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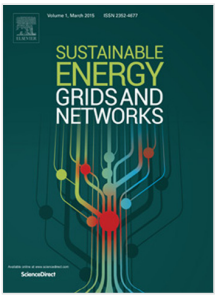

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Van Hoa Nguyen, Quoc Tuan Tran, Yvon Besanger

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SCADA as a Service approach for Interoperability of micro-grid platforms

Van Hoa NGUYEN[1], Quoc Tuan TRAN[2], Yvon BESANGER[1]

[1] Univ. Grenoble Alpes, G2Elab, F-38000 Grenoble, France
CNRS, G2Elab, F-38000 Grenoble, France
[2] CEA-INES, 50 Avenue du Lac Léman, 73370 Le Bourget-du-lac, France
Email : van-hoa.nguyen@grenoble-inp.fr

***Abstract*— In the context of smart grid development, this paper considers the problem of interoperability of micro-grid platforms, particularly among research institutions. Various levels of interoperability are introduced with the respective requirements. The primary aim of the paper is to propose a suitable private hybrid cloud based SCADA architecture satisfying various necessities in the framework of interoperability of micro-grid platforms while maintaining security restriction conditions. Due to the limited time restriction of critical SCADA functions in the electrical grid (protection, real time control, etc.), only selected non-critical SCADA functions (back-up, data historian, etc.) are accessible to partners from the private cloud. The critical SCADA tasks functionality remains under control of local server, thus, a hybrid cloud architecture. Common Information Model (IEC 61970 and IEC 61968, CIM/XML/RDF) is proposed to be used as model for information exchange. The communication model is based on PaaS delivery model and OPC Unified Architecture (OPC UA) specifications are considered. OPC gateway is proposed as conversion between the old OPC Distributed Common Object Model (DCOM) protocol and the Simple Object Access Protocol (SOAP) for cloud.**

***Index Terms*— Smart Grid, Micro-grid, Interoperability, Hybrid Cloud Based SCADA, OPC UA.**

ACRONYMS

AMI	**A**dvanced **M**etering **I**nfrastructure
CIM	**C**ommon **I**nformation **M**odel
DCOM	**D**istributed **C**ommon **O**bject **M**odel
EMS	**E**nergy **M**anagement **S**ystem
HMI	**H**uman-**M**achine **I**nterface
IaaS	**I**nfrastructure **a**s **a** **S**ervice
IEC	**I**nternational **E**lectrotechnical **C**ommission
IP	**I**nternet **P**rotocol
LAN	**L**ocal **A**rea **N**etwork
MTU	**M**aster **T**erminal **U**nit
OPC	**O**pen **P**latform **C**ommunication
OPC UA	**OPC U**nified **A**rchitecture
PaaS	**P**latform **a**s **a** **S**ervice
RDF	**R**esources **D**escription **F**ramework
RTU	**R**emote **T**erminal **U**nit
SaaS	**S**oftware **a**s **a** **S**ervice
SCADA	**S**upervisory **C**ontrol **A**nd **D**ata **A**cquisition
SOAP	**S**imple **O**bject **A**ccess **P**rotocol
TCP	**T**ransmission **C**ontrol **P**rotocol
UML	**U**nified **M**odeling **L**anguage
WAN	**W**ide **A**rea **N**etwork
XML	e**X**tensible **M**arkup **L**anguage

I. INTEROPERABILITY OF MICRO-GRID PLATFORMS

A. Problem of interoperability of micro-grid platforms.

Facing the enormous growth of energy consumption and the demand of effective integration of renewable energy resources into the electric grid, the conventional unidirectional power grid has been being considered insufficiently adapted [1]. Defined as an electrical network equipped with informatics technologies which dynamically optimizes performance, minimizes network losses, efficiently integrates distributed generations (renewable energy resources), the new generation "Smart Grid" is believed to increase reliability and to improve the energy efficiency of the whole system [2]. The integration of communication and information technologies allows smart grid to enable the exchange of data and to consider the actions of all factors in the electricity system in a communicative and interactive way, in order to act on demand and to adjust in real time the production and the distribution of electricity according to their urgency [3], [4].

The growing number of smart grid research and development projects around the world has led to a significant portfolio of demonstrators and advanced networking features. According to [3], there are 459 projects and demonstrative platforms smart grid in Europe (2002 to 2014) with an investment of around 3.15 billion €. Notably, we can mention Secure Interoperable Open Smart Grid Demonstration Project [4], JRC Smart Electricity Systems and Interoperability[5], Irvine SG Demonstration [6] and GreenLys (http://greenlys.fr). The collaboration and information