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INTEGRATION OF INFORMATION SUBSYSTEM SCADA/NMS/DMS OF EDB

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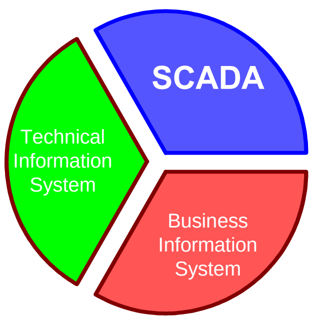
INTRODUCTION

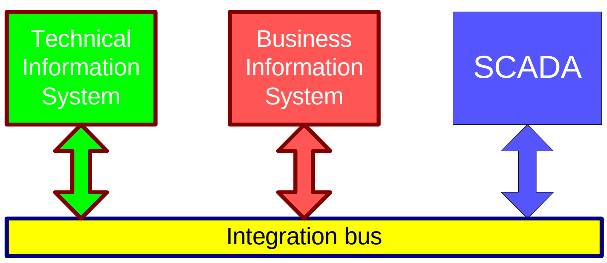
At the beginning of ninths, the Electric utility of Belgrade (EDB) started the realisation of Integral Information System of EDB (IIS EDB), including the following Information Subsystems (ISS EDB), shown on Picture 1:

- Business Information System (BIS) – Finance.
- Technical Information System (TIS) – Maintenance, Construction and Planning.
- SCADA/NMS (Network Management System).

Due to the imposed sanction of UN against our country, the realisation of IIS EDB was significantly slowed down and in this moment it was decided to start realisation of IPS BIS and TIS using our own resources. On the other hand, as it was impossible to complete the international bidding procedure we postponed the realisation of new ISS SCADA/NMS EDB. The agreed strategy for the realisation of IIS EDB didn't defined clearly the ways of integration of these three ISS EDB. The applications developed within ISS BIS and ISS TIS didn't care about their later integration with ISS SCADA/NMS/DMS. Partially because of technical solutions they made the integration between ISS BIS and ISS TIS inefficient, it happened that even realised ISS practically work separately, without any possibility of applying some of integration scenarios.



Picture 1 – Integral Information System of EDB



Picture 2 – Integration of Information System of EDB

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As EDB is finally at the very realisation of Project "Information network of EDB (WAN EDB)", there is the need to do complete integration of IIS EDB in the whole enterprise level and thus make the exchange of information efficient. This Project enables connection of all EDB's 19 locations with organisation units into unique WAN EDB. This is one of basic prerequisite for the integration into unique IIS EDB. The absence of clear strategy of integration among these systems will result in the effect of "spaghetti". It means that each business function would have its own informational solution, heterogeneous in the respect of using platforms, tools and environments, and the exchange of information would be made by various interconnections.

The strategy planned for the next period accepts world standards that support inter-application on enterprise level, shown in Picture 2. This integration provides the connection of different applications, that have already used, and also those intended to be integrated in future, supported by different environments and heterogeneous in various program languages, platforms, communication protocols and tools.

Various new standards in both electrotechnical and informational fields will be applied and tested in the Project of new SCADA/NMS/DMS of EDB. In order to define the new model of data it was necessary to encompass present architecture, users' needs, business process, as well as flexibility of information exchange and communication among external systems. It was decided that in the first phases of realisation of new SCADA/NMC/DMS to accept new world standards. Making of Common Information Model (CIM) and solving communication problems between heterogeneous system is subject of work of two working groups into IEC TC57 - WG13 and WG14. These two working groups publish series of standards - 61970 i 61968, respectively (3, 4). The stipulated standards IEC 61968 i 61970 are imposed as the only right solution for interoperability within informational system, and they are accepted as basic for development of new SCADA/NMS/DMS of EDB.

STRUCTURE OF SCADA/NMS/DMS OF EDB

During the task defining of the new SCADA/NMS/DMS of EDB it is insisted on the system as modern and all-inclusive informational system. This system is meant to integrate all the present applications working within SCADA/NMS, as well as to provide integration of the new application, in the first range, basic network calculations.

According to its structure of SCADA/NMS has two parts:

- **RT** (Real Time) a part of system working independently, but in the permanent connection with **ERT**, a part sending telemetric data collected by RTU (Remote Terminal Unit). This part of system consists of application server, SQL database and managing users programs. Data recorded in RT database are normalised, consistent and in accordance with proper formats and enumeration of ERT database.

- **ERT** (Extended Real Time) a part of system containing all data of SCADA/NMS of EDB including actual telemetric data. It consist of application servers that control the whole system, database server, meta-model server, graphic server managing viewer of one-line diagram and users applications directly integrated in viewers of electric network, shown in Picture 9.

Within present SCADA/NMS, several systems has been realised, supporting completely or partially some of business processes:

- **SCADA/NMS** (Supervisor Control and Data Acquisition / Network Management System) - RT part enables management form one control centre over electric network of EDB voltage level 110, 35 i 10 kV, i.e. control, monitoring and acquire measurements and indications over RTU (Remote Terminal Unit) installed in electric objects.

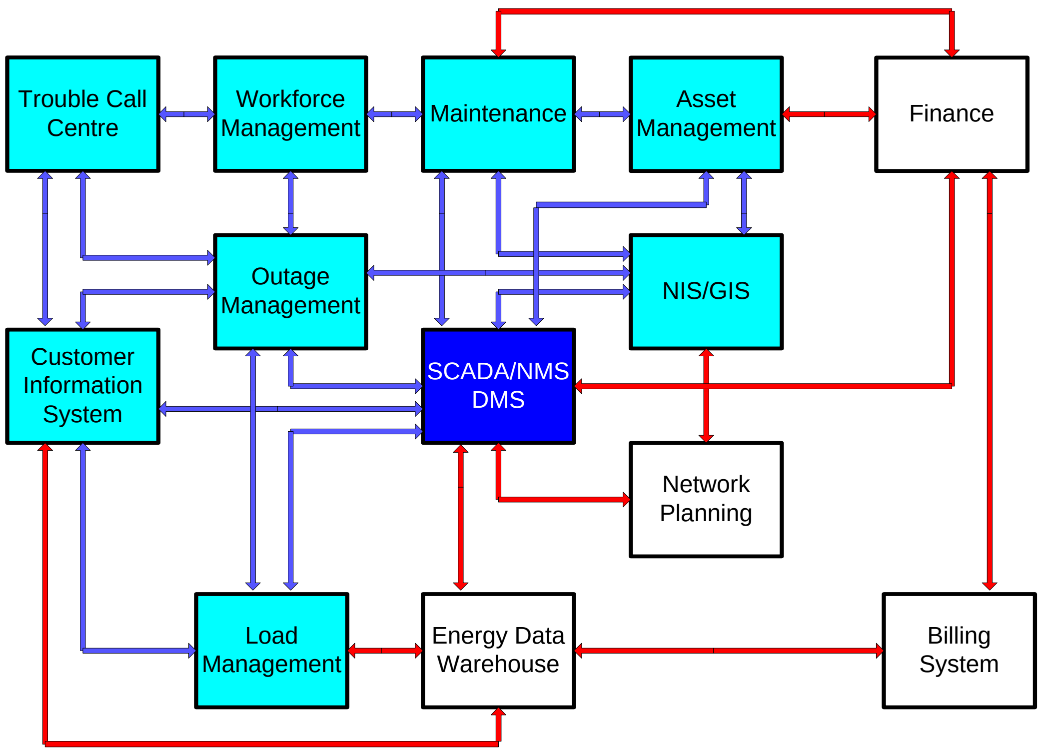
- **NIS/GIS** (Network Information System / Geographical Information System) – System enables viewer of physical view of HV and MV electric network of EDB. Also, systems provide geographical view of electric network, including LV network, as well as other data.

- **CIS** (Customer Information System) – System provides work with technical data of customers, necessary for the need of network operation.

- **Outage management –** System enables preparing for the planned work on the electric network based on sent documentation, analysing current state of network topology. Also, system provides generation of reports of affected customers.

- **Load management** – Ripple Control System (RCS) manages load control according to current tariff policy, but manages load control within certain groups of customers (public lighting, public heating plant, etc).

- **Workforce Management –** System enables workforce management within dispatcher crew, maintenance crew, construction crew, etc. Also, system provides documentation management related to all work on electric network.



Picture 3 – Current state of integration

The Picture 3 shows the realised systems that can be found in SCADA/NMS, as well as connections between these systems. If we consider that this system are realised in the different platforms and that each system has practically its own data model it is clear that the goal that has to be reached in the realisation of the new system is to reach the full effectiveness of integration over common data model. The connections that have to be made with the other systems within EDB are clearly shown and there is great need for common data in the realised systems.

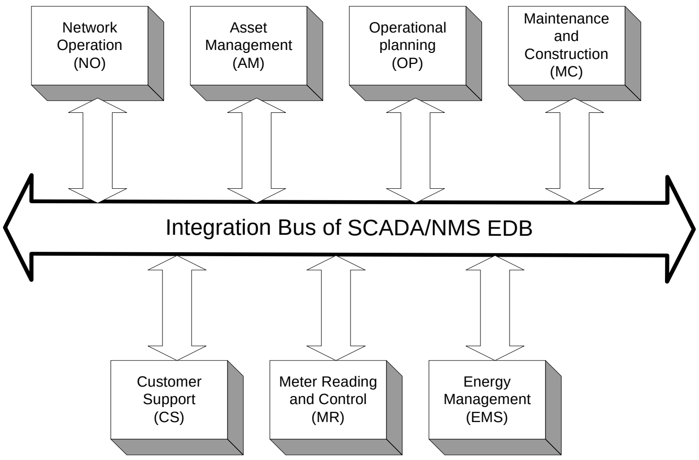
The systems planned to be realised within SCADA/NMS are:

- **Trouble Call Management** – The system for acquisition and processing of trouble call tasks made by the customers. The system is coupled with SCADA/NMS and in the order to automatically identify the affected customers by outage on HV or MV level. The integration of this system is planned to be done within the present realised system for supporting Call Centre, which is merged with full functionality of phone exchange.

- **Network Calculation** – Number of network calculations as the base of DMS, making analysis of operating of electric network of EDB possible. It consists of: forming mathematical model of network, load estimation, load flow and fault current calculation.

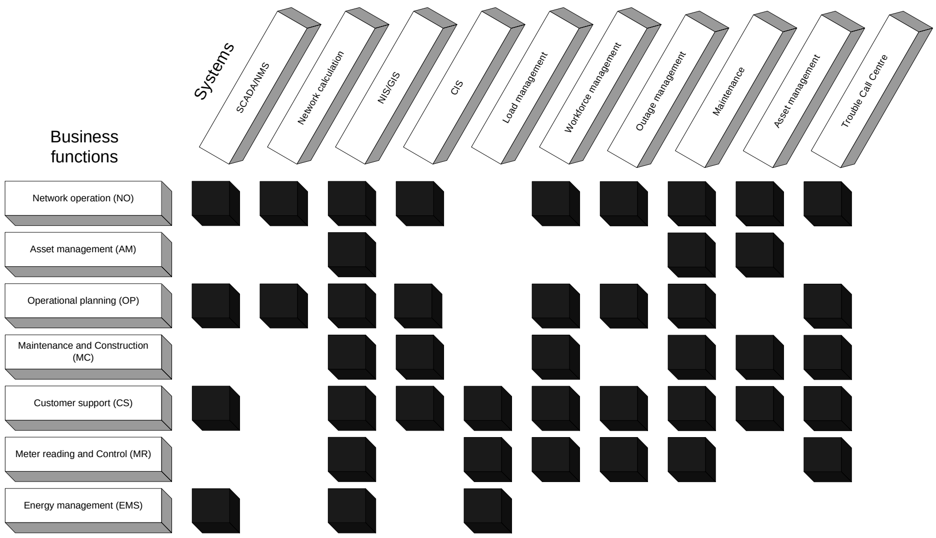
BUSINESS FUNCTIONS

The network operation is done by co-operation of different organisation units within electric utility. The modern trends of electric utility organisation suggest segmenting by business functions, such approach is given within IEC 61968, in Interface Reference Model (IRM) (4, 5).



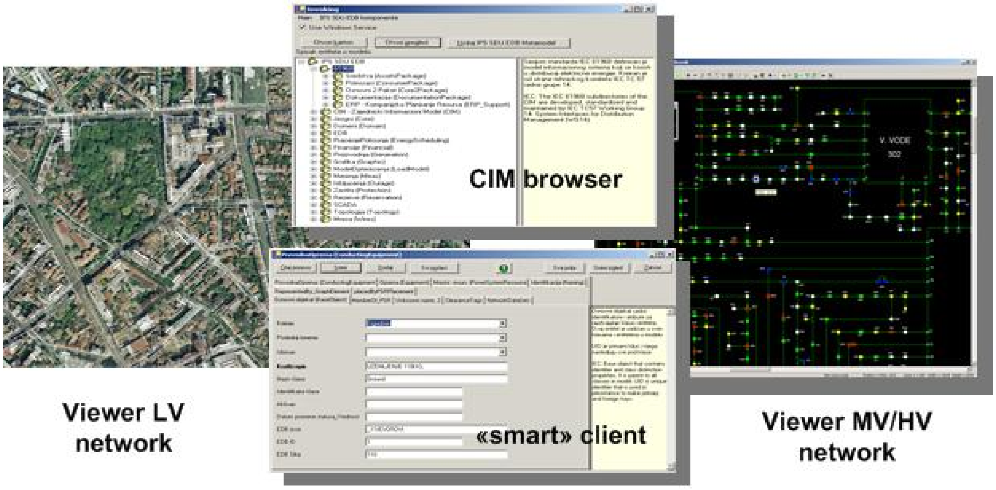
Picture 4 – Integration of business functions within ISS SCADA/NMS/DMS of EDB

The Picture 4 shows just a part of business function defined in IRM and which will be supported by application in new SCADA/NMS/DMS. As rule electric utilities use different systems/applications that the employed in electric utility may use to manage DMS more efficiently.



Picture 5 – Map of utility systems to the business functions within ISS SCADA/NMS/DMS of EDB

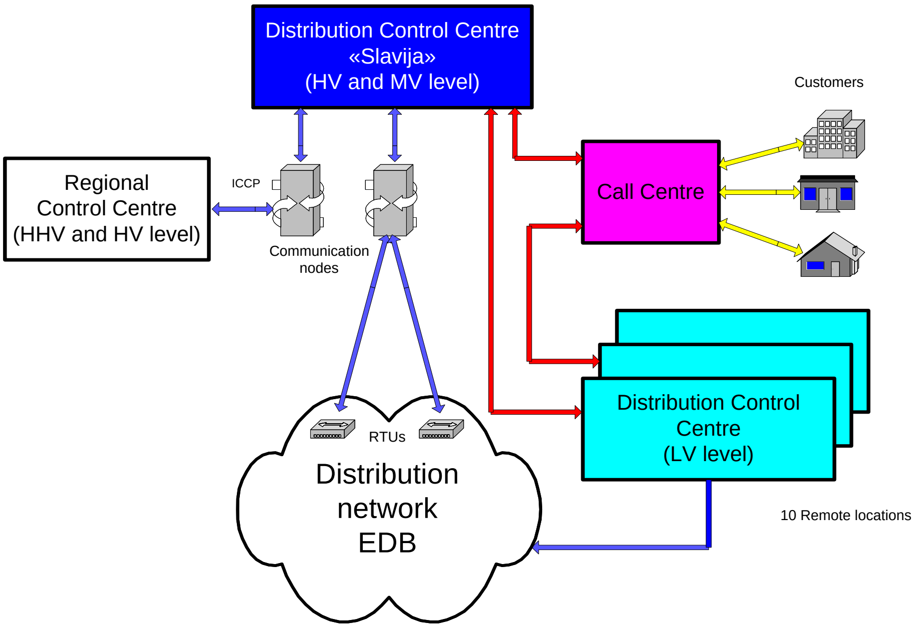
The functional relation between different business functions in IRM, supported within SCADA/NMS/DMS and systems/applications developed or are to be developed within it (1), shown in Picture 5. It is obvious that NIS/GIS is practically common of all business functions performed within SCADA/NMS/DMS. Considering network operation tasks are opposite regarding details of electric network view demanded by for example maintenance department or technical documentation department, we started with development of new viewers of electric network based on vector (1:5000) design and raster (ortho-photo) design. It has been realised than new viewers of electric network are integrated “smart” application for data management with common data on users’ side. The goal is to give support to maintenance departments and to provide more efficient planning works on the electric network. Also, the same approach will be implemented in technical documentation department and to support network topology. Of course, integrated solution of GIS (Geographical Information System) on the all levels of electric utility will be final solution.



Picture 6 – Preview of integration viewers of electric network within "smart" clients

NEW CONCEPT OF DISPATCHER OPERATION OF EDB

In comparison with previously accepted concept of dispatcher operation of HV and MV electric network of EDB, that defined three hierarchies' levels of organisation of dispatcher operation, the new concept promotes only two levels of dispatcher operation. The first level deals with control centres of HV and MV electric network of EDB, on the location "Slavija", on the second level deals with telemetric equipment (remote terminal units or gateways) in the network objects.



Picture 7 – Preview of levels of organisation of dispatcher operation

According to the new concept of dispatcher operation of LV electric network the dislocation of control centres of LV network is planned within maintenance departments (10 locations). Present Call Centre should take over the complete contact with customers, through integrated application of Trouble Call Management (TCM). In this way, it has been calculated that the propagation power of customers fault reports will be significantly increased. On the other side, the control centre of LV network are focussed on workforce management, fault location and outage management. Of course, in order to realise the accepted concept of dispatcher operation it is necessary to do planned integration of applications/systems within SCADA/NMS/DMS and that will define common framework.

INTEGRATION SCENARIO

The special emphasise is given to the use of technological solutions of this integration based on WEB services, as one of the most efficient way for the process of integration. The usage of WEB services in the electric utility has to be analysed as the evolution approach. This way provides the possibility of additional integration of applications currently being not integrated. .NET technology has been used for the realisation of WEB services, remoting servers and clients, and it proved in practice as robust, efficient and fast developing environment.

While the WEB services were being used for the information exchange and calling functions, COM “interop” was successfully used for integration user interface. As the approach of integration based on Model Driven Integration (MDI) (2) has been applied, it provides automatic generation of clients’ “smart” applications. Special software techniques within MDI are used for specific adaptation of application according to users’ needs.

It is important to mention that the whole process of integration application was proceeded by number procedures aiming at the verification of the last version of CIM model (version 10.4). In the verification process of CIM model, the all-necessary was marked, as well as new attributes and new classes existing in the present models of date bases. During the verification process, the present ways of development of CIM model were considered. These additional extensions of CIM model will be resulted in the easiest implementation of final definition of CIM model, regarding business process within EDB.

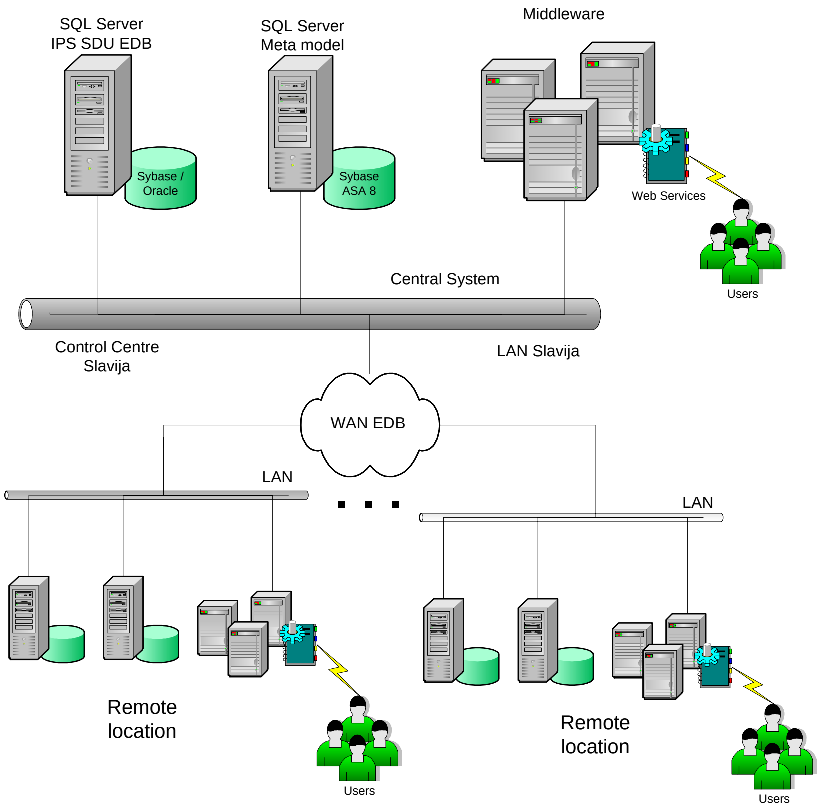
DESCRIPTION OF SCADA/NMS/DMS OF EDB

The goals of ISS SCADA/NMS/DMS of EDB development are:

1) Provide complete, reliable and actual information.
2) To ease access to information (middleware – XML – “smart” clients).
3) To integrate present applications and make possible new integration.
4) To make possible the exchange information within or out the enterprise (IEC 61968-8,9).
5) To enable the further development of system.

Implementation of ISS SCADA/NMS/DMS should fulfil next issues:

1) To realise the unique common database of all resources, documents, telemetric information and business rules.
2) To provide distributive work of system with different type of connections between control centres and slave locations.
3) To provide access to the different systems process (viewers of electric network, network calculations, “batch” procedures, etc.), as well as to the users from different environments (COM “interop”, DCOM, Web services, direct clients) and through various protocols (SOAP, COM “interop”, TCP/IP).
4) To provide that the forms for access to the information will be changeable according to the type of users and work performed.
5) To provide unique way of forming and maintaining of viewer applications of electric network with standard tools (AutoCAD).
6) To provide full security of data within all realised system.

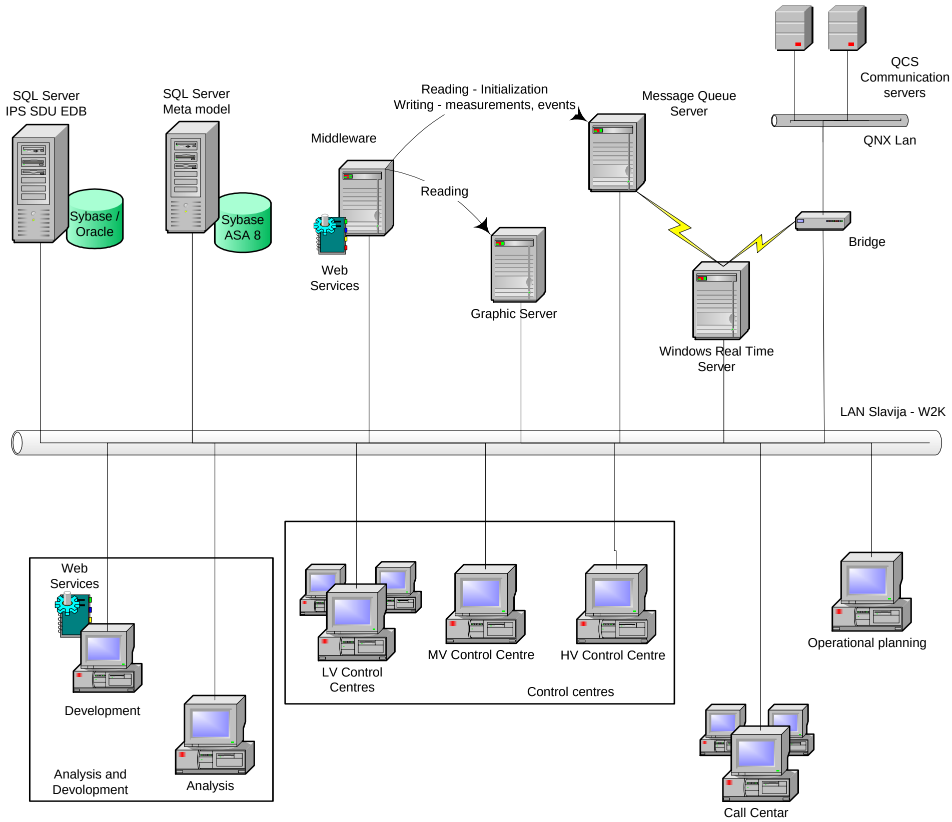


Picture 8 – Initial configuration of proposed IIS EDB

The initial architecture of the ISS SCADA/NMS/DMS of EDB on the location “Slavija” is shown on the Picture 9, and it is composed of the next components:

1) The primary SQL Server with all data (maintaining of central database of the ISS SCADA/NMS/DMS of EDB).
2) The secondary SQL Server which serves “meta-model” (“meta-model” consists of definition of documents and business rules).
3) Middleware (.Net WEB services and “remoting” components).
4) The Graphic Server in which the middle application layer of viewer application of distribution networks all voltage levels was realised.
5) Message Queue Server is used for exchange of messages between different systems.
6) Real-time Server provides communications between RT and ERT part of the system.
7) The direct users of the applications or activation of software components within other applications.
8) The replication of the system on the distant locations containing identical software/hardware components with subset of the data from central database.

“Middleware” perform the process activated by clients (“Client Activated Objects”) and WEB services, while the hardware performances of the realised servers are decisive for obtaining well performance of planned system. This realised solution is scalable, as the function of the load balancing can be used. On the distant locations, it’s planned to unite several functions in the one server or more, depending on the size of database and load of the system. On the some locations with good communication support it’s possible direct access to the central system. Currently, during the development and implementation of the ISS SCADA/NMS/DMS we don’t know finale size and structure of data, as well as all functions that should be included and so we use modular and scalable variant of the system. This architecture allows further work of the system and adaptation to the needs of the users without break during the work of the system. The planned system will be a complex system with very powerful database and “smart” users applications and may be expected that it will be difficult for the users to adapt, as they are accustomed to the different system.



Picture 9 – The initial configuration of the ISS SCADA/NMS/DMS (Slavija)

The implementation of the system, training of the users, migration of the data from the existing databases will need intensive engagement of the both human and technical recourses of EDB. That is the reason, the activating of ISS SCADA/NMS/DMS will be done step by step in accordance with technical and human possibilities of EDB. As the system increases functions and covers more users will be necessary to increase hardware/software recourses of the system as well. The further development of ISS SCADA/NMS/DMS will cover the following: resize of the system due to new users, new functionality of the "middleware", optimisation of the system performances and connecting with other external systems.

CONCLUSION

The successful integration of applications within ISS SCADA/NMS/DMS of EDB represents the beginning of total integration process on the modern organised enterprise level. It is proved that the application of the latest world standards providing integration of the applications is the imperative at this moment. It defines the way that each electric utility should follow in the near future. The implementation of the latest world standards should also reduce cost and the time of integration present applications, as well as new applications. But also to secure investment in the present applications or the system that have been already working successfully within certain part of present ISS SCADA/NMS of EDB. The given framework for application in the near future will represent the real business and technical challenge, as it should provide the continual flow of information, both within enterprise and towards external system and business environment.

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