

## GINISED ENTERPRISE GIS - FRAMEWORK FOR THE UTILITY OF THE FUTURE

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### ABSTRACT

*This paper presents GINISED – geo-information system which is developed to support control and management of electric low-power supply network. But introducing a GIS into a business process of utility company will not cause change to occur if it is viewed merely as a replacement for manually drawn circuit maps. Besides describing standard GIS tool, this paper discusses its transformation to enterprise GIS solution for power utility company. Enterprise GINISED helps integrate data from different sources, both internal and external, and generates new information and conclusions from existing data. Enterprise GIS integrated within the utility IT framework provides a solid framework for the utility of the future*

### INTRODUCTION

Geo-Information Systems (GIS) are being widely used for more than forty years. They have found their purpose in environmental monitoring, transportation management, public safety, facility security, disaster management, etc. GIS enables us capturing, storing, analyzing, and displaying geographically referenced information. It allows us to view, understand, query, interpret, and visualize data in a way that is quickly understood and easily shared. GIS technology can be used for scientific research, resource management, and development planning.

Efficient functioning of utility companies engaged in the transmission and distribution of electricity cannot be achieved without proper record keeping and monitoring of the transmission and distribution network system [1]. Any power utility company that expects to run an efficient day-to-day operation and to manage and develop its services effectively must know what asset it has, where they are, their condition, how they are performing, and how much it costs to provide the service. Nowadays, knowledge about physical assets of the enterprise is necessary to make crucial decisions vital to the operations, growth and management of electricity distribution facilities. Information must be collected and analysed to its full extent, contributing not only to efficient services, but also to the operation and

maintenance of assets, and to the sensible planning of extensions and new works [2].

Therefore, almost any electric power supply company has a need for the existence of specialized geo-information system that should provide mechanisms for collecting, storing and manipulating spatial data. GIS applications enable connecting various types of information in the spatial context and generating new information and conclusions on the basis of these connections. GIS enables fast, accurate and unique presentation of network data. GIS output of electric network can be viewed and easily interpreted compared to any other system output. GIS technology promises benefits not only in increasing operational efficiency but also in improving policy design, decision making, communication, and dissemination of information [3].

### GINISED - GIS FOR ELECTRIC UTILITY

GINISED is the geographic information system specially designed for electric power utility companies. It uses the most modern GIS technologies and methodologies for collecting, editing, visualization and analysis of spatial electric power supply network data. GINISED was developed by CG&GIS Lab, Faculty of Electronic Engineering, University of Niš, and is deployed in ED Jugoistok Niš (Serbian public electric power supply company). GINISED helps ED Jugoistok Niš in everyday operation and maintenance as it provides the accurate, reliable spatial and non-spatial information to the utility operational staff, and in turn help them better meet customer needs [4].

GINISED (Figure 1) tools can be divided into three groups [4][5]:

- Tools for collecting (digitization, map scanning and vectorization using GPS and other specialized equipment) and editing the spatial electric power supply network data.
- Tools for visualization of spatial electric power supply network data for a certain geographic area.
- Tools for spatial analysis of electric power supply network, potential or actual events in electric power supply

network and risk factors for a certain geographic area.

GinisED uses *centralized geospatial database* for storing data about electric power supply network. Elements of electric power supply networks are stored as a collection of geobjects. Each geobject is presented by its spatial component (coordinates or geometry) and thematic component (e.g. parameters for the conductors and protective devices such as voltage level, conductor type, length, construction and device type) [6].

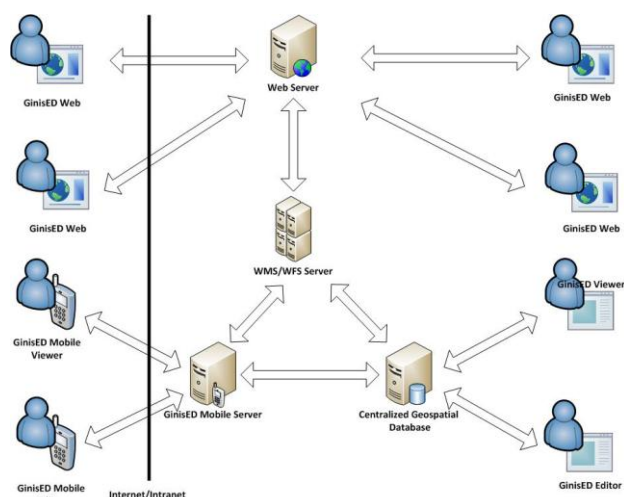


Figure 1 Architecture of GinisED system

The process of recording and editing of electric power supply geo-data is crucial during implementation of a GIS into electric power utility company. Proper data collection leverages the overall value of the system. Editor components act as entry points during this process. They are developed to provide simple and intuitive procedures for geo-data collection whether on the field using mobile device or in the office using standard desktop computer. Beside its core functionality, editor components need to address security issues and provide editing only to employees with proper user privileges. *GinisED Editor* (Figure 2) [4] is specialized tool for geographic editing of distribution network. It is a desktop application developed in accordance with carefully studied needs and requirements of customers. It is used for creation and editing of geographic schemes of the network, editing parameters of network elements and their connectivity. It provides multi-user and user-friendly, complete graphical environment for browsing and editing spatial data of distribution network with carefully chosen set of commands similar to popular vector graphic editors, but also with specialization for editing of the distribution networks schemes. *GinisED Mobile Editor* [7] is tool for GPS survey of electrical consumers and relevant electrical assets. *GinisED Mobile Server* [7] supports mobile GIS applications and provides map segments and synchronisation between mobile database and centralized geospatial database.

Visualisation of electric power network using GIS is crucial in different departments of an electric power utility company. For dispatch, repair, control and maintenance departments that need to have constant access to geo-data a robust desktop visualisation tool *GinisED Viewer* [4] is developed. In order to make access to electric power network geo-data for broader set of users in company, a WebGIS application *GinisED Web* (Figure 3) [8] is used. It is a Web GIS application with three-tier software architecture. This application, developed according to modern Web 2.0 standards, delivers feature rich user-interface and provides users with visualisation, searching and reporting capabilities.

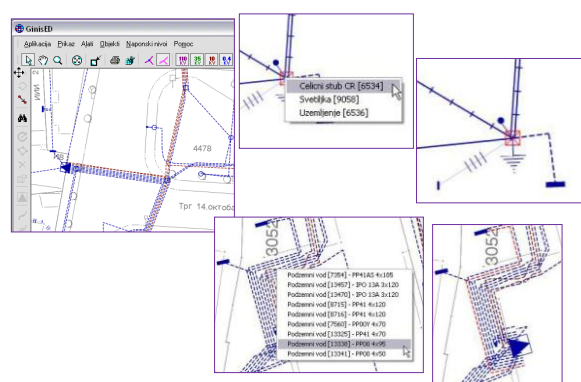


Figure 2 Editing parameters of network elements

*WMS* [9], *WFS* [9] and custom Web Services are components that provide GinisED Web and GinisED Mobile Server with raster maps and information considering geo-objects. WMS and WFS are components built according to Open Geospatial Consortium specifications. Custom Web Services are used for data integration and enable GinisED Web with searching and reporting capabilities.



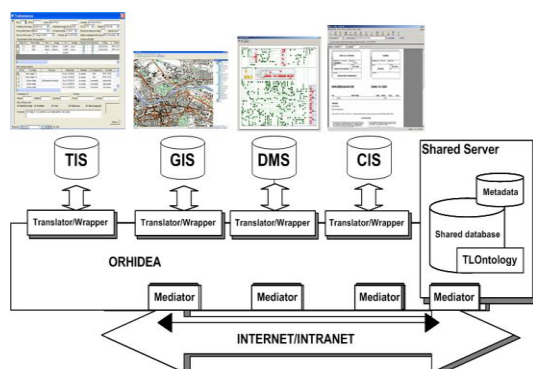
Figure 3 GinisED Web

GinisED quickly became an essential part of the ED Jugoistok Niš day-to-day business. Today, GinisED is

considered very important data resource for the distribution analyses as it contains most facility information including major network topological structures. The circuit map display provided by the GiniSED system is the most natural graphic user interface for engineers. In some applications, such as the trouble call analysis, geographic maps provide more information to engineers than the traditional one-line diagrams. Database integration technology offered by the advanced GiniSED functionality enables easy communication with other utility database systems.

## TRANSFORMATION TO ENTERPRISE SYSTEM

But GiniSED cannot be treated just as a replacement for manually drawn circuit maps. The main objective of our work is to efficiently integrate IT systems within the enterprise, and GiniSED GIS represents the step toward enterprise application integration within ED Jugoistok. Enterprise GIS in power supply companies provides the means to display, manage and operate the data about power supply network equipment, and helps in the integration of information from many distributed and heterogeneous data sources. For this purpose, GiniSED started to evolve from standard GIS solution to enterprise GIS solution. During this process critical business workflows and process models (with spatial component) within ED Jugoistok Niš have to be examined in the context of core IT systems such as: Customer Information System (CIS), Assets Management, Outage Management, Automatic Meter Reading (AMR), Utility Billing System and Supervisory Control And Data Acquisition (SCADA).



**Figure 4 GeoNis platform for the interoperability of GIS applications**

This transformation of GiniSED from standard GIS for electric utility to enterprise GIS solution is based on our experience with GeoNis platform for the interoperability of GIS applications [10]. GeoNis platform provides the mechanisms and infrastructure for the exchange of information in the environment of local government, but can be applied for integration of information on a single company level. This platform is developed for purposes of

intelligent integration of information from a number of heterogeneous GIS (geographical and spatial) and non-spatial data sources [10]. Companies, institutions or their parts that have some information of interest are considered to be data sources.

Electric power supply network analysis demands usage of technical information about the electric power supply network elements. In order to implement this analysis, GiniSED uses information from a number of heterogeneous and distributed information sources. The position of GiniSED system among other information systems is presented in Figure 4 [11]. GeoNis platform is located between GiniSED system, which operates as a C3 (Command Control and Communication) module, and relevant data sources. GeoNis environment nodes can be existing applications. Nodes may also be new applications developed in accordance with the Open Geospatial Consortium standards and component software development methodology.

At the current stage of development, GiniSED uses GeoNis infrastructure for integration with CIS, AMR and Assets Management [11]. Information considering customers, contained inside CIS system, is integrated with low voltage (LV) network GIS data. Integration of GIS and CIS allows determination of consumer's exact position on the LV electric power line. It also permits the determination of geographical location of connection that the consumer is related to. GIS and CIS data integration performed in this manner enables easy identification of all customers related to the particular LV electric power line. In addition, integration between GiniSED and CIS, allows integration with AMR data thus providing GiniSED with information about consumer load profiles. In a similar manner GiniSED implements integration with Assets Management system. E. g. GiniSED geobject that represents electrical substation is linked to appropriate record in Assets Management database. Using this linked information GiniSED can obtain additional thematic attributes for electric substation geobject (voltage levels, number of transformers, transformers info, etc.).

GiniSED also provides interfaces for cross-application information exchange. Since GiniSED is developed using broadly accepted industry IT standards and web services, the non-GIS applications and systems would be able to easily access GIS functionality and spatial data. With this integration CIS can provide full information about consumers of electric energy including the source from which the consumer is supplied with electricity [11]. This information can be used for Energy Audit, Load Management, Network Planning and analysis.

Similar, application for calculation of electrical losses in LV network [12][13] can obtain from GiniSED system all vital



data related to LV network topology and technical description of LV electric power line sections (section lengths, type of the conductors, number of consumers attached, their location etc.). Based on this data other data needed for electrical losses calculus could be obtained from other systems like CIS and AMR.

## CONCLUSION

Development of GinisED system for ED Jugoistok Niš has started in 2004. For the past six years implemented GIS solution has improved efficiency in overall company operations. Before GIS was implemented, data maintenance was erratic and time-consuming. Keeping track of changes was difficult because hard-copy maps or digital CAD drawings were shared among the utility's different departments. Nowadays ED Jugoistok Niš uses GIS in many of its departments to keep costs low and quality of service high.

Data collection was major part of the project because it involved extensive surveys in six organization units of ED Jugoistok Niš. Until now all major cities on the territory of ED Jugoistok Niš are covered with base raster maps. During this period of time a significant number of electrical network assets have been digitized: approximately 4,000 km of power lines and more than 220,000 of different electrical objects (Substations, Feeders, Poles, etc.). At the same time for more than 200,000 consumers service connections were identified which makes more than 30% of total number of ED Jugoistok Niš consumers.

Once the enterprise GIS is fully implemented it would act as the base system for all the organizational assets, and would cater to the requirements of other departments. The GinisED electrical data model is designed keeping this as an important requirement. Every IT system in a utility has a specialized role to play. The GinisED system is never a substitute to any of these systems, but once integrated enterprise wide, it would enhance their capabilities, hence increasing the benefits.

In the near future, GinisED will be a management asset tool to enable the ED Jugoistok Niš to make wise investment decisions about its infrastructure. It will serve as one of the important building blocks for operational and customer service excellence, which will be critical in the world of deregulation and increased competition.

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