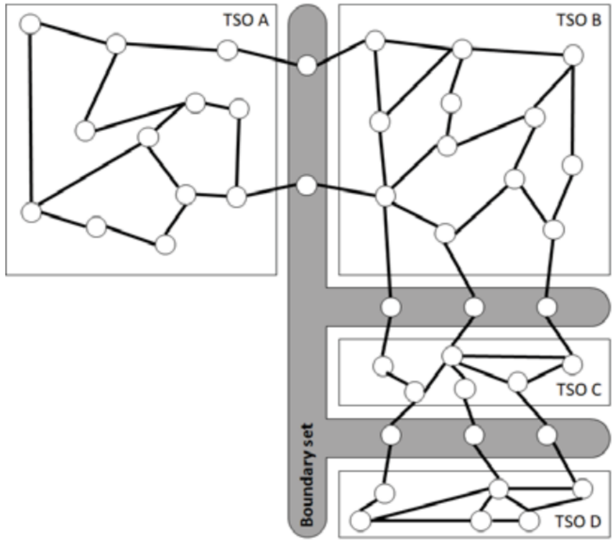


Fig. 4 Use case for boundary set application while assembling CGM.

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CGMES as an interface for multilateral grid modelling data exchange

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***Abstract*— Common Information Model (CIM) is an important framework used to describe electrical power systems at different voltage levels, widely applied both in the area of event message exchange and in network topology and parameter exchange. Common Grid Model Exchange Specification (CGMES) is a superset of CIM, developed specifically to meet needs of ENTSO-E, related to coordination of different actions performed by Trans in the reality of i European power gri between European N for Electricity (ENTS modelling informati their reliance on diff**

This article is me its history, current results of interop development. Key interconnected trans

ENTSO-E, which was created in 2009, as a merge of six regional TSO associations (including UCTE), decided to build up on this initiative, by creating Common Grid Model Exchange Specification (CGMES) with its first release, based on CIM14 in 2011, and currently used version 2.4.15 based on CIM16 released in 2014. CGMES holds status of IEC ...nd 61970-600-

...BUSINESS

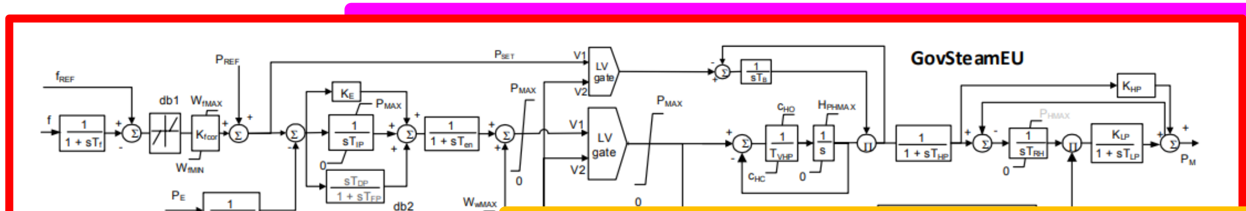
...ch CGMES is

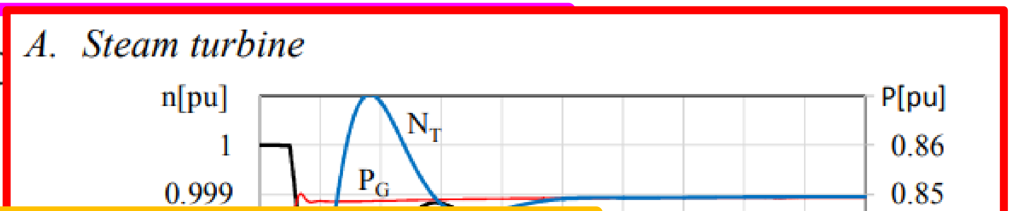
...g Congestion ... Short Circuit

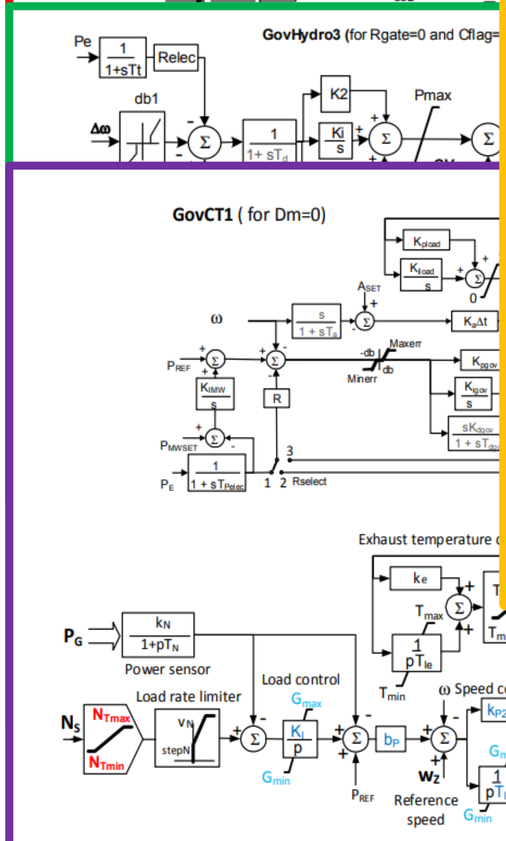
VI. FUTURE

With ambitious targets set by European regulators in a form of Network Codes, new environment for Transmission System Operators is forging, in which multilateral data exchange and pan-European grid analysis and optimization is of high importance. CGMES, as standard based on CIM and tailored to ENTSO-E needs, is an important part of this process.

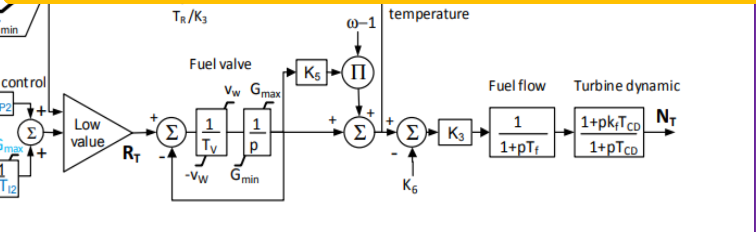
2018 19th International Scientific Conference on Electric Power Engineering (EPE) in IEEE







Preparing input data is a critical part of the application. All data must be prepared in near real time, and computations must be carried out automatically with little or no human intervention (and in a tightly time constrained cycle). The use of standardized or compatible dynamic models is necessary because of a universal data interface based on the plug-in concept. Therefore generic models of exciters and turbines from the CGMES standard will be used. Such turbine models, including typical parameters, are presented in this paper.



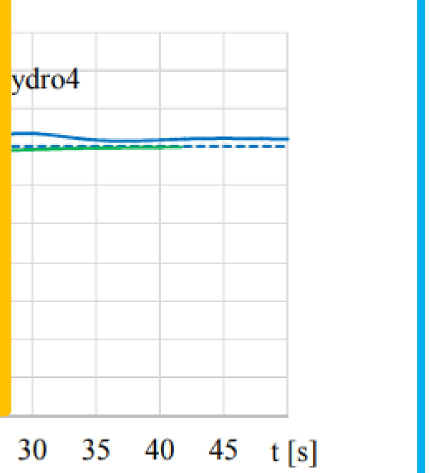


Fig. 8 Comparison of the speed waveforms for generic turbine models

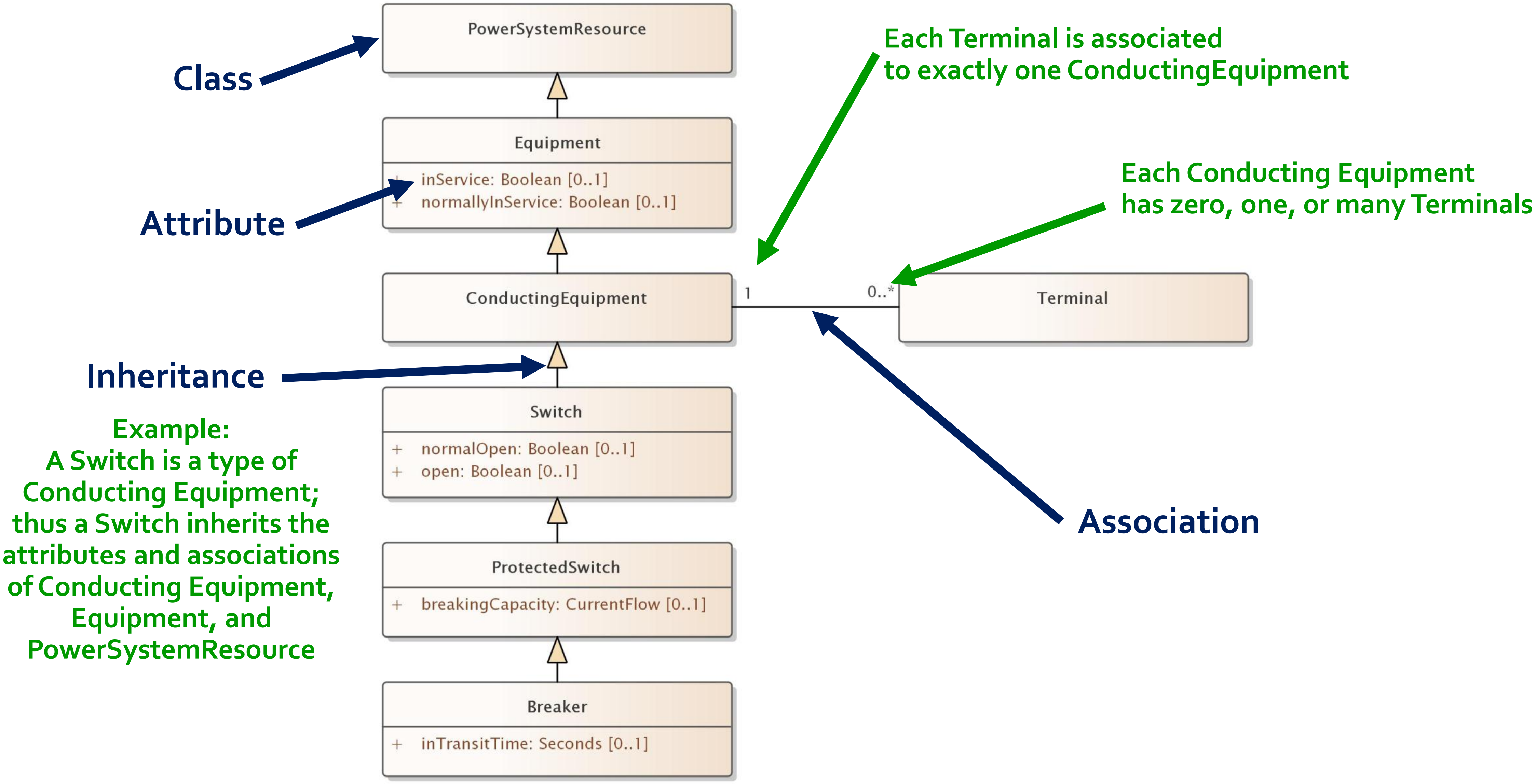
Fig. 7 Gas turbine response to load step change

Scheme of GovCT1 model (above simplified and modified according to [1]) and the corresponding alternative model GASA from the MODES library

Single line diagram for the test grid configuration (according to [4])

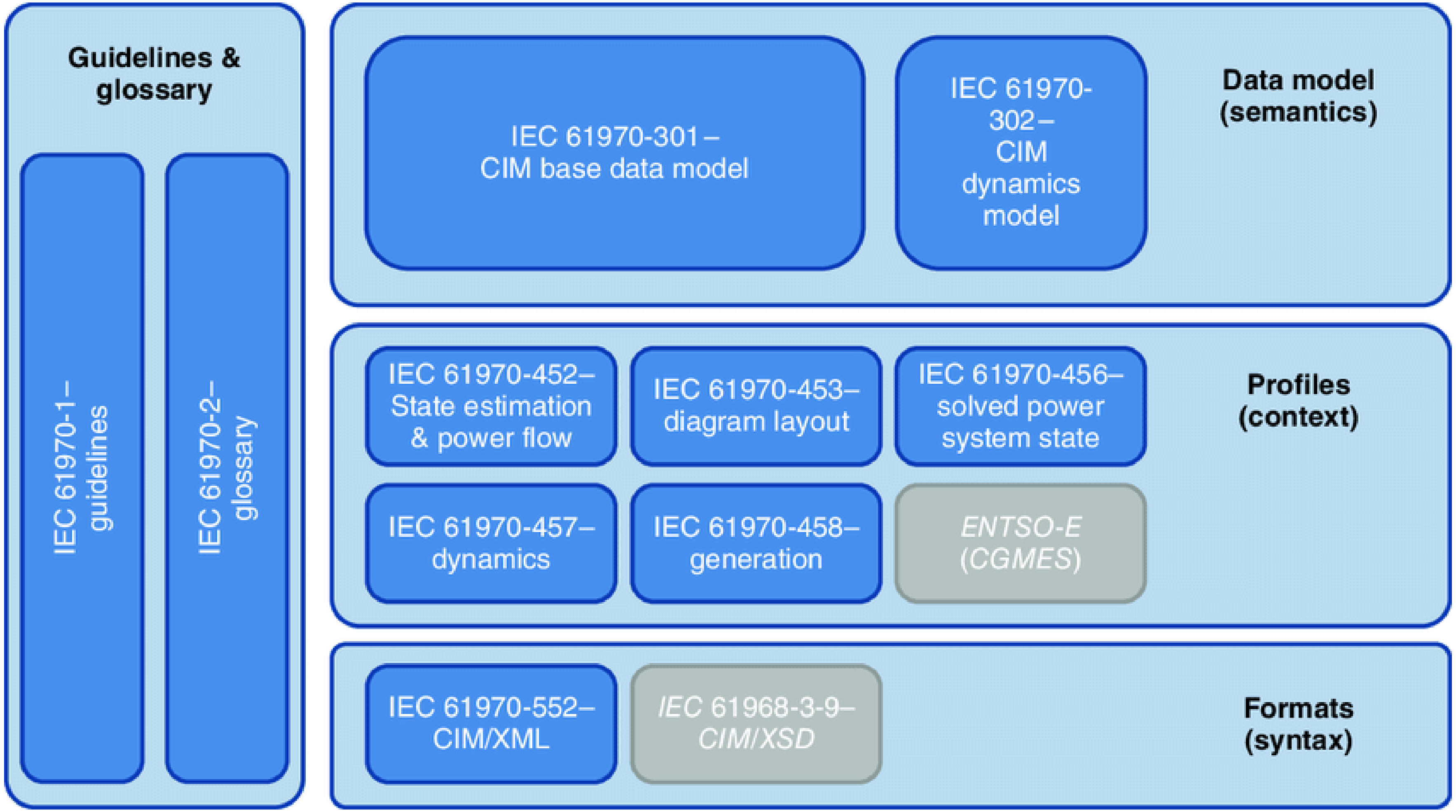
Thank You

UML Basics



Class
Attribute
Inheritance
Association
Each Terminal is associated to exactly one ConductingEquipment
Each Conducting Equipment has zero, one, or many Terminals
Example: A Switch is a type of Conducting Equipment; thus a Switch inherits the attributes and associations of Conducting Equipment, Equipment, and PowerSystemResource
PowerSystemResource
Equipment
+ inService: Boolean [0..1]
+ normallyInService: Boolean [0..1]
ConductingEquipment
1
0..*
Terminal
Switch
+ normalOpen: Boolean [0..1]
+ open: Boolean [0..1]
ProtectedSwitch
+ breakingCapacity: CurrentFlow [0..1]
Breaker
+ inTransitTime: Seconds [0..1]

IEC 61970



Guidelines & glossary
IEC 61970-1 – guidelines
IEC 61970-2 – glossary
IEC 61970-301 – CIM base data model
IEC 61970-302 – CIM dynamics model
Data model (semantics)
IEC 61970-452 – State estimation & power flow
IEC 61970-453 – diagram layout
IEC 61970-456 – solved power system state
Profiles (context)
IEC 61970-457 – dynamics
IEC 61970-458 – generation
ENTSO-E (CGMES)
IEC 61970-552 – CIM/XML
IEC 61968-3-9 – CIM/XSD
Formats (syntax)