Research on the Application of Microservice Architecture in Administrative Law Enforcement Supervision System

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Abstract. Traditional WEB system costs a lot of resources but takes less effect. Thus, this problem should be solved. In this paper, we take administrative law enforcement supervision system as an example to show why microservice architecture is a good solution to the above problem. And evaluation proved that microservice architecture is more effective.

1. Introduction
With the continuous advancement of computer network technology and the continuous advancement of the government information management process, information management systems have become an important approach for government management. Presently, the construction industry in Xi’an is developing rapidly. Large-scale construction projects are being put into construction. However, the working mode of the administrative law enforcement department is still based on paper document, which directly leads to the inaccurate information communication between law enforcement departments and the inconvenient storage of construction project information[1].

Traditional administrative law enforcement supervision system used the WEB single architecture design which consumes a lot of human resources, but with minimal effects. Because single architecture design will result in poor system flexibility, system scalability and difficult for system maintenance[2]. But microservice architecture gives a solution for above problems. Microservice Architecture is a new software architecture with good generality, loose coupling and single responsibility[3]. Each microservice is independent and can be deployed independently. They can be called by lightweight APIs to ensure high system availability. The core idea of the microservice architecture is to divide the individual application functions in the system into a series of tiny services in the application system design and development phase. Each service focuses on the single function of the system and realizes decoupling[4].

2. Feature of Microservice
With the rapid development of software technology, the functions, requirements, technical scale and other aspects of software products are becoming larger and larger, resulting in greater coupling between modules within the products. In order to reduce the coupling of software products, microservice software architecture emerged and was widely used. Microservice is a new emerging software design architecture, which was first proposed by Martin Fowler and James Lewis in 2014. It adopts the service approach to design and build an application system. Services in the system can be deployed independently, and they can be deployed on different servers or in different processes on the same server. At the same time they use lightweight communication protocol for message...
communication. "Micro" means small size, and "service" is a relatively small and independent functional unit, which is the smallest set of functions that users can perceive. The micro-service architecture solves the disadvantages of coupling successfully by subdividing a large software product into several scattered small applications. The subdivided applications are simple and orderly, which greatly reduces the coupling of products, reduces the difficulty of development and reduces the expenditure of research and development.

In a complex environment, the microservice architecture is a better solution to the problem of designing, developing, expanding, and integrating enterprise integrated application systems than traditional single-application architectures. The microservice architecture divides the service functions of the system, and degree of coupling between the divided services is low. Each service provides an external access interface, which can interact with other services and cooperate with each other to implement system functions. The design of administrative law enforcement information system based on microservice architecture has the following advantages[5].

1. Platform independence. Inter-service messaging uses platform-independent data formats such as JSON or XML. The implementation of client and service applications is not limited by programming languages.

2. Low service complexity. Each microservice focuses on the functionality of a single module in the system, describing the functionality of the service and the boundaries of the service by defining the service interface. Each service has a single function and low complexity, which improves the system development efficiency and system maintainability.

3. Low degree of service coupling. The services in the system are divided according to the service functions of the system, which reduces the coupling degree between system services. At the same time, according to the division of functions, it is not necessary to divide a specific service for each function, which reduces the number of services and simplifies the work of system service management and service invocation.

4. Service reusability. There is no close relationship between service and system presentation layer in the application system. A service is not designed and developed for a specific function page in the application system. Therefore, a service can be used by multiple functional modules in enterprise integrated system.

3. Design of Microservice Architecture

Based on the microservice architecture, the related functions of the law enforcement monitoring system are designed to solve the problems of system function expansion and post-maintenance, and reduce the coupling degree between system modules. The microservice architecture is used to deeply divide the system hierarchy, mainly the server-side microservice management layer and the client layer. The layers and their detailed functions are divided as follows:

Service layer is responsible for logic processing of specific business requirement. Client layer is responsible for initiating a request to the service and receiving the data result returned by the service layer. At the server layer, the system is divided into granularity, and the system functions are divided into multiple microservices. The services included in this application system are project information service, log information service and file management service. Each microservice needs to have the capability to provide a lightweight API interface externally for the information communication between them. This application system uses Spring Boot and the lightweight REST API released by it to develop and implement these micro services.

Microservice management layer is mainly responsible for managing all service information in the administrative law enforcement monitoring information system and looking for target services requested by users. In addition, the microservice management layer is responsible for managing all services divided by the application system. Each microservice may have a unique database resource, or multiple microservices may share a database resource, and multiple microservices may be deployed on the application server. When the service starts, the microservice saves the IP address and port number service information to the service registry and lets it manage all the information. When the
micro-service client makes a request, Firstly, it obtains the target service information from the service registry through the service gateway, and then the service gateway invokes the target microservice. A common database resource is shared among various microservices of the application system. When the current system starts, each microservice of the application system will save the service information to the service registry.

Client layer firstly needs to obtain the service proxy object of this module, then passes the request to the microservice management layer, and delivers the request data to the target service through the external interface provided by the target service. After the target service processing request is completed, data results will be responded to client layer in reverse order. The microservice architecture of administrative law enforcement monitoring information system is shown in Figure 1.

4. Microservice management technique’s application in system
The architecture of microservice is different from the traditional Web single application architecture in many aspects of application design. The microservice architecture divides the application system into multiple services, each with its own unique IP address and port. When the user clicks the system function button to make a request to the back-end service, the front-end needs to know the information of the target service, which increases the complexity of the front-end program. Based on the analysis of above problem, this section studies the unified invocation technology of microservice to reduce the complexity of the system client program.

4.1. Client calls system microservice
Theoretically, each service in the application system provides an external access interface, which the client can directly request the system service and obtain data results. However, there are many limitations for the client to directly call the microservice based on the service URL information. For example, it is not conducive to the microservice architecture refactoring, the system efficiency is low, and various services on the server need to call each other to complete the client's request.
Based on the above problems and limitations in the process of the client directly accessing the system microservice through the URL, we introduce the specific microservice network technology to solve these problems. Microservice gateway technology provides unified request entry for application system clients. All requests initiated by the client to the application system must pass through the service gateway, which microservice maps the requests to specific microservices. The client does not need to know how the back-end services are partitioned and the details of the services’s partition. Even then, the procedure of system request invocation can be completed successfully\[6\]. The microservice gateway technology simplifies the client application program, reduces the complexity of the client program development, and improves the operating efficiency of the system. The procedure for the client to call service is shown in Figure 2.

![Fig.2 The procedure of client invokes service](image)

![Fig.3 The microservice invocation process](image)

The overall architecture of service gateway includes three parts: service gateway, openservice and microservice. Service gateway, service processing, and specific business microservices all need to save information to the service registry at system start up. When the client makes an administrative law enforcement request to the server, these administrative law enforcement request information first arrives at the microservice gateway, and then the gateway forwards the request and the microservice handles it uniformly. Finally, the administrative enforcement service is responsible for returning the data results to the service gateway, which returns the results to the client. The specific working process is shown in Figure 3.

The administrative law enforcement system based on the microservice architecture realizes the unified invocation of the microservice by the client, which mainly solves the problems caused by the direct invocation of the service by the client from the following aspects:

1. The microservice gateway can distinguish the public API outside the service from the API inside the system, which is conducive to the addition and change of various microservices in the administrative law enforcement system. The microservice architecture can be continuously expanded with the increase of system business requirements, and the upgrade of administrative law enforcement system can also be realized through micro-service reorganization.

2. The microservice gateway provides a unified entrance to receive the request sent by the client, and then distributes the request to the target micro server, which reduces the number of requests forwarded by the client and improves the operation efficiency of the administrative law enforcement and supervision system.
3. The communication between the internal services of the administrative law enforcement supervision system needs to use different protocols according to the specific business needs, and the API provided to the client is usually based on HTTP or REST. Microservice gateway can provide a unified rest-based API to clients across these different protocols.

4.2. Microservice management technique
Microservice gateway technology solves the problem of unified invocation technology of client. All requests initiated by the client go through the microservice gateway, which forwards the request to the target service. Meanwhile, in the process of service forwarding the request, the service gateway will obtain the target service information from the service registry, and then request the specific interface through the instance of reverse proxy for service information. This series of operations completes the entire request process[7]. Based on the process of service registration and service acquisition, this section develops a study of service management technology.

Research on service registration and discovery based on zookeeper distributed service coordination middleware[8]. The zookeeper service registry is responsible for managing the services in the application system, monitoring the current state of each service, and acquiring information about each service timely. Zookeeper has a data model of the ZNode node inside, which is used to store service information published by the system, and its structure is similar to the directory structure of the file system, and ZNode is the specific content of zookeeper. When a system service is started, zookeeper encapsulates the service information into a ZNode data model and stores it in the zookeeper service registry. There are four types of ZNode, namely persistent node, persistent sequential node, temporary node and temporary sequential node. When the client is disconnected from zookeeper, the persistent node still exists, but the temporary node will be deleted. Persistent order nodes are sorted on the basis of persistent nodes and temporary order nodes are sorted on the basis of temporary nodes[9].

Application system is based on ZNode data model to store configured service information. The process of realizing service registration function mainly as follows: Firstly, you need to create a root node, which needs to be designed as persistent because there are other children under the root node[10]. Next, you need to add specific service nodes under the root node, each named after the service name. Since there may be multiple deployments of services in the system, and service node names are not allowed to be repeated, child nodes need to be created under specific service nodes, which are also persistent nodes. Finally, the third-level child node stores the information of the specific service, namely the service IP address, port and its service description information. Based on zookeeper distributed service coordination middleware and ZNode data model, the service registry data structure model is implemented as shown in Figure 4.

![Fig.4 Data structure model of service registry](image)

5. System Evaluation of Microservice
Microservice performance test is to measure the response time of the application system interface, which is designed to verify the real-time performance of the system. When the application system processes the business request initiated by the client, only in a relatively short time to complete the
corresponding function can give users a better experience. The system interface performance is evaluated by calculating the time when the application system receives the users’ request and the time when the users’ request is processed. The test based on microservice in this section is mainly carried out from the following aspects:

Test of patrol log interface. Testing the performance of the patrol log interface based on the microservice framework. Patrol log interface is used to obtain a specific log record of a construction project, and its response time data is shown in Figure 5.

![Fig.5 Test of patrol interface](image1)

![Fig.6 Test of downloading image interface](image2)

Test of downloading project image. The image download interface is used to obtain the image file information related to the construction project. When users request access to the application system to download pictures, the application system can complete the processing of user requests within 200ms, and the interface to download images can meet the performance requirements of the system. This can also directly indicate that the microservice architecture plays a significant role in the application system and contributes a lot to the efficiency of the system. The specific performance data of the downloading image interface are shown in the Figure 6.

6. Summary
This paper takes the administrative law enforcement and supervision system under the microservice framework as the research object, analyzes the problems existing in the development of the administrative law enforcement and supervision system based on the traditional WEB single framework, and gives reasonable solutions to these problems. In order to realize the low coupling, extensibility and maintainability of administrative law enforcement and supervision system, this paper makes an in-depth study of the overall architecture of the system, proposes a solution of the administrative law enforcement and supervision system based on the microservice. This paper mainly studies the basic idea and specific application of the microservice architecture, and fully combines the microservice architecture with the system application to better apply the microservice in the system application. And this paper describes the microservice architecture design in detail in the system application process and efficiency.

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