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Mapping and geographic information system based on microservice architecture

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Abstract

The service architecture of the existing GIS is easy to deploy and expand at the initial stage of development and service, but with the gradual expansion of the service volume, the subsequent development is more difficult, the maintenance cost is increased, the response efficiency is reduced, and the function expansion is difficult. The traditional method adopts the single architecture to implement the platform construction. The function and data in the platform are closely coupled, and the expansion ability is limited. This paper studies the mapping and geographic information system based on micro service architecture. The method of this paper is micro service architecture. Microservice architecture divides a large single application or service into multiple microservices, which can expand a single component rather than the entire application, so as to meet the service level agreement. Aiming at the problem that the geographic information service platform designed by single architecture is difficult to quickly meet the changing needs of users, this paper uses micro service architecture to design and implement the system platform. After this study, this method is effective and suitable for wide application in practice.

Keywords

Microservice architecture, Cartography, Geographic Information System.

1. Introduction

With the continuous development of society, geographic information services are becoming more and more popular, which puts forward the demand that geographic information service system can effectively adapt to changes [1]. Due to the low development efficiency, low integration ability, low deployment efficiency and difficult expansion of services, the traditional GIS monomer architecture is facing the problem of being difficult to meet the rapid changes of user needs under the new form of the rapid development of the Internet. The service architecture of geographic information is the basic framework for the system to achieve external services. A good service architecture can help the system achieve stable and efficient operation and services [2]. Improving the informatization level of the road can realize the overall management of the road network, enhance the traffic information flow between the nodes and sections of the road network, promote the mutual understanding between the upstream and downstream, and then realize the load balance of the road network and improve the traffic capacity of the road network; It can enhance the ability to perceive the static health status of the road and the dynamic operation status of the traffic flow, reduce the management cost and resource consumption of the road operation management unit, quickly respond to adverse road conditions and accidents, and realize intelligent management; It can provide travelers with more real-time and more dimensional travel information services, provide basis for travel decision-making, and improve service level [3]. Geographic information service is an important part of IT services, and every progress of its technology is closely related to the rise of the latest IT technology. The development and application of information technologies such

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as big data, cloud computing and micro services provide development opportunities for the innovation and reform of geographic information services. The emergence of micro service architecture has effectively solved a series of problems faced by current enterprise informatization [4]. Through micro service architecture, complex applications can be segmented into services, a large and complex problem can be resolved into multiple small and simple problems, and a set of small services can be used to develop a single application to realize micro service functions [5].

2. Microservice architecture

2.1. Characteristics of microservice architecture

Unlike the monolithic architecture, the microservice architecture only focuses on specific businesses, with clear business functions [6]. The whole application is divided into several micro services, and each service is deployed independently, which is conducive to the overall development and maintenance of the project. Microservice architecture divides a large single application or service into multiple microservices, which can expand a single component rather than the entire application, so as to meet the service level agreement. Microservice architecture divides services around the business field. Each service can be developed, managed and iterated independently, and communicate with each other using a unified interface, realizing the deployment, management and service functions in decentralized components, making product delivery easier, so as to achieve the purpose of effectively splitting applications and realizing agile development and deployment. The basic idea of microservices is to consider creating applications around business domain components, which can be developed, managed and accelerated independently [7]. Using micro service Cloud Architecture and platform in distributed components makes deployment, management and service function delivery easier. The microservice architecture is shown in Figure 1.

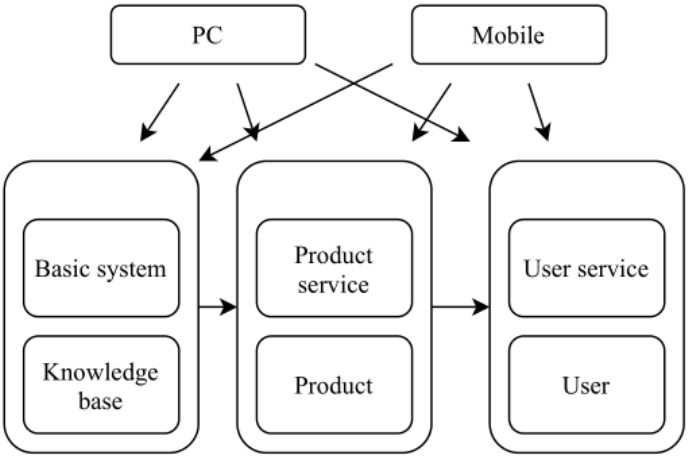

Fig. 1 Microservice architecture

Due to the advantages of microservice architecture, it will not only have an impact on software development management on related industries. Before the microservice architecture was proposed, the traditional website service and interface service (mobile terminal) architecture design embodied the "one-stop" design idea [8]. This one-stop design idea often sets up many external interfaces and modules in a service event, which is convenient for external access on the one hand, and functional expansion on the other hand. Moreover, the traditional design scheme often adopts the top-down hierarchical design idea, which is convenient for the design of different design teams, as well as the maintenance and development of the architecture [9].

Microservice is a design grid of software architecture. The whole software service architecture is composed of multiple microservices. It has no fixed regulations, but needs to be designed

according to business needs [10]. Compared with the traditional structure, microservices emphasize more on the componentization and service orientation of services. Each service runs independently in its own container, and there is no interference between different containers. At the same time, in terms of external structure settings, microservices only use API form for external use.

2.2. Impact of microservice architecture

The flexibility of the microservice architecture can make the project development process easier to manage, which greatly improves the development efficiency of the project development team. The flexibility of the microservice architecture can make the development process of the project easier to manage, thus greatly improving the development efficiency of the project development team [11]. The independence of microservices and the design concept of exception division can make developers pay more attention to the internal structure of components, so as to improve the quality of software code. At the same time, the reuse of services enables developers to dissect from the previous reuse of code, objects and modules. The advantage of service reuse is that developers do not need to care about the internal structure of components in the project, so as to improve the quality of software code [12]. This will greatly reduce the time and labor costs of enterprises or project teams in building follow-up functions, so that the entire industry has more time to develop more new micro services on the basis of existing micro services, which can not only effectively improve the development efficiency and quality, open the developed micro services to the outside world, but also reap certain economic benefits in the process of opening up.

With the increase of microservice developers, more and more developers are willing to open their own microservices to users of the whole network, and even some developers have specialized in developing microservices. In recent years, more and more industries have merged with the Internet industry, and entrepreneurial projects have sprung up. The process of information service platform development and outsourcing software development of entrepreneurial projects is usually very different. Many software projects in start-ups are experimental, which leads to more frequent changes in their needs, and the traditional unified integrated service development framework is difficult to adapt. If the entrepreneurial team cannot grasp the pace of demand changes and the production environment, it is easy to lead to the lack of service integrity. The emergence of micro service architecture enables the software development of start-up projects to follow the order of micro service development from center to periphery, from important to secondary, so as to reduce the impact on the integrity of the project caused by temporary changes in demand, so as to accelerate the formation of the project.

3. Geographic Information System

3.1. Current situation and problems of geographic information system

At present, in the development process of traffic information system, the software of each subsystem is mostly a stack of independent systems. Because at the beginning of software development, each system is developed independently, which brings problems of poor scalability, insufficient coordination and high maintenance cost after it is put into operation. For geographic information services, with the increasing volume of resources and complexity, the requirements for the sustainability, diversification, stability and efficiency of basic services such as retrieval services, data analysis services and data visualization services are becoming higher and higher, and some new service needs are also emerging. Compared with SOA architecture, the lightweight and independent design characteristics of microservice architecture are more suitable for the current requirements of geographic information services. However, in the reconstruction of geographic information services using microservice

architecture, there are still difficulties in how to use the unified apigateway to realize the service architecture. In order to solve the problems of data sharing and function dependence between modules, the solution of integrating the interrelated system modules into a software is adopted in the architecture design. Due to its single technology stack, it is difficult to carry out low-cost decoupling through reasonable design, which brings the problems of high development cost and difficult reuse of existing systems.

With the expansion of software system scale, its internal coupling relationship increases, maintenance and management are difficult, and the fundamental scalability problem has not been solved. The service apigateway is the unified entrance of the whole microservice system, which needs to efficiently support the basic functions such as proxy and load balancing of all back-end microservices. As the business scale and team scale develop to a certain stage, the amount of code continues to increase, and there are more and more external dependencies. The coupling between multiple modules is also increasing, and the code structure is chaotic, which makes team members unable to understand the overall code logic, which further increases the complexity of the code. At the same time, in team cooperation, due to the difficulty in understanding the modules in charge of others, the code reuse rate is low, and may cause the problem of external dependent version conflict. In the microservice architecture, the registration, permission control and other interfaces of microservices need to deal with flexible microservice adjustments, and a set of apigateway interfaces that meet the design specifications need to be provided to facilitate the microservice organization. How to highlight the business of complex traffic information system at the software architecture level and reduce additional system development costs has increasingly become the focus of traffic information practitioners.

3.2. GIS based on microservice architecture

Geographic information service platform should have the requirements of simple development, simple expansion, simple operation and maintenance, and simple deployment. At the same time, as a multi-user oriented service platform, geographic information service should have the requirements of high performance and high availability. In view of the problems that cannot be solved by the single structure application in the application process of the current development and maintenance of the integrated business management system, the core architecture is designed. Logically, the traffic information system is divided into three modules: information collection, information processing and information release. In the actual micro service architecture, the division of micro service functions is also different for different types of information. In order to have high performance and availability, application services are usually deployed in multiple instances. Therefore, the web interface layer also has load balancing capability, and can be routed to different service instances according to the service name. The functional structure of the system is shown in Figure 2.

For some fields where information is published vertically, the information may be published directly without processing, and the micro services related to information publishing directly access the information collection micro services of related businesses. The application service layer realizes the business functions of the system. This layer splits and encapsulates business services based on the principle of micro service splitting. In the geographic information service platform, application services are divided into data services, technical services, thematic services and other services. In the framework of microservices, modules with different functions are divided into different microservices, and microservices with similar functions can be classified into a kind of microservice group. When the interface is defined, microservices can call each other. The registry is responsible for maintaining all micro service instances, and other service instances report their basic information to the registry as clients.

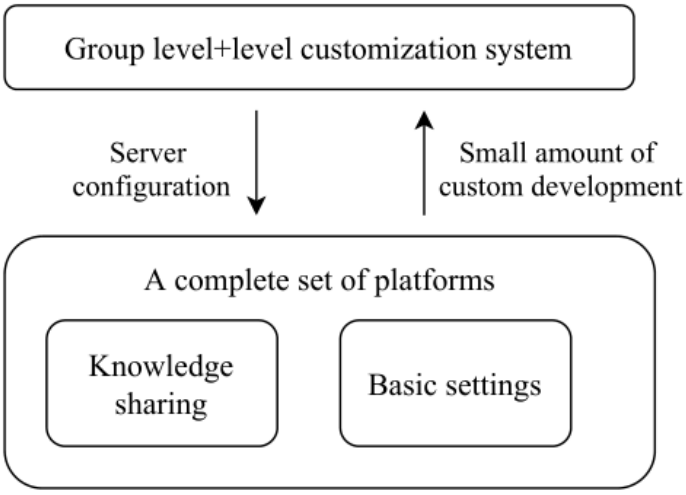

Fig. 2 System function structure diagram

For the traffic information system, the ultimate goal is to provide traffic information services for road traffic participants. There are many ways to obtain relevant information, such as desktop client, mobile client, browser. For these different user terminals, their data display forms are different, but these different data display forms correspond to the same information or a limited combination of several kinds of information. The configuration center is responsible for simplifying the configuration during operation and maintenance. In the microservice architecture, each microservice is responsible for maintaining its own configuration information. If the system has different environments such as development, testing, production, etc., the whole system has a large amount of distributed configuration information to maintain.

4. Conclusion

Aiming at the problems of high complexity, low delivery efficiency, poor scalability, poor reliability and high maintenance difficulty in the application of single structure at present, a traffic information system architecture based on microservice is proposed. Microservices have high cohesion and autonomy. It also has the advantages of componentization, independent deployment, reducing complexity, technological diversification, and reducing maintenance risks. It is especially suitable for the construction of complex business systems at the group and institute levels with both similarities and differences. This paper designs a geographic information service architecture based on microservices, which can effectively realize the proxy service response to client requests, and the service performance is almost zero loss. At the same time, the load balancing algorithm can effectively realize the server-side load when high concurrent requests, and double the service capacity of the architecture. The geographic information service platform system designed and implemented with the idea of micro service architecture has changed the design and development mode of geographic information system under the single architecture. In the face of diversified traffic information data, how to use microservices to undertake and persist data, use discrete microservices to process different types of data, and use special microservices to publish different types of information are the problems we have to face.

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