

Geoinformation Portal as a Component of Unified Geoinformation Environment

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Abstract

The relevance and necessity of the implementation and use of geoinformation systems for military purposes is due to the general increase in the requirements of the troops (forces) for the efficiency, completeness and quality of the information support of the management process. The armed aggression of the Russian federation against Ukraine creates new challenges to the state's information security and necessitates a review of the requirements for information support in general and for geoinformation support in particular.

The substantiation of the principles of creation and functioning of the Geoinformation Portal of the Armed Forces of Ukraine as an integral part of the Unified Geoinformation Environment of the Armed Forces of Ukraine are shown in the article.

The paper determined that the foundation of the Unified Geoinformation Environment of the Armed Forces of Ukraine should be a service-oriented architecture (SOA) of distributed geodatabases, that provides a common platform for all subjects and users to access the resources of the Unified Automated Management System of the Armed Forces of Ukraine. The Unified Geoinformation Environment (UGE) of the Armed Forces of Ukraine should be formed as a set (network) of interconnected geoportals, the purpose of that is to consolidate information on spatial data available in the Unified Automated Management System of the Armed Forces of Ukraine, that are processed and provided for use in the form of geoservices as well as creating a single entry points of users into this environment. UGE of the Armed Forces of Ukraine should provide access to data stored in the system of distributed geodatabases. The format and method of using the services should be based on the use of national, international and military standards, that are a single, agreed and approved set of data presentation standards, interfaces, as well as computer programs developed according to the principle of service-oriented architecture for all types of armed forces.

KEYWORDS: *Unified Automated Control System (UACS) of the Armed Forces of Ukraine, geoinformation support of the troops, service-oriented architecture (SOA), geoportal, geoinformation system (GIS).*

1. Introduction

The current views on armed struggle, their impact on the using of the troops (forces) in the war with the Russian Federation, new asymmetric threats to Ukraine's national security, and the reform of the Armed Forces of Ukraine require a review of information requirements in general and geoinformation in particular.

The purpose of the paper is to substantiate the creation and functioning principles of the Geoinformation Portal of the Armed Forces of Ukraine as a component of the Unified Geoinformation Environment of the Armed Forces of Ukraine, that involves the following tasks:

- the characteristics of the optimal model of the spatial data organization of the Unified Automated Control System (UACS) of the Armed Forces of Ukraine;
- the substantiation of the necessity of implementing the Geoinformation Portal of the Armed Forces of Ukraine and determining its structure and functioning features.

The following research methods were used: the method of analyzing scientific and reference literature on the research problem; methods of systematization and generalization of scientific information related to the essence and content of defined tasks; the systematic analysis of current governing documents related to geospatial data and UACS of the Armed Forces of Ukraine.

The development and introduction of new weapons, the ephemerality of the armed struggle at the present

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stage require a significant increase in the efficiency of the military management system. In solving this problem, one of the key roles should be played by geoinformation technologies as a tool for analyzing the operational situation and a means of automating the process of making managerial decisions by military authorities officials. The geoinformation technologies, offering new effective approaches to the analysis and solution of territorial problems, continue to gain more and more popularity and official recognition in our country, and digital spatial information begins to play an increasingly important role in the tasks of socio-economic, political and environmental development and environmental management, production and labor potential in the national interest.

Foreign experience in operating various GIS- technologies indicates that the need to analyze the geographical location of phenomena and objects, their quantitative and qualitative characteristics using a map arises among representatives of armed forces and various sectors of economy. An analysis of the tasks solved by the topographic services of the Armed Forces of Ukraine and some other countries as well as the means and methods of solving them, indicates that there is a serious lag in these issues from the armies of developed countries [1,2]. A review of various directions and examples of the geoinformation technologies using to solve the problems of topographical and navigational support of troops (forces) in the armies of developed countries of the world proves their effectiveness in supporting decision-making during training and during operations and combat operations [3,4].

The geoinformation technologies, based on geographic information, make it possible to form a unified picture of situational awareness, to develop modern methods of control and management of means of armed struggle, including unmanned and robotic complexes, to increase the transparency and efficiency of rear operations, and to reduce the level of direct presence through the formation of virtually remote headquarters and other control bodies. [5] Unlike other types of information processing tools, the GIS- technologies understands the concept of location, as it's based on information tied to the coordinates on the map, and allows the information presentation in a graphical form for interpretation and management decisions. The main feature of the GIS, that determines its advantages in comparison with other Automated Information System (AIS), is the presence of a geographic information base, giving the necessary information about the earth's surface. In this case, that base must ensure:

- exact binding, systematization, selection and integration of all incoming and stored information;
- comprehensiveness and visibility of information for decision making;
- the possibility of dynamic modeling of processes and phenomena;
- the ability to automatically solve problems associated with the analysis of the features of the territory;
- the ability to quickly analyze the situation in emergency cases [1].

The problem of providing units and subunits with geospatial data can be solved in practice with the help of geoinformation technologies. Such technologies are widely used in local conflicts in recent years and during peacekeeping operations. The elements of such technologies are used in the operational and tactical units of the armies of the leading countries of the world. The Armed Forces of Ukraine have several structural divisions that deal with geospatial information processing. Information to these structures arrives in parallel, although it could complement each other. There is a need to combine all the spatial information that can be obtained from different sources. This information must be stored in one computer database, that is constantly updated. Such database can be a Unified Geoinformation Environment of the Armed Forces of Ukraine, that is the modern spatially distributed subsystem of system-wide information support of the UACS of the Armed Forces of Ukraine and able to process spatial data in conjunction with other information circulating in it [1-3]. The review of various areas and examples of the use of geoinformation technologies in military affairs necessitate substantiation of the creation aspects and operation of the Unified Geoinformation Environment of the Armed Forces of Ukraine [1,5,7].

2. Investigation Results

The use of information technologies in the military sphere has its own specifics, as a result of that the technologies used must meet a number of requirements, among that the support of safe work in everyday activities and during combat tasks is particularly important. Modern information and network technologies in military affairs are the basis for the integration of control bodies, means of intelligence, surveillance, destruction, targeting, as well as groups of troops into a highly adaptive global system. The main purpose of geoinformation technologies is to provide management bodies at all levels with access to spatial data about the area and objects on it in real time or close to it, providing a visual form of their presentation. GIS stores geospatial information in the form of a set of thematic databases, that are combined with model and calculation functions for manipulating and transforming them into spatial information [2].

In the process of planning the use of troops (forces), a certain number of persons responsible for individual areas of operational support participate. It's clear that the requirements for the presentation of information to solve the tasks of a separate type of operational support are different. In this situation, the ability to create the necessary information

environment for each individual official is required from the geoinformation system, without losing the properties of the management system regarding the coherence and synchronization of all its elements. The implementation of such a requirement is achieved by using a unified core of geoinformation support, that provides software developers and users with basic geoinformation services and tools for their joint use when solving specialized tasks. At the same time, the core of geoinformation support must operate in a spatially distributed environment, be protected from external interference and be maximally accessible to internal users according to the established distribution of powers. The use of such an approach makes it possible to provide the unified approach to the use of spatially distributed information, flexible scaling of system elements from the tactical level to the strategic level (and vice versa), and allows to focus on solving applied tasks. Geoinformation support of the management system should use functional components that are built into an open, extensible software and hardware platform to achieve interoperability of spatially distributed information, using standard rules within the framework of basic services that support message exchange, data transformation for further dissemination (distribution) by publications and subscriptions to standard and custom-made design templates. In order to achieve a tactical advantage on the battlefield, it's necessary to ensure constant situational awareness of the commanders of the tactical chain of command.

In this sense, the tasks of geoinformation support are to provide commanders with detailed maps, plans and pictures of the area of hostilities, displays of objects of the operational situation on portable devices in conditions of significant limitations of the bandwidth of data transmission lines [2]. GIS-technologies makes it possible to create information products that exactly meet the user's requirements, and makes it possible to visualize cartographic information that isn't available for paper maps. A three-dimensional display of the terrain from a specific point of the observer's location or a virtual survey of the terrain gives the commander more complete picture than the paper map with the situation drawn on it.

The foundation of the Unified Geoinformation Environment of the Armed Forces of Ukraine can be service-oriented architecture (SOA) of distributed geodatabases [8,9]. The purpose of deploying service-oriented architecture is to provide a unified form of information resources management of the Armed Forces. The main role of the SOA is that it provides the common platform for all actors and users to access the resources of the UACS of the Armed Forces of Ukraine. In the case of flexible design methods, the transition to SOA should be through one or more pilot projects.

The basic means of the geographic information environment of the UACS of the Armed Forces of Ukraine should include server components that are specifically designed to support the SOA (both tools and tools to support its operation). This model of the spatial data organization goes beyond editing the unified geodatabase by creating the decentralized geodatabase. Many entities (users) can publish their data and register it for search and use by any number of remote users. Those, in turn, can either download the data set in full, or use cartographic WEB-services to dynamically sample and download the small amount of data needed in their current map extent. The process of asynchronous editing and publishing can be extended to support the process of data distribution according to the subscription, with that each user can access the updated data only when they need it [6]. At the same time, an important condition for the creation of the Unified Geoinformation Environment of the Armed Forces of Ukraine is to ensure the process of disparate data's integration. One of its types is WEB-integration, that is most appropriate to use in our case. During its implementation, the data remains with the owners and even their location is unknown. The query refers to certain services that are related to the sources where the information is located and its specific address. The data integration integrates information from multiple sources so that it can be provided to the end user as the service. The SOA approach focuses primarily on identifying and sharing services in the form of services with relatively limited number of the key functions in the UACS AFU. Thus, the service-oriented interfaces are based on the limited number of requests for the necessary information to be provided to the consumer [8,10,11].

The following approaches to WEB integration are practiced:

- the integration at the presentation level. This level allows the user to interact with the application. The view-level integration provides access to the user interface of remote applications;
- the integration at the level of functionality. This integration provides direct access to the application algorithm. It's achieved by direct interaction of applications with API (Application Programming Interface) or interaction using WEB-services;
- the integration at the data level. In this case, the access to one or more databases used by the remote application is assumed;
- the complex integration. These WEB integration solutions usually include all three types of integration.

Analyzing the technical aspects of the spatial data integration and modern server technologies for access to resources, it can be argued that the most optimal way to create the Unified Geoinformation Environment for the UACS AFU is to implement a geoinformation portal of the Armed Forces of Ukraine (hereinafter – the geoportal). It's the software information and communication platform designed to create the Unified geoinformation and information-analytical environment of military authorities, military units and subunits of the Armed Forces with delimitation of users' access rights to these resources.

The geoportal as a set of software and hardware, network services and geospatial data services that provide display in the geodata network, must perform the following main tasks:

- the processing and issuance of information on automated workplaces of military administration bodies officials (military units);
- the providing access to the unified geographic information space to officials of military administration bodies (military units, subdivisions);
- the ensuring cooperation with other military formations and law enforcement agencies within the unified geographic information space;
- the providing search / access to necessary information.

The geoportal must have the following basic set of the map services:

- 1) the cartographic service of electronic (digital) maps – a multi-scale cartographic service that contains vector information of the entire range of topographic and survey-geographic maps;
- 2) the cartographic service of electronic (digital) maps in three-dimensional display - a copy of the cartographic service of electronic (digital) maps with the possibility of geographical information visualization in three-dimensional display;
- 3) the cartographic service of remote Earth sensing - a service that contains materials of remote Earth sensing (aerial photography, space photography and filming from a UAV) and allows to quickly create photo documents about the area;
- 4) the cartographic service of remote Earth sensing in three-dimensional display;
- 5) the cartographic service for downloading raster maps - a cartographic service that allows to download topographic maps of the entire range in raster formats with the possibility of their further printing (reproduction).

As a software component, it's optimal to use ESRI's ArcGIS server multi-user software with Enterprise performance level and Advanced functionality class. To ensure continuous operation of geoportal software and services, to prevent data loss, it's necessary to deploy a fault-tolerant configuration according to the "active-passive" architecture. Each of them has its own local configuration stores, server directories and backs them up. In case of software or technical failures on the main GIS server, the backup "passive" GIS server automatically takes over the "active" functions until the main one is restored. Thanks to the specified principle, the three-level service and data protection is ensured.

3. Conclusions

Thus, the creation of the Geoinformation Portal as a component of the Unified Geoinformation Environment of the Armed Forces of Ukraine are an important stage of the integration of all other technologies that are used or planned to be implemented as part of the UACS of the Armed Forces of Ukraine to solve various problems related to the management of troops. The modern challenges that have arisen in connection with armed aggression against our country require thorough research and practical testing regarding the creation of the Geoinformation Portal of the Armed Forces of Ukraine as a complex of software and technical tools, network services and geospatial data services. The implementation of the Geoinformation Portal of the Armed Forces of Ukraine during fighting should provide the following:

- the formation of the unified information space within the theater of operations of troops (forces);
- the reflection of the area's state, as well as the operational situation;
- the generalization (scaling) of cartographic information depending on the tasks to be solved;
- the supplying of cartographic data to ensure the setting of tasks for the implementation of commanders' decisions of all levels of the subordination's hierarchy;
- the processing of coordinate and raster (space images, aerial, photo) information from all types of intelligence;
- the providing technologies for automated analysis of the combat situation;
- the geoinformation support of automated solution of tasks related to the types of operational support of the Armed Forces;
- the ensuring the compatibility of automated systems and means of automation of the UACS of the Armed Forces of Ukraine in terms of spatially distributed information with other similar systems in terms of performing tasks in the coalition of troops (forces).

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