METHOD AND APPLICATIONS OF IEC COMMON INFORMATION MODEL STANDARD FOR DISTRIBUTION OPERATIONS : A PATH TOWARDS SMART GRIDS DEVELOPMENT

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ABSTRACT

The first part of the paper describes the method and tools EDF has developed to create a unique integration infrastructure designed to automate EDF business processes and facilitate future evolutions. The approach to deploy CIM in EDF environment, is a Top-Down approach which creates messages (used to connect two applications) from an Information Model based on CIM. This method is based on the United Nation standard UN-CEFACT Core Component Technical Specification. The key idea is that the CIM could play the role of the Core Component model of the Electrical Industry.

The second part of the paper highlights the implementation of CIM interfaces within ERDF (Electricité Réseau Distribution France) Information System. After having implemented CIM interfaces between ERDF Distribution Network GIS and MV and LV planning tools, the main project under development is the integration of GIS to DMS. A pilot for all ERDF Distribution Network Control Centers (30 covering France) is in Paris Control Center. Furthermore, a roadmap for CIM deployment within EDF Distribution Information System is being established.

The third part gives an overview of the remaining challenges and how new R&D project DIGI²TAL will address them. ***Smart grids will exist if a semantic-based integration infrastructure is achieved****.*

INTRODUCTION

The gradual integration of the national markets into a single electricity market has created new constraints along with new opportunities. In France, the French electricity market has been opened since July 2004 and is fully opened since July 2007. In 2007, EDF Group had 38.5 million customers in Europe, €59.6 group sales, €4.7 billion net income, 126.7 GW of installed capacity, and 158,000 employees worldwide. EDF Group in France is present in all businesses of the electricity industry: the deregulated activities regroup Energy Generation, Supply, and Trading, The regulated activities , are carried out in France by RTE EDF Transport and ERDF (Electricité Réseau Distribution France).

ERDF distribution network in France has 2200 distribution substations, and 570000km of MV network (35% is underground). It has 730000 MV/LV substations. The LV grid has 630000 km (40% is underground), and connects 29 millions customers.

Tremendous changes in business processes have occurred since deregulation took place; a new set of rules defined by the French regulator (Commission de Régulation de l'Energie) must be satisfied. In order to be competitive and to continue increasing its number of customers, ERDF adapted some of its former business processes and created new ones within this new context. In order to support the changes that occur in business processes, information systems must be able to handle these new challenges. Some parts of a formerly centralized information system management scheme have been distributed among business entities.
As a consequence of all this change, information flow has increased and new integration points have appeared. ERDF's experience is consistent with market analysts which state that over **50% of system integration costs are attributed to semantic issues**.

FACILITATING BUSINESS TRANSFORMATION WITH STANDARDS-BASED INTEGRATION

Accordingly, EDF R&D has established a methodology and a supporting tool set that leverages standards for incrementally implementing a semantic-based integration infrastructure in step with business needs. This approach will enable the turning of many data sources into one coherent body of information that will facilitate business transformation (e.g., business process automation, business activity monitoring, decision support) and make it possible to create new application functionality based on consistent data even though this data may be coming from multiple sources.

A quick look at the relevant standards

Accomplishing this is a challenge when so many standards, most still evolving, are relevant to EDF R&D's integration strategy. The standards organizations we are participating in, or are following the most are :

- The International Electrotechnical Commission

(IEC) is the leading global organization that prepares and publishes international standards for all electrical, electronic and related technologies. These serve as a basis for national standardization and as references when drafting international tenders and contracts. EDF participates in IEC TC57, the Technical Committee in charge of Power Systems Management and information exchange. This technical committee is composed of several working groups (WGs), among them WG16 is in charge of Electricity markets, WG13 of Energy Management Systems (61970), WG14 of defining System Interfaces for Distribution Management (61968). WG13 and WG14 are responsible for collaboratively building and standardizing the industry's Common Information Model (CIM). WG10 has developed a new standard (61850) for Substations and Intelligent Electronic Devices [1].

- UN-CEFACT (United Nations Centre for Trade Facilitation and Electronic Business) provides Trade Facilitation Recommendations, Electronic Business Standards, and Technical Specifications. Among the latter, the Core Components Technical Specification, which is part of the ebXML Framework, is of particular interest for us.

TopDown Approach: from Information model to Messages

Internally, EDF R&D has established a methodology and tools to support CIM usage [2] :

1. The methodology is based on the UN-CEFACT Core Component Technical Specification. This methodology has been retained by ETSO (European Transmission System Operator) which has defined several message schemas. The key idea is that the CIM could play the role of the Core Component model of the Electrical Industry.

2. The tools include ones EDF R&D has either developed or selected. We are looking forward to tools that are compliant with standards UML 2 and Xml Metadata Interchange. Our goal is to have a standardized methodology that will be implemented using several tools.

In accordance with the methodology, use cases were used to establish requirements for the business processes. This work has helped to promote the approach and to convince managers and other technical persons that it is valuable.

Key steps of the methodology are depicted in the following figure :

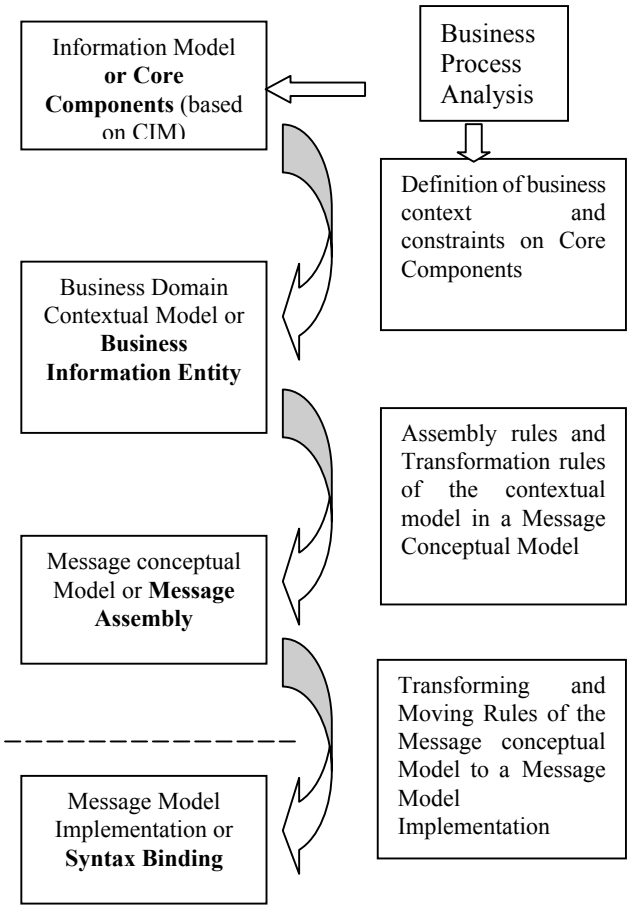

Fig. 1. The Methodology based on IEC CIM and UN-CEFACT CCTS

In order to apply this top-down approach, **EDF R&D has defined a CIM based model for managing ERDF data**. Internally a CIM model manager has been nominated, he is in charge of delivering the UML reference model on which CIM interfaces will be based. The CIM-EDF model named MSITE is based on CIM, with some extensions due to EDF specificities. It is based on CIM release 11, published beginning of 2007 by CIM User group. At the present time it covers all the needs to represent ERDF MV Network. In 2008, the model will be extended to cover all complementary MV network data required for planning studies and in 2009, all LV network.

IMPLEMENTATION OF CIM INTERFACES WITHIN EDF DISTRIBUTION INFORMATION SYSTEM.

In order to experiment CIM, a bottom-up approach started few years ago. It primarily consists of the development of several APIs (Application Programming Interface) based on the CIM for several LV, MV applications. Some are operational, connected to a GIS system which is managing all MV, LV asset ERDF Data. These concrete works helped

to prove the feasibility of using CIM in operational purpose and it reinforced the Top-Down Approach as CIM objects begin to circulate.

From now, all CIM interfaces will be developed according to the CIM-UN-CEFACT CCTS methodology principals.

Some of these CIM APIs, realized as prototypes for EDF off-the shelf products (Prao, Eurostag) and working on CIM RDF profiles, have been demonstrated during interoperability tests organized by EPRI. As a result of these CIM Apis we have a set of CIM-converters regrouped in a software package called CIM-BOX and which also allow to better interoperate with internal tools and off-the-shelf products like EMTP or MATLAB [3].

ERDF has also mandated EDF R&D for establishing a roadmap implementing "CIM approach" in its Information System. This roadmap is taking into account ERDF key business processes and propose a plan to derive the global methodology in a pragmatic way.
This roadmap takes into account the status of 61968 interface reference model as described in the following picture and ERDF information system upgrading plan :

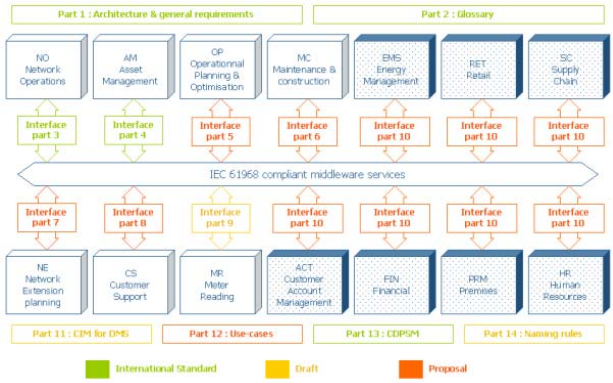

Fig. 2. Status of each 61968 interface reference model

A corresponding diagram maps each ERDF application to the 61968 Interface Reference Model. The first phase of the roadmap relies on the fact that parts 61968-3 (Network Operation) and 61968-4 (Asset Management) are International Standards and that part 61968-9 is mature enough. This first phase will also rely on 61968-7 (Network extension planning) on which EDF wants to participate actively.

This first phase identifies the following tasks :

- « Synchronize the distribution network descriptions » between the GIS managing our assets, the remote control system and the future AMM system. A pilot project for all EDF distribution centres (30 covering France) regarding GIS-DMS integration is under development for Paris EDF Distribution Center. The retained solution is based on CDPSM profile (Common Distribution Power System Model) which is associated to 61968-13 part of the standard. This profile is a Distribution Network Data Exchange; it is based on the transmission one known as CPSM (Common Power System Model – standard part 61970-452).
- « Populate and use a quality repository » for sharing quality data in a same format
- « Populate and use Measurement repository » for sharing load and generation data in a same format

The second phase of the roadmap leverages parts 61968-5 (operational planning), 61968-6 (maintenance and construction), 61968-8 (customer support) and anticipates the standardisation of these parts. The second phase suggests to address the following tasks :

- « Reinforce computer assisted maintenance project »
- « Dematerialize documents exchanged between remote control system, operation, maintenance »
- « Reinforce the asset life cycle » in order to follow equipments which are exchanged between applications from their purchase, their operating to their disassembly

DISTRIBUTION SYSTEMS NEED FOR MORE FLEXIBILITY : EDF R&D DISTRIBUTION 2015 CHALLENGE PREPARE THIS EVOLUTION

The challenges ERDF is facing are : optimising energy resources, reducing gas emissions, optimisation of assets (aging assets, integration of DERs), managing higher constraints, enhancing quality of supply, facing poor flexibility of network assets.

Distribution 2015 challenge is a set of projects for providing an answer to these challenges. One of these project called DIGI²TAL (DIstribution Grid Intelligence InTegrAtion Laboratory), defines an architecture which is closely linked to ERDF Business Process analysis and implementation. DIGI²TAL permits to our R&D teams involved in Distribution Challenge 2015 or more operational projects to promote their work to ERDF and third party players. It helps to demonstrate our "know-how".

A portal gives access to a set of applications, prototypes which exchange data using CIM based interfaces. CIM-EDF modelize all Distribution Data that need to be exchanged between applications. Some converters exist in order to facilitate interoperability between applications. The business fields demonstrated will be : new advanced functionalities for network operation as Dispersed Generation increase, new MV/LV planning capabilities, leveraging on AMM architecture and data flow, new Asset Management prototypes. This platform, closely related to others Distribution 2015 challenge projects, will be

synchronized with ERDF priorities.

The following picture illustrates DIGI²TAL concept :

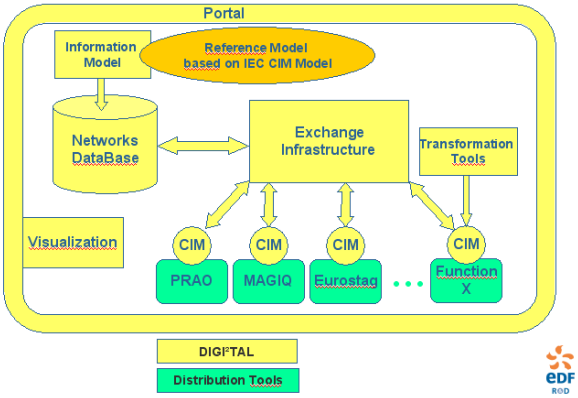

Fig. 3. DIGI²TAL concept

CONCLUSION

EDF R&D's initial usage of EDF's model-driven integration methodology, combining CIM model and UN-CEFACT Core Component Technical Specification is a promising approach. Even though the methodology and tool set has begun to be sorted out, success hinges on business participants deciding to use it. Each of the above restraining forces along with the perceived and real standards issues will need careful attention at all impacted levels if the methodology is to become a normal part of business across ERDF. While this is no simple task, the benefits are well worth it :

- The reusable methodology, with its resulting artifacts, articulate how business objectives are implemented and provide end-to-end requirements traceability.
- As more projects leverage on the infrastructure, more data becomes available as part of one coherent body of information. This makes it possible to create new application functionality based on consistent data even though this data may be coming from multiple disparate sources.
- Faster integration of application systems and information should improve ERDF's ability to react quickly to business changes while still providing the right information to people when they need it.
- Improved ability to integrate business processes across commercial-off-the-shelf (COTS) applications is lowering dependence on individual vendors.
- Re-use and adoption by future projects is encouraged by an extensible and adaptable design. There is one methodology and managed tool set to ensure consistency and leverage, leading to implementation of fewer, simpler, more consistent interfaces throughout the enterprise.

Digi²tal project, coupled with other Distribution Challenge 2015 projects provides a semantic-based integration infrastructure which helps to answer the challenges that ERDF is facing. Smart-Grids will become a reality if a semantic-based integration infrastructure is put in place gradually in ERDF information system which is tightly coupled to ERDF business processes.

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BIOGRAPHIES

Eric Lambert is graduated in Computer Science with a specialization in artificial intelligence and has a master in robotics from Ecole des Mines de Douai. He began his career in Power System Controls at HydroQuébec from 1988 to 1994 and entered EDF R&D in 1994. He is project manager, member of CIM user group executive committee and expert on working groups 13, 14 19 within IEC TC57.