Towards Distribution Smart Grid in Mexico

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Towards Distribution Smart Grid in Mexico

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Agenda

- Introduction
- Semantic interoperability
- Semantic Service Oriented Architecture (SSOA)
- Architecture for Semantic Interoperability
- Semantic Model
- Conclusions
- Future works

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Introduction

- *Comision Federal de Electricidad* (CFE) is the Mexican electric utility that is in charge of all the processes in the electricity delivery system (Generation, Transmission and Distribution).
- CFE provides energy to about 34.2 million customers, representing more than 100 million people, and annually incorporates more than one million of new customers, with an average annual growth rate of nearly 4.4% over the last six years.

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Introduction

- CFE in Numbers*:
  - 47,496,014 km of Hi Voltage lines (69 to 138 kV)
  - 401,512,999 km of Medium Voltage lines (2,4 to 34,5 kV)
  - 705,510,391 km of Lines (Hi, Med and Low Voltage)
  - 1,718 Distribution substations
  - 2,321 Hi Voltage Transformers (45,944,985 MVA)
  - 1,146,570 Distribution Transformers

* September 2011

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Introduction

- The *Instituto de Investigaciones Eléctricas* (IIE) is the main research institute in electrical domain in Mexico.
- The structure of IIE includes 4 technical divisions:
  - Electrical Systems.
  - Mechanical Systems.
  - Control Systems.
  - Energy sources (Geothermal, Nuclear and Non-Conventional).

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Introduction

- CFE and IIE are working in CIM interoperability since 2007. Regarding, three projects has been developed:
  1. On-Line Simulator for Decision Support in Distribution Control Centers (2006 - 2009).
  2. Interoperability for a Regional Distribution Control Center (2009-2010).
  3. Smart Distribution Power Network (2010-2013).
- A new project was approved recently:
  - Smart Distribution Power Network at Mexico City (2011-2013).

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Introduction

- In the Smart Grid context, the Smart Distribution Power Network (SEDI Project by its Spanish acronym) is the initiative of the CFE-Distribution to implement the vision and strategy for a more efficient, secure and reliable distribution network.
- SEDI includes the power quality benefits, improved response time to failures, automatic detection and self-healing, flexible to integrate distributed generation and storage, among others.
- One of the main goals of SEDI Project is reach the semantic interoperability of CFE's legacy systems.

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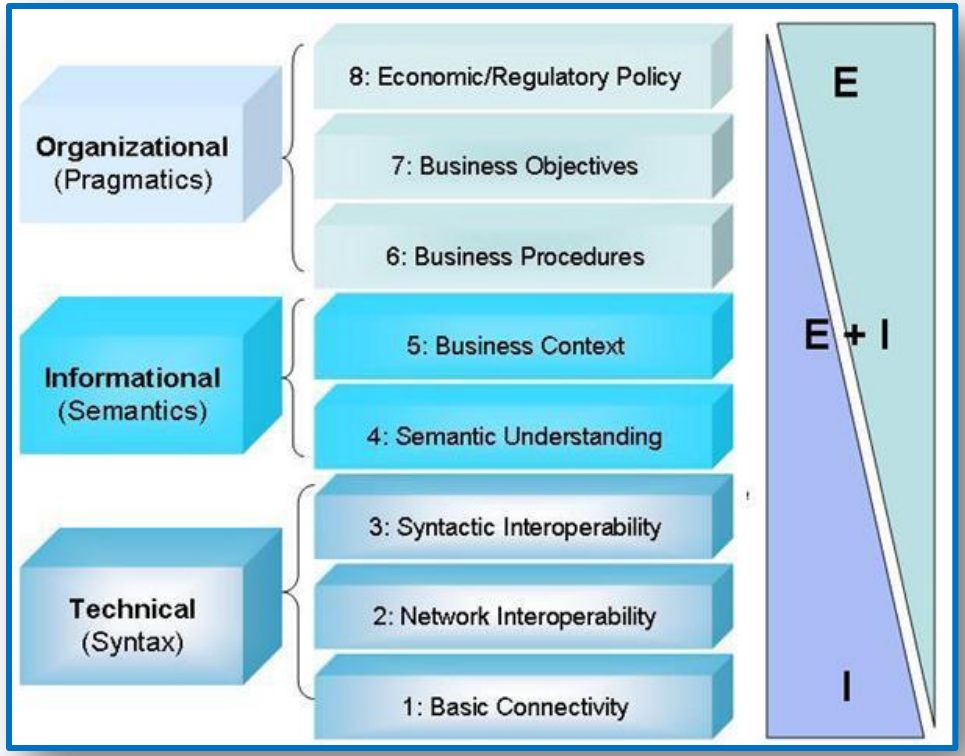
Semantic interoperability

- SEDI Project uses the GridWise Architecture Council - Interoperability Layered Categories.
- The Informational Interoperability Category (Semantics) is based on CIM definition.



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Semantic Service Oriented Architecture (SSOA)

- The Service Oriented Architecture (SOA) is an information architecture and strategy; it defines the use of services with low level coupling and components kind of “black box”.
- SOA assures the message deliveries syntactically well written because it establishes the architecture, structure, means and message formats, for example WSDL and XML, but it does not assure that the meaning or its interpretation is the same for the source system and for the destiny system.

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Semantic Service Oriented Architecture (SSOA)

- A Semantic SOA (SSOA) provides an information model and a common language, in such a way that the messages sent among applications are obliged to respect besides the syntax, a scheme or a common Semantic Model. This Semantic Model is CIM based.

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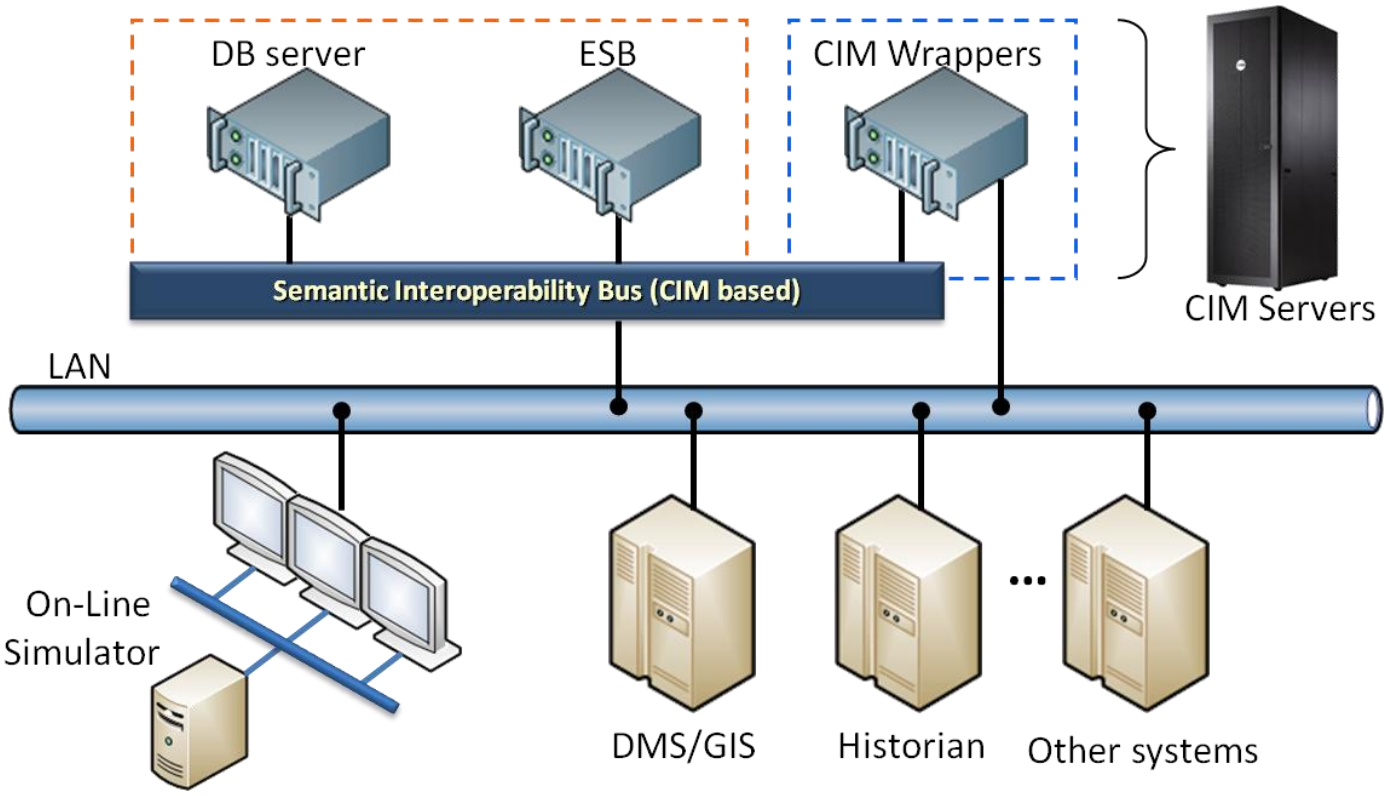
Architecture for Semantic Interoperability



Physical architecture for the semantic interoperability of the Smart Distribution Power Network (SEDI)

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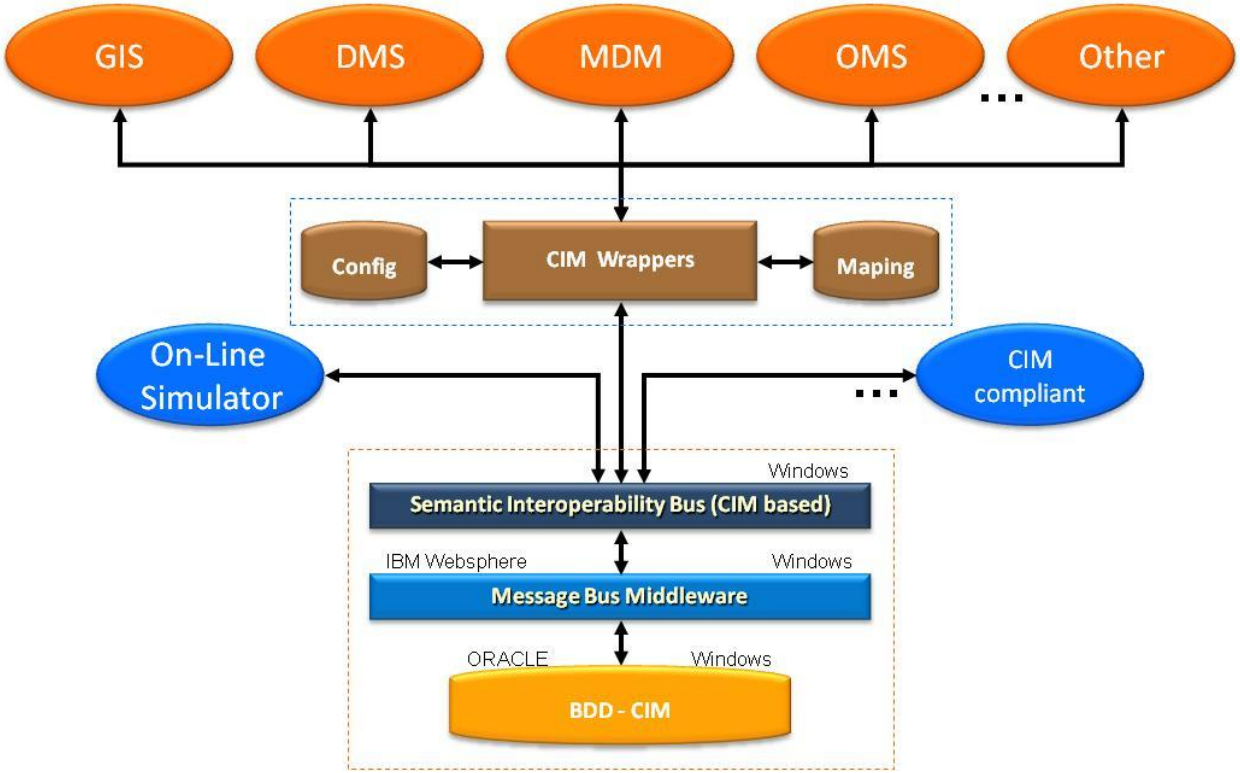
Architecture for Semantic Interoperability



Logical architecture for the semantic interoperability of the Smart Distribution Power Network (SEDI)

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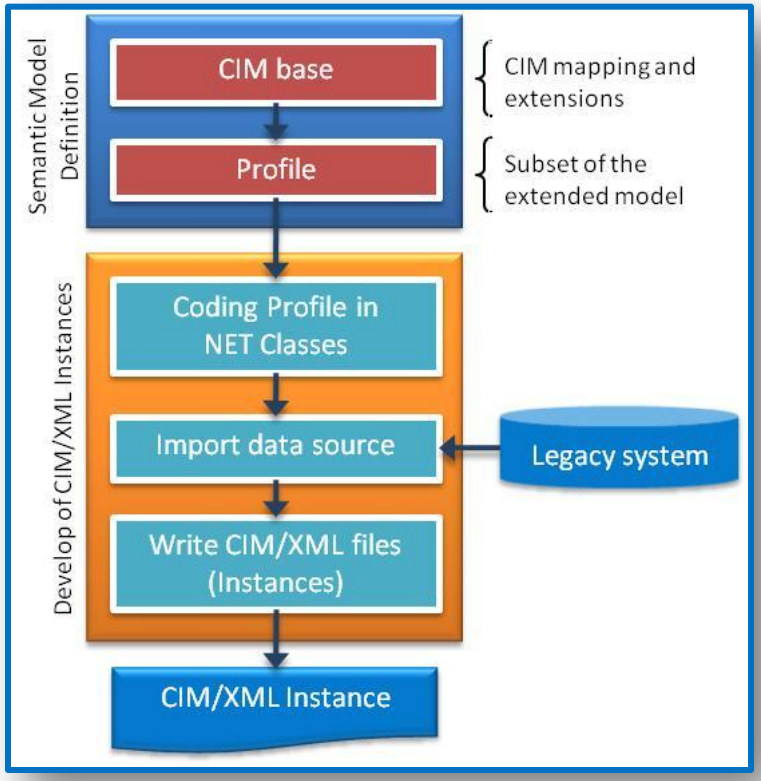
Semantic Model

- In CFE, in order to obtain the Semantic Model of the Electrical Distribution Network as well as CIM/XML Instances of the real world, the following sequence was applied:



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Semantic Model - Results

- Now, CFE have a Semantic Model CIM-based for the real Electrical Distribution Network using the Common Distribution Power System Model (CDPSM) definition.

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Semantic Model - Results

- Currently CFE counts with the Semantic Model and CIM/XML Instances for:
  - The topological model of Distribution Network (georeferenced) from 135 kV up to 13.8 kV.
  - The one-line diagrams for Distribution Substations.
  - The electrical and physical models of the electrical elements (electrical assets) and integrated devices (such as telecontroled devices).
  - SCADA data acquired in real time.
  - Historical data of Distribution Substations.
  - Important customers (VIP) that are connected to the Distribution Network in MV.
  - Operational data (failures and maintenance).
  - Historical data of energy quality events (Sags and Swells).

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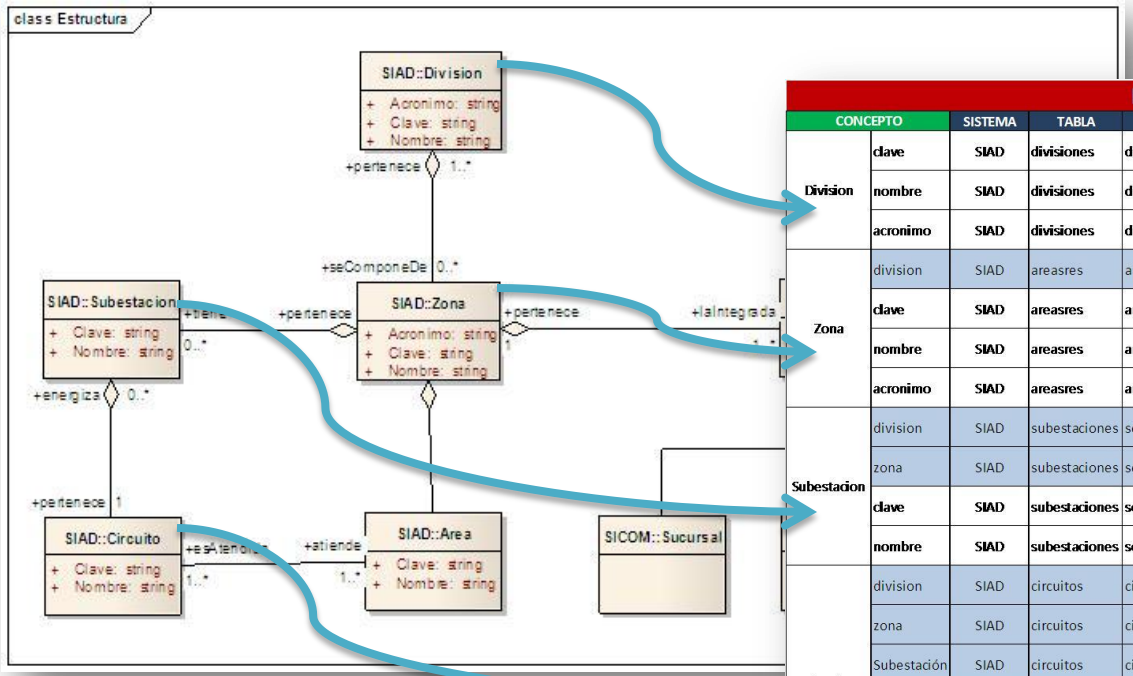
Semantic Model - Results



Identificación de fuente de datos

CONCEPTO		SISTEMA	TABLA	CAMPO	Ejemplo	Operación CIM	Clase CIM	Atributo CIM
Division	clave	SIAD	divisiones	didiv	DU	NA	GeographicalRegion	name
	nombre	SIAD	divisiones	dinom	División Golfo Centro	NA	GeographicalRegion.Names.0	name
	acronimo	SIAD	divisiones	diabr	DGC	NA	GeographicalRegion.Names.1	name
Zona	division	SIAD	areasres	ardiv	DU	NA	SubGeographicalRegion.Region	name
	clave	SIAD	areasres	arare	01	NA	SubGeographicalRegion	name
	nombre	SIAD	areasres	arnom	Zona Tampico	NA	SubGeographicalRegion.Names.0	name
	acronimo	SIAD	areasres	arabr	TPC	NA	SubGeographicalRegion.Names.1	name
Subestacion	division	SIAD	subestaciones	sediv	DU		Substation.Region.Region	name
	zona	SIAD	subestaciones	seare	01		Substation.Region	name
	clave	SIAD	subestaciones	sesub	CHR		Substation	name
	nombre	SIAD	subestaciones	senom	Chairel		Substation.Names.0	name
Circuito	division	SIAD	circuitos	cidiv	DU		ext_circuito.EsalimentadoPor_Subestacion.Region.Region	name
	zona	SIAD	circuitos	ciare	01		ext_circuito.EsalimentadoPor_Subestacion.Region	name
	Subestación	SIAD	circuitos	cisub	CHR		ext_circuito.EsalimentadoPor_Subestacion	name
	area	SIAD	circuitos	ciage	T		ext.circuito.EsAtendido	name
	clave	SIAD	circuitos	cicir	01110		ext_circuito	name
	nombre	SIAD	circuitos	cinom	Auditorio		ext_circuito.Names.0	name

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Conclusions

- CFE is working in the adoption of international standards and best practices in the industry, such as IEC 61850, IEC 61968, IEC 61970, IEC/PAS 62559, UML, among others, with the purpose of conforming an electrical network more efficient, safe, robust and reliable.
- In this effort, the definition and strategy of the Smart Distribution Power Network (SEDI), it will mark the guidelines of the CFE-Distribution on its way to the required technological change that is needed to conform the electrical network of the future.

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Future works

- Some of next works includes:
  - Install the On-Line Simulator in 4 new Distribution Zones in Mexico.
  - Install the CIM interoperability infrastructure in two Distribution Divisions in Mexico (Tampico and Mexico City).
  - Complete the Vision and Technological Roadmap for Smart Grid in Mexico.
  - Teach more people in the CIM interoperability technology.

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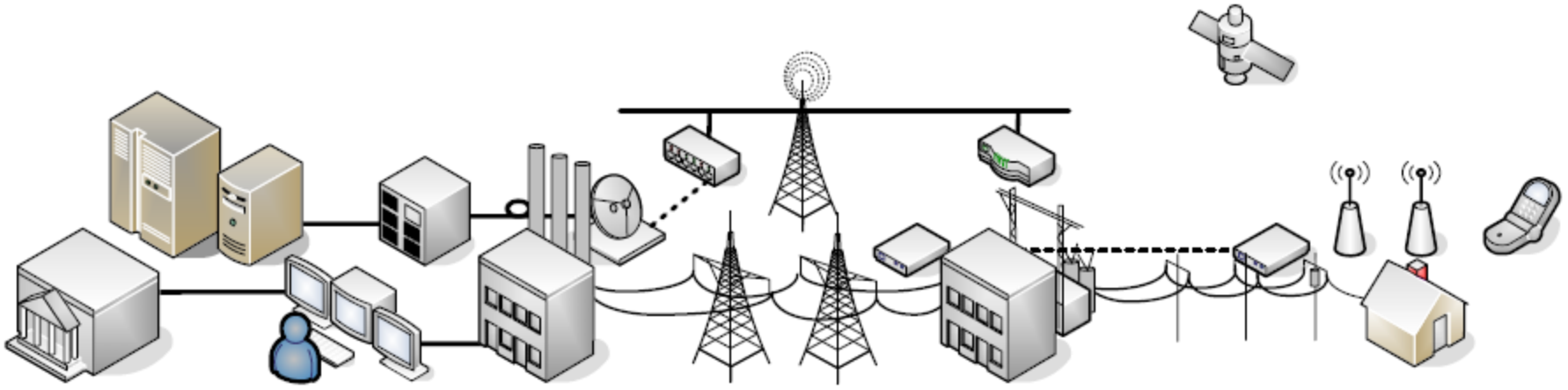
Thank you



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