IPE GridPortal® Design White Paper

Integrated Power Engineerign, Inc.

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IPE GridPortal® is a big data visualization, management and analysis tool and a grid information presentation framework for electric utilities and other related industries in the Commonwealth of Virginia, across the United States and around the Globe. It will provide a platform for planners, operators, technicians, engineering, managers, and executives in the power grids all around the world to visualize, analyze and synchronize the grid data to design and operate the grid in a more efficient, more reliable and greener manner.

IPE GridPortal® is aiming at uniting the prevalent technologies in different departments and organizations in the electric utility industry to will weave the frequently used features in those major software systems of those technologies into an overarching and cross-referencing data driven platform to meet the challenges at the present in the electric power industry and offer the data oriented applications of the future for the power grids.

1) Background

Since the advent of the application of IT (Information Technology) into the design, planning, operations, maintenance, and markets of the power grids in the 1980s, a wide variety of software and processes have been established in the electric power space on the departmental and organizational basis in a uncoordinated sprawling way, which has posed significant big data challenges in the following that are being exacerbated by the recent ever-growing renewable energy integrations.

1) Data Silos

2) No semantics layer on top of the data

3) Lack of cross system integration

4) Not all relevant data is shared

6) Difficult to share data and models

7) Excessive time used to validating data/models, not running studies

8) Data accuracy and inconsistency

9) Common data not in sync and up to date

10) Impossible to propagate data change to all pertinent data destinations

IPE GridPortal® is setting up an integrated platform to meet the aforementioned challenges in an automated, computer aided approach with high degree of artificial intelligence to enable users design and operate power systems with much needed cross-software, inter-organization information exchange, data validation and process coordination features.

2) Design Essence

The foundation and core of the IPE GridPortal® are its electric grid modelling capabilities that can derive and manage meta-data from various data systems in distinct data formats without very limited usable data patterns. The data sources that are being integrated in IPE GridPortal® include but are not limited to the following: database records, text files, proprietary binary files, CAD files, in-memory databases, geospatial data and a multitude of others. The IPE GridPortal utilizes the APIs (Application Programming Interface) and SDKs (Software Development Kits) of the major power system software systems as well as the open data structures and industry standard formats to interface with those software systems, read the data into the Portal program, extract data schema out of the data, and structure the data in a certain form, make available the data in a user-friendly UI (user interface) and visualize data geographically. Once the data is retrieved and visualized, the platform organizes the data in the common data hierarchy in the memory for users' data analytics requests. The information structure or data model in the memory is key to distill and refine the metadata from the existing power grid data systems for better data presentation and faster analytics performance.

The IPE GridPortal® also builds and exposes its data, graphics and analytics through its own API (Application Programming Interface) that the users are able to do self data services in terms of dashboards, plots, tables, graphics and calculations. This IPE GridPortal is a platform for many players in the electric power industry to get the information they need to carry out the work to run the grid reliably and better deal with the integration of the renewable energy and it simplifies the data skills of the users by the philosophy of "one data source, one set of tools, one knowledge base and one learning curve".

IPE GridPortal® integrated platform also simplifies the work processes by concentrating data in one repository, providing an analytics engine for users to navigate the system and develop analytics, supplying an ergonomic user interfaces for better efficiency and human performance. The platform relieves the users with its burden of finding data, processing data, displaying data and calculating data by dis-engaging the user from using the tools in their raw forms with its preprocessed, organized and easy to access data set and streamlined analytics engine and state-of-the-art user graphics. It really is a data super highway that links up siloed data systems and separate departments into a hub of fast speed engineering activities.

3) Technology Highlights

Smart Oneline is one of the IPE GridPortal®'s key technology highlights. It reads and analyzes the CAD (Microstation or AutoCAD) files of the electric grid and generates power grid schematics as the basis of the application for metadata structuring, analysis semantics, and user interface environment. Other data, such as project design, equipment nameplate, apparatus conditions, electrical connectivity, real-time measurements are then incorporated into the platform in an organized, common format manner. Smart Oneline is designed to be polymorphic, process-driven, data-backed, standard-compatible, connectivity-aware, CAD-styled, cross-platform and legacy-reconcilable.

Polymorphic is a feature that renders the schematic to different users in different fashions according to the user's job function. For example, the users in electric planning department may need to view the schematic in a simplified form and the users in the substation physical design team may need to see the diagrams in a more detailed way. Some users need to retrieve and visualize the data from a specific set on the schematic while other users may be required to work with the data from a broader spectrum.

The IPE GridPortal can accommodate different needs by presenting the grid schematics in an adjustable style.

Process-driven enables the procedures of the utility companies be reflected in the platform with schematic displays. A click on an item on the list of projects of a substation will re-render the schematic and display the changes of the substation equipment and connections when the project takes place. The comments from an upstream group will be routed to the schematics viewed by a downstream group for recommended engineering actions.

Data-backed emphasizes the design intent of centering the platform on relying on data to construct all aspects of the schematics. The platform uses the geometry and text data in the raw forms (lines, arcs, plain texts, etc.) from the CAD files to build model-rich schematics validate and complement the metadata schematic from other data sources such as the ERP (Enterprise Resource Planning) database and so on. Mismatches are presented to the users to reconcile and update.

Standard-compatible is the product's object of being compliant with the major international industry standards, more specifically the IEC (International Electrotechnical Commission) 61850 and CIM (Common Information Model, IEC 61970, IEC 61968 and IEC 61325). This capability of the platform will great increase the interoperability with other technologies and expand the areas where the platform can be utilized.

Connectivity-aware is a crucial differentiator of the regular schematics from the CAD file and the schematics in IPE GridPortal® that have been checked, refined and most importantly connectivity enriched. This means the platform change a dumb lines in CAD-files to an electrical wire in the IPE GridPortal® schematics. This opens a door to a great deal of applications for the users with the new electrical wire metadata integrated into the schematics with the end goals of operating the grid more efficiently and reliably.

CAD-styled is an improvement on the engineering process to reduce tedious repetitive mouse clicks on drop-down menus and buttons and provide interactive schematic for users to easily navigate through the power grid models and visualize the data the users need to run the grid safely. A large number of in-context commands are also built into the platform for the users to take advantage of to improve their work processes.

Cross-platform means IPE GridPortal® brings data from a multitude of other sources and homogenize the data in the platform and make the data read for users in an common format

Legacy-reconcilable is IPE GridPortal®'s capability to convert the legacy CAD files fraught with errors and inconsistencies into consistent well templated schematics with filtration of errors, which will greatly add values and credibility to the data in the schematics. Furthermore, the data in the schematics will also be validated by the data from other sources.

To sum up, the uniqueness of IPE GridPortal® is its capabilities to concentrate and schematize major data sources and improve the electric power utility operation processes and that is a widely needed application with significant value added to the operations of the power grid.

The IPE GridPortal® platform can undoubtedly provide a scientific big data infrastructure with unique capabilities to solve the pressing challenges in the electric power space around the world. The product

will establish the leadership of state of Virginia and more broadly the United States in terms of the economy of power grid big data solution.

As a summary, IPE GridPortal® platform, with its unique capability of data processing, modeling and schematization, turns bad data into good data, turns good data into information, turns information into process improvements, turns process improvements into earnings increase for the utility companies and a more efficient, reliable and environment friendly grid for the society.