STUDY OF INFORMATION INTEGRATION ARCHITECTURE BASED ON THE EXTENSIBILITY OF SMART GIRD CIM MODEL

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ABSTRACT

This study extends IEC 61970 and IEC 61968 series standard on common information model(CIM). An information integration framework model of smart grid has been proposed, which includes electricity generation, transmission, distribution and consumption.Modeling of distributed energy put forward a unified information modeling specification and information communication standard. It provides a basis to support interconnection and interoperability, which also facilitates seamless access and coordinated control.

INTRODUCTION

Current study on smart grid info-tech is insufficient in three major aspects: first, most study on information architecture has been confined to field distribution ,rather than a combined one of power generation, transmission, distribution, utilization, energy storage and micro-grid links of information infrastructure. Secondly, functions of local smart grid research are separated from each other. Necessity of united information integration architecture model is demanded. Thirdly, bidirectional interactions among power generation, transmission, distribution and utilization are insufficient.

Common Information Model defined in IEC61970 and IEC 61968 includes only traditional transmission and distribution grid model, the study extend CIM model and construct distributed energy (photovoltaic systems, fuel cells power systems, wind energy systems), micro-grid, electric vehicles, electric vehicle charging stations, intelligent home which play an important role in the smart grid.Extended basic premise is the difference between analysis and principles. The so-called differentiated analysis of the model, which is built after the model is based on two different standards or a detailed comparative analysis of the text point by point, to identify similarities and differences between the two models. This analysis CIM model, in particular upgrade or expand existing model based on the time, has a very important value.On the basis of international standards IEC 61970 and IEC 61968 Common Information Model defined (CIM) based on the object to be built with the standard CIM carried out on the grid model differentiated analysis, taking public part, logical extension of the private parts, we can eventually form global unity, public and private mergers grid panoramic CIM model.Differentiated analysis of the main purpose is to improve the utilization of existing models, reduce duplication of class or property brought model and data redundancy, improve productivity applications run. In modeling especially when extended model, if not carefully differentiated analysis, not carded similarities and differences in detail and to be extensions of existing models, and will be extended directly as a part of all direct extension added to the existing model, when the final application, the data conversion effort will result in a surge, and the upper and lower class affiliation or property, it will also lead to confusion on the organizational structure.

METHOD DESCRIPTION

This paper, by means of differential analysis, extension IEC61970 common information model CIM definition and IEC61968 constructing a grid, power distribution network, new energy, information integration architecture model. First of all the smart grid power system resources and management were analyzed, and abstract the corresponding classes and attributes, and then with IEC61970 and IEC61968 standard CIM model, find out the similarities and differences between them, and finally follow the relevant principles and model extensions methods for extension. Extension principle of smart grid information mode is presented in Fig.1.

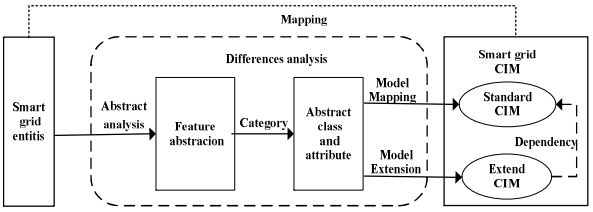

Fig.1: The smart grid information model extension principle diagram

Extension Pack

In IEC61970 and IEC61968 series standards based on CIM extensions, the need to maintain the integrity of the original CIM model, cannot extend in the original package, for the extension of the different objects to create different package. The study mainly expands the Smart Grid Model Extension both the contractor and Distribution Grid Model Extension package, which contains the distributed energy (wind power generation systems, photovoltaic power generation system, fuel cell power generation system), battery storage system, micro-grid systems, electric vehicles, electric vehicle charging station, intelligent household extension model, which includes distribution network extension model.The diagram is shown in Fig.2.

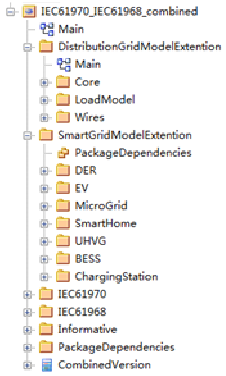

Fig.2: The CIM model extension pack structure

Extension classes and attributes

In the new class, the first to find the corresponding class in the standard CIM model, and then inherited, as shown in Fig.3, in the wind power system modeling, expand synchronized fan, found in the CIM SynchronousMachine class, since there is no fan SynchronousMachine some unique attributes, so the need for new extended attributes, in order not to destroy the original structure of the existing CIM, by way of inheritance, SynchronousMachine class as the parent class, new WTP_SynGenerator class as a subclass and extended attributes; In extended class attribute at the same time, if the units in the standard CIM no extended attributes, attribute types of extension is needed, as shown in Fig.4, extension of the type of attribute BatteryType BatTyp not in standard CIM, needs to extend the corresponding type, as shown in Fig.5, extending an enumeration class BatTyp as BatteryType units. while in the extended class attribute, should fully consider the information support platform for grid steady-state analysis, transient analysis, dynamic analysis, planning analysis and application of production management, as shown in Fig.6 for wind power system model for the fan in the modeling and extending the parent of the asynchronous motor, when the attribute extension contains the steady-state analysis and transient analysis, dynamic analysis and basic USES need to use all of the parameters.

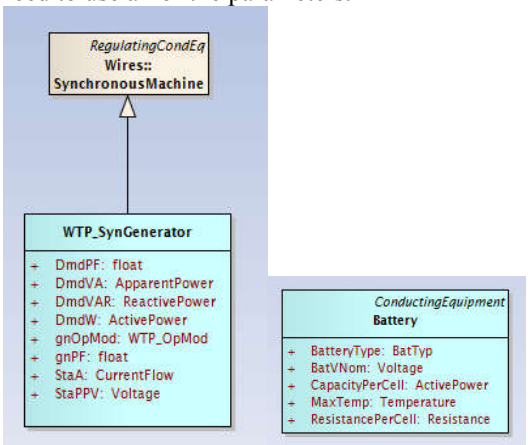

Fig.3 Fig.4

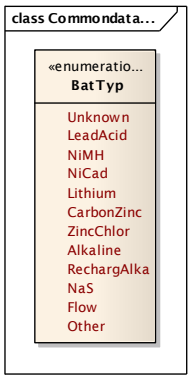

Fig.5 Fig.6

Extension relationship

In extension class, also need to pay more attention to the new extension classes relationship with the extended class and class that already existing, and the relationship between the new extension of class, the relationship needs to be extended if necessary.. As shown in the Fig.7, when building Micro-Grid class, to establish its relationship with the wind, solar, storage power station, micro network generally contain wind and solar storage power supply station, therefore, WindPlant, PVPlant and BESPlant with MicroGrid class has aggregation relationships that need to be extended.

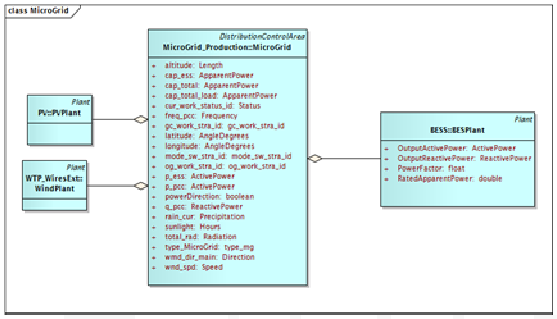

Fig.7:The wind and solar storage power supply station and micro-grid relations

Device Properties extension rules

Extended device properties in addition to meeting the principles of extended attributes and processes, it should also meet some other extension mechanism. Depending on the scope of application of network equipment properties, property types can be divided into the basic parameters of electrical properties, accounting and property assets, property status, and measurement property are the most important property category. According to the above classification, combined with application specific equipment needs, expanding these types of properties.

In addition, the modeling of distributed energy component has some particularity extended device attributes. CIM is not an independent unit of the distributed energy model, thus establishing a distributed energy model requires some standard support. IEC61850-7-420 standard is a standard for distributed

energy abstract modeling and communication. Although it does not describe the relationship between the CIM and distributed energy, and in order to achieve communication, modeling and CIM are different, but the basic idea of CIM is exactly the same, is the use of object-oriented approach, will be built abstract goals mold and decomposition, the corresponding extended attributes, and in a certain way to build relationships between objects, which constitute the entire abstract information model. Thus, in a distributed energy modeling process, reference is made IEC61850-7-420 section of the distributed energy model, logical node and the CIM classes corresponding. Attribute parameter IEC61850 standard model provides power system can support applications such as coordination of basic control, operation analysis, etc., referring to the standard attribute extended CIM model, it will make the device class attribute will be very rich and full, to meet the information supporting platform Construction needs.

Model description of equipment network topology relationship

Information support platform need model can support the global topological search first. In the CIM model, the topological connection between power system equipment is through the Terminal and ConnectivityNode. As shown in the figure below the instance of the circuit, the circuit Breaker1, Load Line A and Line Alpha on the topological connection with each other.The diagram is shown in Fig.8.

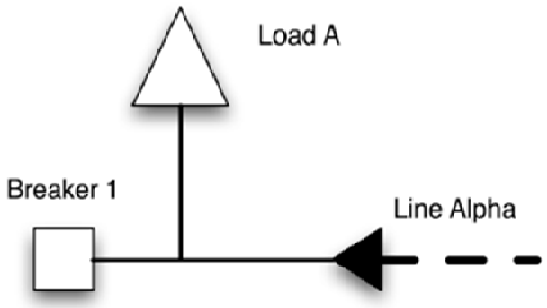

Fig.8:Examples of line topology connection

Circuit Breaker, load and line corresponding to a Breaker in the CIM model, EnergyConsumer, ACLineSegment (or DCLineSegment) class instances, Breaker, EnergyConsumer, ACLineSegment (or DCLineSegment) classes are conductive device, three electrical equipmentare connected by ConnectivityNode, but in the CIM model, the conductive device is not directly connected with a topological connection ConnectivityNode, conductive devices typically have a to multiple Terminal, conductive device Terminal through the ConnectivityNode topological connection. In the CIM model, the circuit corresponding to the model as shown in the Fig.9. Terminal equipment for topological not only connection, but also can take measurements on the Terminal value.

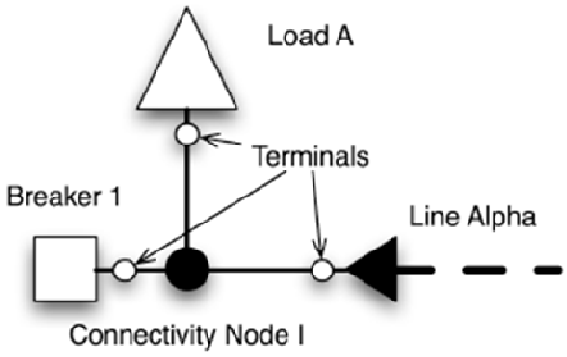

Fig.9:Examples of line connection topology of CIM

All models in this paper extended smart grid unit, including distributed energy, energy storage, micro-grid, electric vehicles, charging stations, intelligent home, etc., to meet the above described manner topology can by Terminal and associated ConnectivityNode relations connecting all conductive equipment to complete the framework to build the network topology, and then through the conductive device association or aggregation relationship with other devices to find all devices of the entire network. Further, in describing the topology of distributed energy, also increased the network modeling and ECP, the description of the topology to connect and manage information more perfect, as shown in the Fig.10.

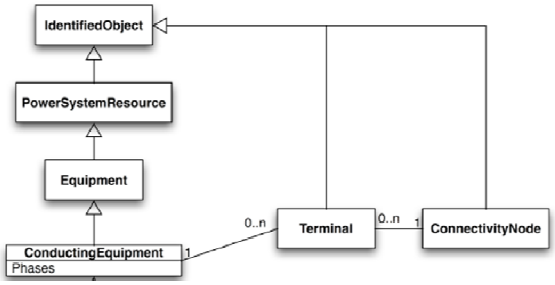

Fig.10:Topological connection between CIM model

INFORMATION MODEL OF UNIFIED INFORMATION SUPPORT PLATFORM

Based on the previous IEC61968/61970 standard model and network model based on which the equipment attribute extension mechanism and extension method, distributed energy, micro-grid, energy storage device, the electric vehicle charging stations and other new equipment and various management systems related to unified management subsystem model, construction of the smart grid network topology model standard, as shown in Fig.11.

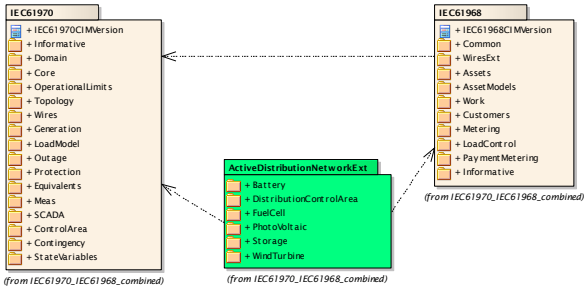

Fig.11The structure of the smart grid information model

Extended smart grid existing information systems and related emerging model unit in practical applications, and integration with existing IEC61970 / 61968CIM model together to constitute a standard information model information support platform. Meanwhile, in the course of the extended attribute model, give full consideration to the needs of various application systems, as far as possible so that the model can contain a wealth of information for all kinds of applications.

CONCLUSION

The study provides a way to the construction throughout a power generation, transmission, distribution and utilization of integrated information integration system.The implementation of optimized and coordinated control promotes utilization of new energy through interaction among the techniques. With the architecture, we are capable of building unified information support platform, deploying smart grid data center, implementing collection and synchronization of distributed data, as well as providing high speed connection to outside users. The architecture provides a practical comprehensive analysis basis for multiple applications.

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