

## AN ARCHITECTURE FOR FLEXIBLE GIS INTEGRATION OF DISTRIBUTION PLANNING AND ANALYSIS SYSTEMS

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### ABSTRACT

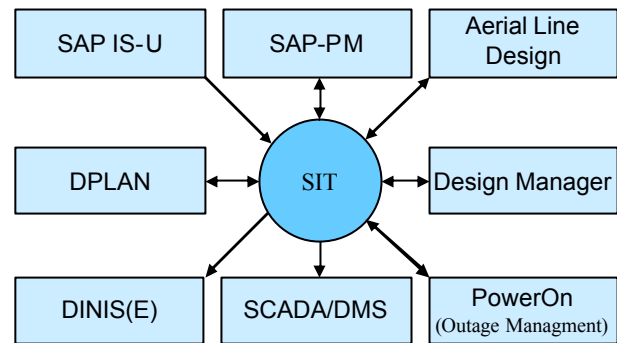
The paper describes the steps and major concerns of adopting an architecture for GIS and DPlan integration, reporting the results of a project in a Portuguese company, EDP. Business requirements, the adopted technical solutions and final results are presented.

### INTRODUCTION

For more than 10 years EDP's focus on system integration was a fundamental vector of its IT strategy. In that context EDP adopted a Technical Information System (SIT) and decided that it should be the central data repository for network data. For this system, EDP adopted GE Smallworld GIS technology.

SIT plays a central role in EDP's overall system landscape providing and integrating information for other corporate systems used in all technical areas.

- GENESys, EDP's SCADA/DMS system, was developed having SIT integration as one of its major requirements and was achieved through a Corba based architecture.
- When SAP/PM, EDP's Maintenance System, was deployed, its technical object hierarchy was defined so it could be populated from SIT with an integration middleware (GISConnect). All network data update is done in SIT and synchronized into SAP/PM automatically.
- PowerON, EDP's new Outage Management System, is a system from GE Smallworld fully integrated with the GIS (SIT).
- EDP's Commercial System (SAP/IS-U) has some of its data synchronised with SIT through using MQSeries.
- EDP had departmental engineering tools for overhead line design and decided to adopt one of them and fully integrate it with SIT. This resulted in an Aerial Line Design tool that allows EDP's engineers to do the complete design, from profile drawing to mechanical engineering calculations, in an integrated environment, ensuring that SIT database is automatically updated in the end.
- SIT/DM is a project tool based on GE Smallworld Design Manager and allows EDP to do their projects in the GIS environment.
- Integration with EDP's planning tools was considered fundamental. EDP used DINIS(E) from ICL and now migrated to DPlan [1].



After some years of successful use of planning tools that had interfaces with SIT, EDP decided to go a step further integrating SIT and DPlan, which was adopted as the corporate planning tool.

### INTEGRATION OBJECTIVES

When analyzed DPlan's use in the company, EDP realized that two types of studies were being done with this tool:

- **Complex studies**, done generally by Planning Department. These studies last longer and use DPlan's most advanced functions such as network optimization.
- **Simple studies**, done not only by Planning Department to analyze small network changes, but also by Operations Department to study different network configurations and by Project and Maintenance Departments to help them proposing designs and answering client demands.

People doing these studies found different limitations in the integration solution they had. In complex studies, the result of the approved study needed to be loaded into SIT (DM) as a new project. This was a manual task where the planner had to load once more the solution proposed in another system. This process took additional time and was prone to errors.

For people doing simpler studies, the problem was that they need to work with up to date information. This means that they should constantly be importing new data from SIT or update their own data. As planning reaches new areas such as Operations and Low Voltage network, this time consuming solution becomes unsustainable.

This drove EDP to a new improved integration solution for SIT and DPlan. The main goal was to be able to support company processes from start to finish, without any disruption, using the best from each of the systems, and not limiting their future evolution.

The integration was divided into two phases:

- **Phase I** were a new SIT-DPlan export and import tools were developed ensuring a bi-univocal process;
- **Phase II** were the integrated DPlan was runs as a background engine in SIT environment;

**DPLAN INTEGRATION – PHASE I**

In this first phase EDP replaced the existing SIT? DPlan export tool with a new and improved version. The old export tool was based on DINIS(E) export tool and exported data from SIT into proprietary DINIS format and from that into DPlan format (DPX).

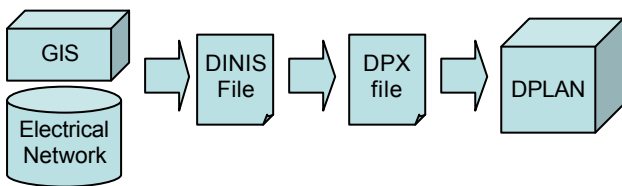


Fig. 1 – Old DPlan integration process

The problem with this solution was that DINIS did not fully support some of the network elements used in SIT such as complex installation internals. SIT internals had to be processed and redrawn by the export tool, with different objects being aggregated in this process. For simplification purposes, some internals were even removed by the exportation. Although the resulting file had less network objects and was suitable for use in DPlan, this was a complex export process which posed some restrictions to

SIT data and eliminated all possibilities of importing data back into SIT because that process was univocal.

A new integration solution was adopted, with the architecture show in Fig 2.

The SIT? DPlan interface specification included an exhaustive mapping of SIT objects and their attributes into DPlan objects and attributes. This mapped 46 SIT network object classes and 13 additional catalogues to DPlan Classes.

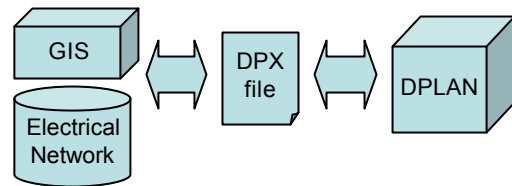


Fig. 2 – New DPlan file integration process

The specification defined that internals were to be exported without any special transformation, ensuring connectivity from inside to outside plants. This was possible because DPlan has no special limitation in supporting internal worlds. The fact that DPlan internally aggregates network elements when doing electrical calculations was also crucial to this approach. As a result DPlan’s performance was not affected by the increase in the number of objects exported. Some auxiliary network elements, such as network poles, were also exported. These objects don’t play an active role in electrical network modeling but are useful elements when proposing changes to the network.

It was also defined that network could be exported by area or by electrical circuit, using network topology. A network voltage level must also be selected limiting data exported to high, medium or low voltage or a combination of these options. In the specification process some changes to DPlan were also identified, namely the inclusion of new DPlan classes.

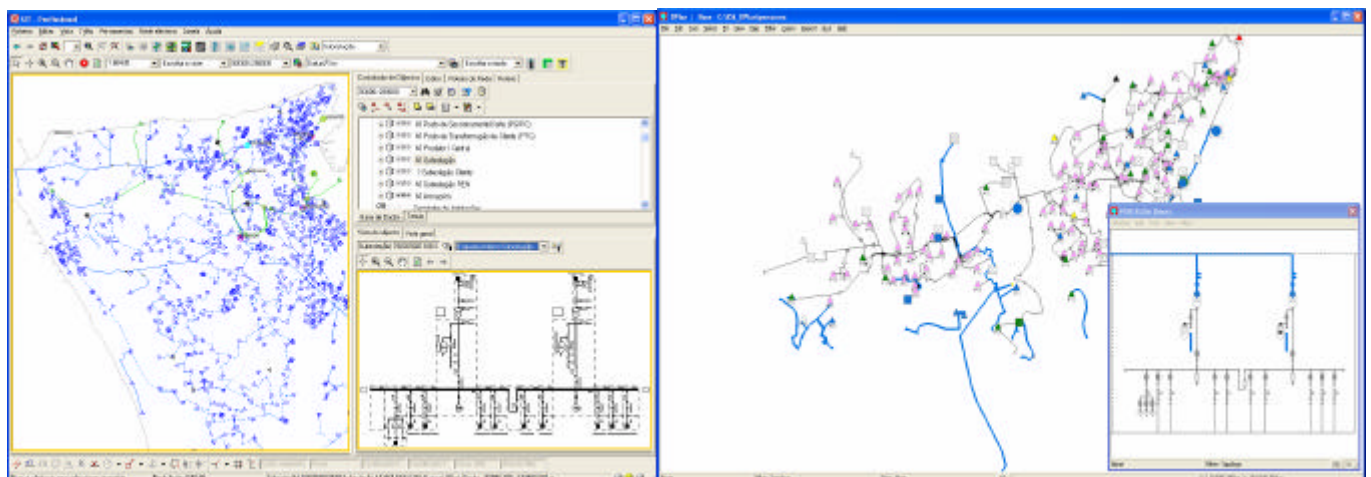


Fig. 3 – The same network in SIT and in DPLAN (including substation internals)

The DPLAN? SIT interface specification had to define a similar table mapping between DPlan classes and attributes and SIT object classes and attributes (28 DPlan Classes). DPlan changes were essential for this interface to be possible. The DPlan status attribute that existed in all network objects was enhanced to include options for proposed install and proposed remove. A new object called project with an area geometry was also introduced in DPlan. This object allows DPlan users to define the projects that need to be done as a result of their study. The project aggregates the proposed changes inside its area.

A DPX format file is then exported from DPlan and imported into SIT. The SIT user is able to review data in the DPX file, namely all projects and network associated to each one of them. This review consists in a preview of DPlan data in SIT done through a Smallworld technology called SOMs (Spatial Object Managers). This technology allows a Smallworld application to visualize data in other formats directly in the application in a transparent way. There are SOMs from GE Smallworld to visualizing different data formats such as DWG/DXF, DGN, etc. A DPlan SOM was developed that shows DPlan data.

After finishing the review, data is actually imported into SIT, creating DM projects and inserting in each one of them the proposed changes.

**DPLAN INTEGRATION – PHASE II**

In the second phase, a DPlan version with some of its functionalities integrated inside SIT was made available.



Fig. 4 – DPlan fully integration process

The integrated DPlan specification focused on identifying the subset functionalities that were to be made available in the integrated version. The criterion used was to include in this phase all analysis functions and switching functions. Optimization functions were not included as users doing optimization do more complex and long studies. Using DPlan directly is the best solution for them.

The DPlan integration development was technically a more complex one. Smallworld communicates with DPlan using a mechanism that allows Smallworld to communicate with other processes, sending and receiving commands, called ACP (alien coprocessor). A new release of DPlan was developed that hides its graphic interface and its expecting commands from the Smallworld ACP. This DPlan version behaves as an engine, responding to the commands received from the ACP with the return of DPlan's results. In order not to duplicate the developments, some of Smallworld commands open DPlan native windows.

Below is an example of a command (Select Contingency Branch) being exchanged between Smallworld to DPlan.

| SIT                | DPLAN                          |
|--------------------|--------------------------------|
| 505                | ?                              |
| Selected branch ID | ?                              |
|                    | ? Number of branches to select |
|                    | ? Id branch 1                  |
|                    | ? ...                          |
|                    | ? Id branch <i>n</i>           |

SIT starts sending DPlan the command ID (505) followed by the ID of the branch selected in the map. Then it gets the number of branches to select. Finally it gets the several branch IDs and selects them on the map.

The integrated DPlan appears in SIT as a menu with the same arrangement as the standalone version, but with a limited number of options available. The results from DPlan are shown on the map windows, changing network styles in a mode similar to standalone DPlan (e.g. showing filter colors). Some more complex actions result in DPlan windows that may interact with the Smallworld GIS map.

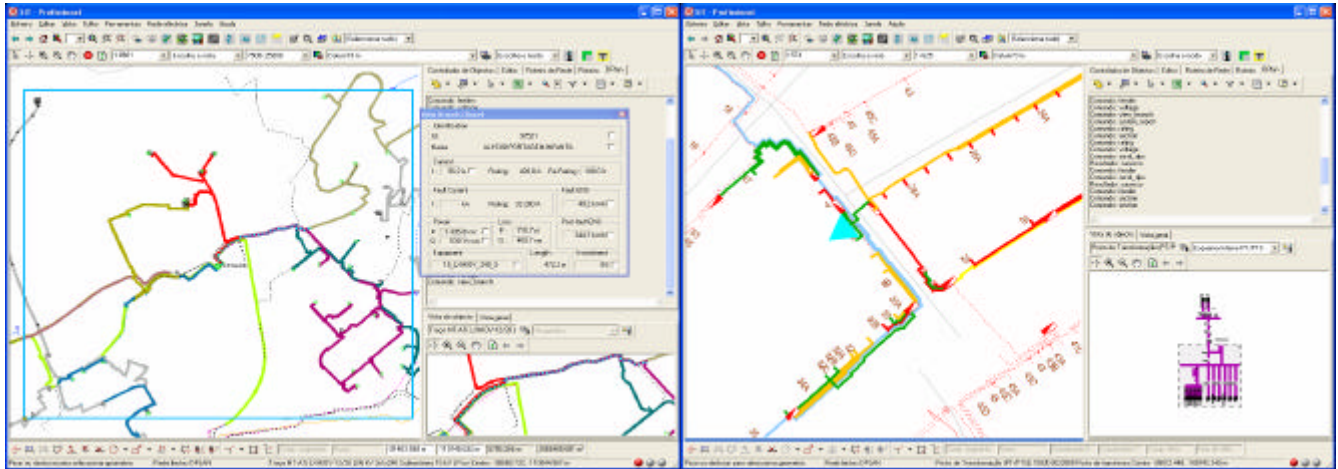


Fig. 5 – Examples of Integrated DPLAN with Medium and Low Voltage networks

## CONCLUSION

With the new integration of DPlan and SIT, EDP has now a fully integrated powerful planning tool. This eliminates labour effort and the possibility of transferring erroneous data from one System to another, thus increasing productivity and data quality. It also brings calculation power to the Technical Information System (SIT), increasing its value. The new integration contributes to maintain the database up to date as new users with high quality requirements are using its data.

## REFERENCES

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