An analysis of environmental data transmission

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Abstract. To comprehensively construct environmental automatic monitoring has become the urgent need of environmental management, is a major measure to implement the scientific outlook on development and build a harmonious socialist society, and is an inevitable choice of "building a resource-conserving and environment-friendly society", which is of great importance and profound significance to adjust the economic structure and transform growth pattern. This article first introduces the importance of environmental data transmission, then expounds the characteristics, key technologies, transmitting mode, and design ideas of environmental data transmission process, and finally, summarizes the full text.

1. Introduction

Since the reform and opening-up is for thirty years, with the rapid growth and advance of China's economic, industrialization and urbanization, "made in China" has gone globalization. At the same time, various pollution, such as the construction noise, radioactive source, chemical residues, automobile emissions, the amount of waste gas and effluent outside the industry, is also rapidly increasing, which makes the existing problem of environmental pollution become completely prominent, and severely restricts the further development of our economy and society. Our country has researched and explored the environmental monitoring from the mid-1980s, and after 30 years of development, has made great progress. In recent years, as computer and Internet technology develop swift and violent, adopting the most advanced techniques of communication, electronic and software to design a software of environmental data automatic monitoring, and to realize the automation of environmental data transmission, has laid a good foundation from a higher level to manage environment pollution, and solves the problem of networking inconvenience brought by the scene monitoring stations scattered, which is in favor of realizing the diversification of environmental data transmission modes and resource sharing, greatly improves the automation and informational zed level of environmental monitoring, guarantees for the development of environmental protection work, and provides an important and far-reaching significance of making the laws and regulations of environmental protection [1]-[8].

2. The characteristics and key technologies of environmental data transmission process

2.1. The characteristics

Environmental protection in the process of data transmission mainly has three characteristics in the following. Firstly, environmental monitoring has the characteristics of complexity and dynamics, referring to multiple departments, multiple regions and multiple fields, to deal with a large amount of

data. Secondly, because it needs to realize the networking protocol of environmental data transmission in the various provinces and cities, the software of environmental data transmission tends to be customized, or different communication interfaces, or different networking communication protocols. Thirdly, because the environmental data holds the balance in the process of environmental monitoring, it is the certificate of environmental quality with good or bad, and is also the basis of formulating the relevant laws and regulations [9].

Of course, there are still some problems of environmental data transmission software that need to be solved, for example, too much strong software coupling and poor universality; Long software development cycle; Low reliability of environmental data transmission; difficult to share environmental data.

2.2. The key technologies

Transmission network is the network platform of realizing data interaction between the different roles of different systems in the process of data transmission with environmental protection. The environmental protection bureau (EPA) requires the software of environmental monitoring can interact environmental data with monitoring platform through the way of wired or wireless transmission. This paper mainly expounds two types of technologies about wireless transmission networking.

2.2.1. General Packet Radio Service (GPRS) General Packet Radio Service (GPRS) is a kind of wireless Packet switching technology based on Global System for Mobile Communications (GSM). At present, the transmission speed of GPRS mobile communication network can reach up to 115 kb/s. GPRS is a developed technology based on GSM, and is the technology between the second generation of digital communication and the third generation of grouping type mobile business, so often referred to as 2.5 G. Compared with the traditional transmission way of GSM, GPRS has higher resource utilization, higher transmission rate (the highest up to 171.2 kb/s), and shorter access time, and supports IP protocol and x. 25 protocol, etc [10]-[12].

2.2.2. Code Division Multiple Access (CDMA) Code Division Multiple Access (CDMA) is a technology used on wireless communication, and has all the characteristics of spread spectrum communication. CDMA allows all users to simultaneously use the total bands (1.2288 Mhz), and has the characteristics of the strong ability to be anti-interference and resist decay. Its self-interference system regards signals from the other users as disturbance signals, completely not considering the problem of signal collision, to ensure the stability and reliability of the data in the environmental data transmission process. In addition, in the case of using the same frequency resource, the mobile network capacity of CDMA is 4-5 times larger than that of GSM, and 10 times greater than that of the analog network [9] [13].

2.2.3. The sharing technology Data sharing specifically points all kinds of data that derive from the environmental monitoring scene and can be also obtained by the other related environmental monitoring center. For the implementation of the sharing technology about environmental data, we can adopt two different techniques to achieve, i.e., networking with synchronous forward and "one point conveys more" [9]. Then we explain them as follows.

Firstly, networking with synchronous forward refers to the environmental data transmission software adopting the method of "one point conveys" in the scene of the monitoring, namely, environmental data only directly connects to the networking to transmit with the corresponding master monitoring center by the transmitting network between the monitoring spots and the monitoring center, and accepts its environmental data about the query and instructions to be obtained. The other non-master monitoring center needs to accept, retrieve, and query the site environmental data, must be through the transmission network among the monitoring center, and synchronously forwards data realized by the master control center. To the initiatively uploaded environmental data, the monitoring spot sends the environmental data to the master control monitoring center by the transmission network

between the monitoring scene and the monitoring center. After the master monitoring center receives the environmental data, on the one hand, it accesses to the database, on the other hand, through the transmission network among the monitoring center, transmits the environmental data to the other non-master monitoring center. The passively uploaded environmental data, according to the direct transmission network between the master monitoring center and the monitoring spot, sends data obtaining instructions to the monitoring site, after the monitoring scene receives them, it responses the obtaining instructions, and uploads the requested data.

Secondly, the way of "One point conveys more" refers to the software to support the function of "one point conveys more", that is, directly through the transmitting network between the pollution sources in the monitoring site and the monitoring center, sends simultaneously the environmental data to the monitoring centers of multiple EPAs (whether the monitoring center of master control or that of non-master), and accepts the query and the obtaining instructions of its environmental data. For the actively uploading environmental data, transmission software at the same time transmits data to the monitoring center at all levels by the transmission network between the monitoring spot and the monitoring center, and ensures the sent data with consistency and integrity. For the passively uploading environmental data, the equipment operating parameters and the initialization parameter of the monitoring scene, the monitoring centers at all levels can directly send environmental data obtaining and the query instructions to the monitoring site through transmission network. After the software of the monitoring spot receives the obtaining instructions of the environmental data, it responses them, and uploads the request of environmental data.

2.3. The mode of transmission
The networking protocols [14] of environmental transmission are communication agreement between transmission software of environmental data and the environmental monitoring centre, corresponding to the application layer defined 7 layer protocols of ISO/OSI [15] [16]. According to the transmitting networking protocol of the environmental data, the transmitting mode of environmental data can be divided into two types: the mode of active transmission and passive transmission.
Firstly, the mode of active transmission indicates after the environmental data generates, every few seconds or minutes, the environmental monitoring scene automatically sends the environmental data to the environmental monitoring centre through the transmission network.

Secondly, the mode of passive transmission is when the monitoring spot receivers the obtaining instructions of data sent by the environmental monitoring centre, it then responses these obtaining instructions of data, and transmits the specified data frames to the environmental monitoring centre.

In addition, when the spot environmental alarm data and statistics data generate, they need to actively upload to the environmental monitoring centre, meanwhile the monitoring centre also can require the environmental monitoring site to start or stop upload real-time data of environmental monitoring spot, or demand the site to upload the historical data of a certain period of time, mainly according to the content of the transmission communication protocols, thus, it has bigger flexibility.

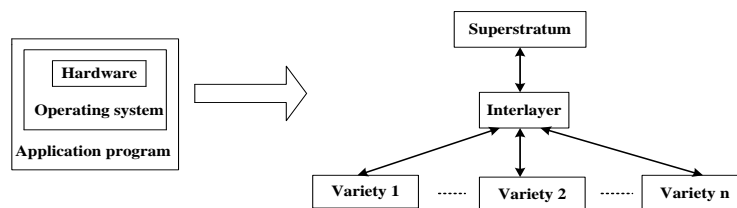## 3. The design ideas of environmental data transmission process
The process of environmental data transmission, from the bottom up step by step, can be divided into three levels: the scene monitoring instrument, the transmission network, environmental monitoring information platform. Industrial personal computer (IPC) through transmission network (such as GPRS, Internet, etc.), according to the communication protocols, uploads the environmental data collected by the underlying analysis instrument to the monitoring center of environmental protection. The network structure of data transmission is as shown in Figure 1 [9].

The design of software framework is a crucial part of the software development, and favorable software architecture is the assurance of succeeding a software development project. Experience shows that the designs of excellent software frameworks have well hierarchical structure, which guides the overall situation of software design. The so-called hierarchical structure
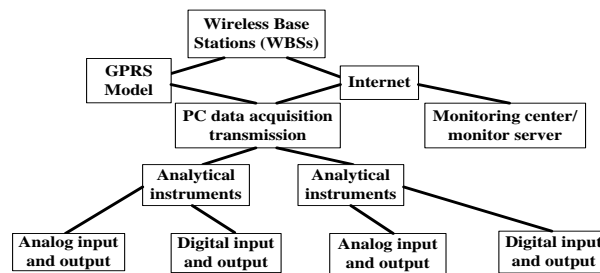
Figure 1. The process of environmental data transmission.

Is a certain structure assembled according to certain level? Hierarchical structure firstly emphasizes the hierarchy, and then stresses the constitutive property among levels. The left of Figure 2 [9] shows the well-informed hierarchical structure. Without doubt, perhaps the actual computer system doesn't conform to the above structure, but it is of universal significance in theory. Firstly, this structure is strictly one-way dependent among the layers from inner to outer, i.e., the application program first depends on the loading links of operating system, and then relies on hardware to execute. In this process, there only exists a kind of dependence, that is, the outer layer relies on the proximate inner layer. Secondly, in this structure, the more the outer layer, and the easier it is for ordinary people to understand. If the hardware details are taken for a kind of concrete and original things, the more the outer layer, the less tangible, and the more independence from the details. In fact, the upper play the role of hidden below details.

Figure 2. The hierarchical structure model from single to diversity.

Hierarchy is necessary in software design, but need further improvement to be applied in the software design of environmental protection data transmission. Because the way of environmental protection data transmission and networking protocols have the characteristics of "diversification", it needs to have a thorough knowledge of the configurability and scalability among the various modules of transmission software.

Hierarchical structure model for dealing with "diversification" is as shown in the right of Figure 2, the middle layer in the graph plays a key role of unified diversity. It interacts with the multifarious modules, adds a sort of diversity, and then will increase a corresponding processing module. At this point, the work of the middle layer is not easy, but the interface between the middle layer and the upper is unique, which greatly reduces the complexity of the upper. In process of environmental protection software transmission designed by software, provide a unified interface, by modifying the configuration file to compose the connections among various modules, in this way it doesn't lead to customized software due to each module of one-way dependence, also reduce the workload for the later software maintenance and the change of each module, and increase flexibility.

4. Conclusion

In a word, it is necessary for us to research and explore environmental data transmission. Not only the reasons are as shown above, but also environment automatic monitoring of transmission system in China is just getting started so far, there is no unified standard and perfect laws and regulations, and it is temporarily difficult to guarantee the reliability and authenticity of environmental data transmission,

which will certainly have great impact on the development of environmental protection work. In the next step we will realize the design idea through the software, and make it applied in the real environment.

References
[1]   Kun Wang, Hui Gao, Xiaoling Xu, Jinfang Jiang, Dong Yue, An Energy-Efficient Reliable Data Transmission Scheme for Complex Environmental Monitoring in Underwater Acoustic Sensor Networks, IEEE Sensors Journal, 16 (2016) 4051-4062.
[2]   Evgeni Volpov, Rima Linder, Application of Local Environmental Data to the Lightning Performance Assessment of the IECo Transmission-Line Network, appeared in IEEE Transactions on Power Delivery, 2017, DOI: 10.1109/TPWRD.2017.2661721.
[3]   S. Deepa, P. Haritha, S. Haridha, M. Harini, V Kamala Kiran, Energy conservative data transmission using Z-Mac technique in wireless sensor network for environmental monitoring, 2016 IEEE Technological Innovations in ICT for Agriculture and Rural Development (TIAR), (2016) 194-199, DOI: 10.1109/TIAR.2016.7801237.
[4]   http://www.zhb.gov.cn, 2006.2.
[5]   Modbus Application Protocol Specification 1.1, www.Modbus. org, 2002.12.6.
[6]   Carlson, Environmental information organization. Database and expert system. applications,
[7]   1991.
[8]   Kefford, Ben J. Effect of saline water disposal: implications for monitoring Programs and management, Environmental Monitoring and Assessment, 63(2002) 313-327.
[9]   http://news.bjx.com.cn/html/20160408/723360.shtml.
[10]   Dongxu Fu, Study on the key technologies of environmental data transmission, Hangzhou University of electronic science and technology, (2012) 6-13 (In Chinese).
[11]   Novato Wireless Inc., GPRS technology overview, Novato Wireless Inc., Nov.2002
[12]   Kalden R., Meiriek1., Meyer M., Wireless Internet Access Based on GPRS, IEEE personal Communications, Apr, 2000.
[13]   Hou Yaling, The Design of Monitoring System Based on GPRS, 2016 International Conference on Robots & Intelligent System (ICRIS), (2016) 432-435, DOI: 10.1109/ICRIS.2016.91.
[14]   Khaled E. Ahmed, Mohamed R. Rizk, Mohammed M. Farag, Overloaded CDMA interconnect for Network-on-Chip (OCNoC), 2016 International Conference on ReConFigurable Computing and FPGAs (ReConFig), (2016) 1-7, DOI: 10.1109/ReConFig.2016.7857179.
[15]   Lin Jin-Yong, Dong Wen-Jie, Zhang Shuo, Luo Dan-Yan, Investigation of Network Communication Protocol on Autonomous Aerocraft Flying Formation, 2015 Fifth International Conference on Instrumentation and Measurement, Computer, Communication and Control (IMCCC), (2015) 171-175, DOI: 10.1109/IMCCC.2015.43.
[16]   S. Kwong, K. T. Ng, W. N. Chau, Design and implementation of remote procedure call based on ISO/OSI reference model, TENCON '93. Proceedings. Computer, Communication, Control and Power Engineering.1993 IEEE Region 10 Conference on, 1 (1993) 544-548, DOI: 10.1109/TENCON.1993.320047.
[17]   Miroslaw Bedzak, Usering. Education self-tuning-recommendations in the 8th level of ISO/OSI model, 2008 International Multiconference on Computer Science and Information Technology, (2008) 79-82, DOI: 10.1109/IMCSIT.2008.4747221.