Development of the Web Application of Geographic Information System Rosvodresursy

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Abstract[1]

In the article analysis of different types of physical architectures of the enterprise geographic information systems is provided. Advantages and flows of those architectures are exposed on the development of corporative geoinformation system of the Rosvodresursy. The transition from desktop to internet application based on the service-oriented platform of the ArcGIS is described.

1. Introduction

Modern enterprise geoinformation systems (GIS) are used in the wide range of tasks, including decision support based on the extensive spatial data processing e.g. water management. The example of such a system is geoinformation system of the Federal Agency of Water Resources (Rosvodresursy) [2, 3].

2. Traditional approach

Software architecture of this system is a client-server with "thick" client (fig.2, designations are on the fig.1). GIS database is implemented on the ESRI ArcSDE and Microsoft SQL Server software and operates on the separate server. GIS functionality is implemented in the "thick" client based on the ESRI ArcGIS Desktop software. Following components are used in the system:

- standard functions of the ArcMap application, e.g. visualization of spatial and attributive data in the GIS Rosvodresursy;
- custom geoprocessing models of the ArcToolbox, e.g. river flood modeling system;
- special .NET program modules for the ArcMap application, e.g. water resources spatial classification subsystem.

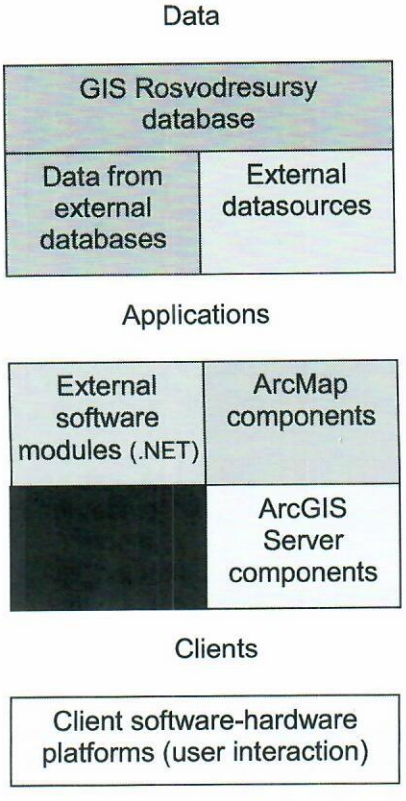

Fig. 1. Types designations of the GIS Rosvodresursy software components

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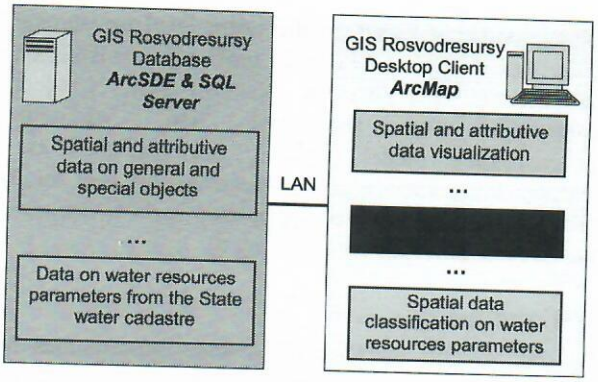

Fig. 2. Client-server architecture of the GIS Rosvodresursy with "thick" client

The limitations of such enterprise GIS architecture are:

- difficulties of installation and support of the "thick" clients for the geographically distributed users;
- high requirements to user workstations hardware due to extensive data processing on the client side;
- high requirements to user workstations software to implement data processing;
- limited cross-system mobility of the GIS subsystems;
- tricky implementation of the interaction with other enterprise information systems due to lack of common interfaces, every system requires special interface module to obtain subject data, for example on the hydraulic structures or water monitoring stations.

Additionally, subject data collection and actualization requires using of mobile devices with GPS or GLONASS satellite navigation feature.

3. Modernization strategy

3.1. Technology in use

To resolve mentioned problems of the "thick" client architecture GIS developers, including ESRI, for some time concentrate on the new technologies, especially service-oriented physical architecture. In the framework of the service-oriented architecture common data exchange infrastructure for the Web-service software modules is created. So the cross-system integration is simplified, software and hardware requirements are eased, supportability of the system and reusability of the components are increased. Software module being implemented as a web-service can be used by different types of clients through standard data exchange interface. All this abilities are provided by ESRI ArcGIS Server software [1].

New technology implementation requires resolving of the task of existing software reusing and system components integration, including GIS components.

Software modules physical partition and interaction in the service-oriented architecture is a result of steady development of the previous architectures (component, client-server).

Aforementioned desktop GIS Rosvodresursy was gradually transformed into the internet application (Web-site) functionally comparable with desktop application. One of the main tasks of this transformation was relocation of the software modules (.NET and geoprocessing) from the client to the server side, keeping intact main algorithm and redesigning interface. The client side of the application implemented on the Flex technology, server side implemented as ArcGIS Server GIS-services and custom .NET modules (fig.4). So the most part of the tasks from the desktop client implemented now on the server side as a set of Web-services. Intermediate step of the Web-application development was based on the ArcIMS or ASP.NET platform. In such implementation most tasks was already relocated to the server side as Web-application (fig. 3) resolving first three problems of the desktop client-based GIS. But problems of cross-system mobility and interaction still exist due to inherited module partition and interaction scheme.

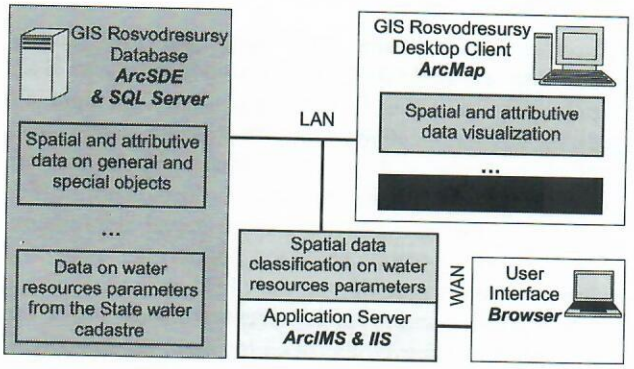

Fig. 3. Client-server architecture of the GIS Rosvodresursy with "thick" and "thin" clients

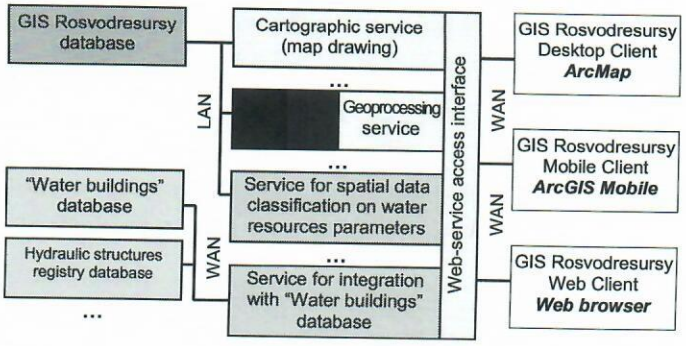

Fig. 4. Service-oriented architecture of the GIS Rosvodresursy

ArcGIS platform provides to the developers number of capabilities in implementing service-oriented technology in GIS (utilization of some of them is shown further on the GIS Rosvodresursyy examples):

1) GIS-services (i.e. Web-services implementing GIS tasks) of the ArcGIS Server – provide maps, spatial data, spatial models and tools to the different types of clients;
2) software extension of capabilities of the ArcGIS GIS-services by custom .NET modules;
3) ArcObjects components for custom Web-services creation.

3.2. Structural system improvements

Use of these ArcGIS Server 9.3 technologies gives ability to implement in the Web-application some features, previously available only for ArcGIS Desktop application users, and provides access to the same service-implemented tasks for different types of client software. For example GIS Rosvodresursyy include: spatial data editing subsystem, resource-demanding tasks of modeling of floods and contamination propagation, water basins building.

Special objects spatial and attributive data editing subsystem available in the GIS Rosvodresursyy as Web-application, as well as mobile application. Data input and editing Web-application of the GIS Rosvodresursyy gives ability to input and modify subject objects location without special software for the users form central office and local branches who have more actual information. Fig. 5 shows the editing panel for monitoring stations and chosen monitoring station on the Chekhovka river. Using GIS Rosvodresursyy mobile client software users can add, delete and move objects on the map, for example to specify location of the waterusers, monitoring stations, hydraulic constructions. Fig.6 shows menu "Map" for choosing navigation tools and "Menu" for choosing objects type, search and another operations with data.

Flood modeling based on the water level measurement data is an example of the tasks previously available only for desktop GIS (ArcGIS Desktop) users. Modeling subsystem was redesigned into ArcToolbox geoprocessing model (fig. 7) and published as a geoprocessing service giving access to this task for the GIS Rosvodresursyy Web-application users by means of the ArcGIS Flex API controls (fig. 8).

4. Conclusion

So, the ArcGIS platform gives wide opportunities for realization of enterprise geoinformation systems in the service-oriented framework. Implementation of some tasks of the GIS Rosvodresursy with service-oriented technology resolves some problems specific for desktop systems: installation and support difficulties, high demand to hardware and software, complicated integration with another information systems and increases efficiency of the water management tasks: data exchange between different branches and the central office, access to the dynamic data about water objects state, hydraulic structures, water users, integration with other information systems of the Rosvodresursy.

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