The Application of Wireless Network in the Process of Remote Data Collection

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Abstract. The use of wireless network for remote data collection can provide a fast and reliable wireless data transmission channel for those monitoring points involving a wide area and scattered equipment layout with the help of its large coverage and high communication quality. This article analyzes the characteristics and advantages of wireless networks, and then discusses the networking scheme for remote data collection using wireless networks, and analyzes the reliability of network transmission. Finally, some program fragments on the server side are given.

Keywords: Wireless Network, Wireless Network Module, Remote Data Collection, Data Collection Server

1. Introduction
With the continuous development of wireless wireless networks and the substantial increase in the demand for wireless network applications in various industries, applications based on wireless networks have gradually become the mainstream of current wireless communication applications [1-2]. The characteristics of wireless networks, reasonable networking methods, and reliable transmission mechanisms [3-4] make wireless network communication technology quickly become the mainstream of remote data collection systems at home and abroad to solve the problems of wide-area monitoring points and scattered equipment layouts. Technology [5-6]. The wireless network provides a wide-area wireless IP connection, and a remote data acquisition and analysis system is built on the wireless network business platform [7-8], which can transmit the data to the manufacturer's data analysis center in real time [9], so that the on-site monitoring Real-time information is combined with fault diagnosis algorithms, empirical knowledge, etc. [10].

This article uses the existing wireless network to transmit. The wireless network provides a simple and efficient means of communication and transmission for the system. The lower computer is connected to the wireless network terminal NW18 through the RS232 serial port, and the collected data is encapsulated and sent to the wireless network through the protocol, and then transmitted to the data analysis center of the manufacturer through the network. After the host computer receives the remote data, it analyzes the data and establishes a remote data acquisition and analysis system that combines on-site monitoring information with remote fault diagnosis algorithms and experience knowledge.
2. **Wireless network technology**

The wireless network (General Packet Radio Service, general packet radio service) is a logical entity formed by superimposing a new network on the basis of the existing GSM system. The main characteristics of wireless network suitable for remote data collection can be summarized as follows: ①Always online, fast access speed. Users can stay connected to the wireless network at any time, and the packet switching access time is shortened to less than 1 second, which can greatly improve the efficiency of remote data collection; ②The data flow accounting method is adopted. Wireless network is a cost-effective packet data technology. Users only need to pay according to the data traffic when transmitting data, instead of paying for the entire link occupancy period as in circuit switching. This can greatly reduce the user's use cost; ③Support IP protocol. Due to the wide coverage of the wireless wireless network, the bottom layer supports the TCP/IP protocol, so that the wireless network can be seamlessly connected to the Internet. At present, wireless data transmission mainly adopts wireless data transmission radio, short message, GSM, wireless network and other methods. The author compares the performance of these several wireless data transmission methods from all sides in the form of a chart (as shown in Table 1).

**Table 1. Comparison of wireless network and other wireless data transmission methods**

| Wireless digital radio | GSM circuit data |
|------------------------|------------------|
| **Simplex or half-duplex** | Full duplex | Full duplex | Full duplex |
| 1.23kbps | 2.6s/piece | 9.6kbps | Maximum 171.2kbps |
| **difference** | Poor | High | High |
| **Smaller** | Large fluctuation range | Build long, then small | small |
| **Very bad** | Very high | Very high | Very high |
| **Within 2km** | Roaming nationwide low | Roaming nationwide Very high | Roaming nationwide low |
| **Almost zero** | | | |

From the above comparison, it can be seen that the wireless network has the characteristics of high reliability, strong stability, wide signal coverage, and low cost. It is very suitable for applications involving a wide area and scattered equipment layout.

3. **The realization principle of wireless network remote data collection**

Figure 1 uses a single data acquisition module as an example to describe the communication process of data collected by the data acquisition module, transmitted through the wireless network and the Internet, and finally reached the data acquisition server.
The specific communication steps are as follows: ① The data acquisition module collects the required data and transmits it to the wireless network module; ② The wireless network module is responsible for the TCP/IP protocol conversion of the data, and then sends it to the wireless network wireless base station in the form of wireless network data packets; ③ Data is sent to the wireless network service support node (SGSN) by the wireless base station of the wireless network; ④ SGSN communicates with the wireless network gateway support node (GGSN), and the GGSN sends the data to the Internet after corresponding processing; ⑤ Uses a firewall to collect data on the Internet Isolation between servers to ensure data security. ⑥ The data collection server connects to the Internet and receives the returned data.

4. Several networking schemes in practical applications
In the process of networking, you will encounter such a problem: if the IP addresses of both the wireless network module and the data acquisition server are dynamic, the module side and the server side will not be able to establish a connection. Because, at least one of the wireless network module and the data collection server must be able to determine the IP address of the other in advance. In practical applications, you can use public network static IP, dynamic domain name resolution, SMS communication, APN dedicated line access and other networking solutions. According to different user needs and application environments, you can choose a suitable solution for networking and planning.

4.1. Public network static IP solution
Since the IP obtained by the same module each time it goes online may be different, in general, the data collection server cannot actively locate the wireless network module.

A good solution is to use a static IP on the data acquisition server, and write this static IP into the module in advance. In this way, the module can contact it through the IP of the data acquisition server written in advance after power-on, and inform the data acquisition server of the temporary IP address obtained to realize the connection between the two. With this scheme, in order to enable the wireless network module to be located according to the IP of the data collection server every time it goes online, the latter must have a fixed static IP, and write the static IP of the server to the initialization of the wireless network module in advance Setting up.

It should be noted that although the static IP of the public network on the server side has higher reliability and stability, the application and use of the static IP requires a considerable amount of expenses, which will greatly increase the cost of system development.
4.2. Dynamic domain name resolution scheme
Due to restrictions on the use of static IP in public networks and installation conditions, the server often uses dynamic IP to access the Internet (such as ADSL dial-up). Therefore, in practical applications, the networking mode of dynamic IP combined with DNS domain name resolution is more common. In this way, the IP on the server side may be different each time it goes online, but an association can be established between the two through DNS dynamic domain name resolution.

To adopt the dynamic domain name resolution scheme, you need to contact the DNS service provider first, apply for a domain name for the data collection server, and write this domain name into the wireless network module. After the data collection server is connected to the Internet, it connects with the DNS server and reports the currently obtained dynamic IP to the DNS server. After the wireless network module is powered on, it first uses domain name addressing to connect to the DNS server, and then the DNS server finds the dynamic IP of the server's public network, so that communication can be established between the two.

This method can reduce the cost of applying for and using the static IP of the public network, but its stability is restricted by the stability of the DNS server, so the reliability of the selected DNS server must be ensured.

4.3. SMS communication scheme
It is also a feasible solution to establish a connection between modules by sending short messages to each other. Taking two modules A and B as an example, both parties first connect to the wireless network and obtain their own dynamic IP addresses. If module A needs to communicate with module B, module A first sends a short message to module B to inform module B of its own IP address. After module B receives the short message signal, it performs the same operation and sends a short message back to module A to inform module A of its own IP address. After both parties have received the IP address of the other party, they can establish a two-point connection through the network for data transmission.

This kind of scheme has high feasibility, but the sending and receiving of short message is susceptible to interference, causing problems such as sending and receiving failure or delay.

4.4. APN dedicated line access plan
The APN dedicated line access program does not need to go through the Internet network, but from the data acquisition server through a 2M APN (Access Point Name?) dedicated line to directly access the wireless network of the mobile company. Private fixed IP addresses are used for wide-area connection between the interconnection routers of the two parties. GRE tunnels are used between the GGSN and the mobile company interconnection routers and a dedicated APN is assigned to customers. Ordinary users are not allowed to apply for this APN. The SIM card used for the wireless network private network only activates the dedicated APN, and restricts the use of other APNs. After obtaining the APN, assign mobile internal fixed IP to all monitoring points and centers. End-to-end encryption is used between the module and the server to avoid possible leakage of information during the entire transmission process. Both parties use firewalls for isolation, and perform IP address and port filtering on the firewall.

It can be seen that this solution is very high in real-time, security or stability, and is usually suitable for application environments with high security requirements, many monitoring points, and high real-time requirements.

5. Mechanisms to ensure the reliability of network transmission
In practical applications, mechanisms such as heartbeat and offline referencing are needed to solve various problems that may cause transmission failure and ensure the reliability of network transmission.

5.1. Heartbeat
Although the wireless network has the characteristic of being online all the time, when the wireless network is online for too long without transmitting data, the priority of the data service will be automatically lowered, and the phenomenon of disconnection will often occur. This problem can be solved by setting the heartbeat.

The heartbeat mechanism is a means of testing the path between the server and the wireless network module. Enable the heartbeat setting. After the module is online, it will send data packets at a certain time interval during operation. After either party receives the other party's heartbeat, it will return as it is. In this way, the priority of the module itself will not be lowered, and it will remain online for a long time. If the heartbeat is not received after the time has elapsed, restart the module to access the wireless network module.

5.2. Reference for disconnection

Due to the data collection server itself, there may be server failures or shutdowns. In this case, the heartbeat cannot be received, but the reason is not that the module itself is offline. This problem can be solved by setting the disconnect reference.

The disconnection reference is to provide the terminal with a means to test whether a wireless disconnection occurs. Using the disconnected reference mechanism, the gateway or router inside the wireless wireless network can be selected as the wireless reference point, and the PING operation in the ICMP protocol is used during testing. Enable the offline reference setting. After the module goes online, it will automatically PING the reference point according to the set cycle, and determine whether to perform the offline reset process through the test results.

5.3. Using two mechanisms at the same time

In actual application, the author uses two mechanisms of heartbeat and disconnection referencing at the same time. In this way, it can avoid the occurrence of wireless disconnection, and it can also prevent the module from mistakenly thinking that it is wireless disconnection after the data acquisition server fails or shuts down, and performs unnecessary reset processing.

Specifically, after the module goes online, whether there is a response to the heartbeat sent by the module to determine whether the wireless path is normal. If it exceeds the time and does not receive a heartbeat response, PING the reference point set in advance. If the PING cannot be connected, it indicates that there is a problem between the wireless network module and the reference point. It is likely that the module is wirelessly disconnected. If you can ping but still cannot receive the heartbeat, it means that there is no problem with the network itself, and it may be that the server itself is faulty. The use of the two mechanisms at the same time facilitates the handling of various situations that may occur in network transmission, and is an ideal way to ensure the reliability of network transmission.

6. Part of the program fragments of server-side data collection

The data collection on the server side can establish a virtual communication logical channel through Socket, which can be realized by UDP or TCP. The following shows some program fragments of UDP (datagram socket) mode.

In the port monitoring part, the server first initializes the Socket object, then creates a socket through the Create function in the CAsyncSocket class and sets the port to be monitored (PortNo indicates the port to be monitored, SOCK_DGRAM indicates the UDP method), and finally receives by listening to the port Information sent back by the wireless network module or control information sent to the module. The program fragment is as follows:

```c
M_pUDPServerSocket->Create(PortNumber,SOCK_DGRAM,FD_READ|FD_WRITE|
FD_OOB|FD_ACCEPT|FD_CONNECT|FD_CLOSE,NULL);
```

In the data receiving part, the server receives the information sent from the corresponding IP and port of the wireless network module through the ReceiveFrom function in the CAsyncSocket class, and at the same time obtains the IP address and port of the module. At this time, you can use this information to send data to the wireless network module. The program fragment is as follows:
Receive From(content,1024,remote IP Address,remote-Port);
The data transmission part uses the IP address and port number obtained when receiving wireless network information, and realizes data transmission through the SendTo function in the CASynSocket class. In this way, data intercommunication between the wireless network module and the server can be realized. The program fragment is as follows:
SendTo(buffer,len,m_remote Port,m_remote IP Address);

7. Conclusion
Wireless network technology provides an effective solution for remote data collection of this fault diagnosis system, and has the advantages of timely transmission and reliable operation. The system has strong scalability and can flexibly expand its functions in practical applications to adapt to requirements. The remote data transmission system based on wireless network technology has a wide range of applications. Almost all low-to-medium-rate data transmission services can be applied, such as urban power distribution network automation, remote water meter reading, gas pipeline automation, commercial POS machines, Internet access, personal information, stock information, finance, transportation, public security and other application platforms constructed using the ideas of this article have been tested and passed in the dual power supply monitoring system of Jinan Railway Bureau and are running well.

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