Analysis and Research on data transmission efficiency of distributed measurement and control system

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Abstract. The data of the measurement and control system of each coal mine group are independent. In order to manage the monitoring data of each coal mine, the Coal Industry Group needs to select a suitable data transmission mode to transmit the data of each colliery to the information centre of the group. To meet this requirement, it needs to compare different data transmission modes and choose a stable and efficient data transmission mode. At first, this paper compared the relative merits of different data transmission methods, and then chose three of them to perform experiments. They are File Transfer Protocol, Web Services and database sharing, compare their data transmission efficiency, and finally, select the most appropriate transmission method and apply it to the actual project.

Key words: data transmission; File Transfer Protocol; Web Service; database sharing; transfer efficiency

1. Introduction

With the development of information technology, in order to achieve information resources sharing and business collaboration as the main content of the coal mine system, data transmission and sharing system construction has been imminent. A global information society is gradually taking shape to promote the timeliness, automation and flow of coal mine system. Sharing of coal mine data has become an important indicator of building a safe coal group[1].

Coal industry group has many coal mines. Each mine has its own set of hydrological observation system, stores various important data of the coal mine from the installation. However, the information between various coal mines is scattered, closed, there is no unified management. Coal mines can only check their own hydrological monitoring data. Now the leader of the group requests to collect all the data of coal mines, set up a server data canter, send hydrological monitoring data of each mine to the server in a suitable way store them in the database of the server, and realize the management of all mines.

According to the requirements of the group, it is necessary to select a suitable way to realize the data exchange between a mine and group’s server. Therefore, the security, stability and efficiency of data transmission must be considered when considering how to realize data sharing. This paper compares the transmission time of different transmission modes, and finally selects the most appropriate method to apply to the actual project. Solve the problem that different coal mines can’t share their data.
2. Different ways of data transmission

Nowadays, more and more application systems begin to carry out distributed design and deployment. Originally need to complete the business in one system, now they need to get data through the interaction between multiple systems, which requires different systems to be able to transmit data.

There are three elements of data transmission between application systems: transmission mode, transport protocol and data format. And generally transmission modes are followings.

2.1. XML and WebServices

Web Services Using standard network protocol and XML Data format for conversation, the problem of interoperability of data on different middleware platforms is solved perfectly [2]. It makes services on Web no longer be isolated, but can be invoked and linked to each other, providing a convenient and a fast way for enterprise information integration.

Web Service is an object deployed on the Web. It is based on XML and open Web specification, which is a distributed computing technology and can create an interactive distributed application platform. The XML syntax rules are simple and strict, and the mark is not predefined, users can customize them [3]. The Web Services protocol uses SOAP protocol (Simple Object Access Protocol), the Soap is built on HTTP to send XML. SOAP is a simple protocol based on XML, use applications to exchange information through HTTP.

Advantages: It has high scalability, XML can achieve cross-platform, cross-system data sharing and exchange, stored data in text, so it is easy to read and record, debug, compatible with different application platforms and operating systems, sharing and exchange data between multiple systems.

Disadvantage: Using Web service interface, its essence is to use interface to solve the business collaboration problem, and it is suitable for small amount of real-time interactive application scenarios and high real-time requirement of data transmission.

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\text{SOAP protocol} = \text{HTTP protocol} + \text{XML data format}
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2.2. File sharing server mode

Transmit data by uploading files need to specify the data format that stored in the file, and the protocol used to realize transmission. There are several network communication protocols in the application layer, such as http, FTP, SFTP, SCP.

2.2.1. FTP (File Transfer Protocol). It is the oldest network protocol and the main way to transfer files on Internet. It is a file transfer protocol located in the application layer of the TCP/IP reference model. Its main function is to upload files to the FTP server or download files from the FTP server [4]. Because it is based on the TCP transport protocol, so it is also a highly reliable transport protocol. When FTP protocol is used for transmission, IIS server should be deployed on the server side, path folder should be established, IP address, username and password of the server should be set. All clients access the server by providing IP address, username and password. When they connect to the remote server, they login to the server with the username and password provided by the other party. And store the data files in the specified directory as required.

Advantages: high reliability and stable transmission. When FTP transfers large files, the transmission efficiency is obviously faster than other transmission modes. For large amounts of data, such as data files or detailed directory lists, the FTP system establishes a separate data connection to transmit the relevant data [5]. Using FTP protocol to upload large files is fast than HTTP; the larger the file is, the faster than HTTP.

Disadvantage: It provides only a few basic services for file transfer, and FTP creates a new connection every time it needs to be uploaded. Creating new connections that need to be repeated is not only inexperienced, but also wastes a lot of time shaking hands when connecting.

2.2.2. SFTP. It is a secure transport protocol that encrypts the transmitted data.

Advantages: encrypted transmission is highly secure.
Disadvantages: this security is at the expense of transmission efficiency, and its transmission efficiency is much lower than that of FTP.

2.2.3. SCP. It is a protocol for remote file replication, and the entire replication process is encrypted. It is a direct copy of files between hosts and hosts.
   Advantages: encrypted transmission is highly secure.
   Disadvantage: The transmission efficiency is low, and the client must specify which directory to the server to transmit.

2.2.4. HTTP protocol. It works on client-server architecture, it is a transport protocol for transferring hypertext from the world wide web server to local browsers, HTTP is an application layer protocol consisting of two messages, request and response[6]. Browser sends all requests to HTTP server through URL as HTTP client. The Web server sends response information to the client after receiving the request.
   Advantages: the client establishes a connection and uses it to carry any amount of data transmission.
   Disadvantages: inefficient transmission of data.

2.3. The way to share database
Two systems in the LAN exchange data from their database by establishing connections. When system A requests data from system B, system B selects a data and processes it, system A insert this data.
   Advantages: Compared with file transfer, the database has its own efficient operations, such as updates, rollbacks, and so on. Such interaction is more flexible, and through the transaction mechanism of the database, can make a reliable data exchange.
   Disadvantages: The current remote sharing mechanism of database information can achieve remote sharing of data to a certain extent, and provide poor real-time sharing of information, and only in the process of users using data to provide personalized services, ignoring personalized services[7]. When a system has more and more database connections, the database connection pool is limited, resulting in fewer connections allocated to each system, as more and more systems, may lead to unavailable database connections. The way of database sharing requires that the database connection between all systems is open, and it requires high stability of the network.

3. Verification of transmission efficiency for three methods
According to the comparison of transmission modes, three methods are finally selected for experimental verification. The first is web services, the second is FTP, and the third is database sharing. By comparing the time taken by these three methods to transmit the same amount of data from the database, we can find out the best comprehensive transmission mode.
   The experimental process is as follows: three different transmission methods are coded separately, after completion, take a certain coal mine under a certain year of data (a total of 21,996 data), using two computers for transmission and reception. In the same hardware environment and transmission bandwidth, the time used to transmit data is compared. The upload time of FTP is as follows.
Figure 1. FTP transmission time.

Then data transmission is carried out by means of Web services and database sharing, and finally five groups of experimental data are obtained.

Table 1. Three Scheme comparing.

| Scheme           | First /ms | Second /ms | Third /ms | Fourth /ms | Fifth /ms |
|------------------|-----------|------------|-----------|------------|-----------|
| FTP              | 23185     | 23326      | 23046     | 23046      | 23388     |
| webservices      | 61885     | 42333      | 42577     | 42577      | 40387     |
| Database sharing | 22277     | 21200      | 24717     | 21404      | 21778     |

According to these five groups of experimental data, the way of sharing data in database and uploading FTP files takes the same time, and the way of Web services takes the longest time.

Figure 2. Transmission time for three methods.

4. Conclusion

Based on the application scenario of the group networking project, the hydrological monitoring data are transmitted to the server through the mines’ software. Their upload times are frequent, but the amount of data uploaded each time is relatively small.

Coal mines’ data transmission is in the group’s LAN implementation, so it has relatively high security, the existence of others to crack accounts and passwords, the possibility of intercepting data is not high. So ultimately FTP or web services can be used to transmit data, but because the way of database sharing requires high network stability, and the transmission needs to obtain both sides’ database user name and password, in practical applications, it is difficult to transmit data stably.
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