Research and Implementation of Computer Laboratory Network Management Tool Based on Telnet Protocol

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Abstract. Telnet protocol is a powerful tool to help computer network management. In the era of big data, the combination of computer laboratory, computer teaching and Telnet protocol is a positive trend. This study discusses the basic principles and characteristics of Telnet protocol, the necessity and implementation of computer laboratory network management tools based on Telnet protocol, which provides a boost for the continued development of this trend.

Keywords: Telnet Protocol, Computer Laboratory, Network Management

1. Overview of telnet protocol

1.1. The basic principles of telnet protocol

Telnet protocol uses port 23 as the transmission port to establish a communication line between the user computer and the remote host computer to connect the terminal equipment with the remote host computer through the line to provide virtual terminal services. RFC854 defines the specification of the protocol, which also defines a general character terminal called network virtual terminal NVT. NVT is a virtual device, and both sides of the connection, namely, the client and the server, must convert their physical terminals and NVT to each other. That is, regardless of the type of client process terminal, the operating system must convert it to NVT format.

NVT divides messages into two types, data objects and control commands. The data object is represented by a 7-bit standard code (the highest bit is 0), and the control command is represented by an 8-bit extended code. Of the 128 standard ASCII characters, 95 visible characters retain the original meaning of these characters. The other 33 characters are control codes, 8 of which are redefined\[1\].
Table 1. Control code of telnet.

| ASCII Control code | Decimal system | Meaning                          |
|--------------------|----------------|----------------------------------|
| MUL                | 0              | Meaningless                      |
| BEL                | 7              | Sound or visual signal           |
| BS                 | 8              | Move one character to the left   |
| HT                 | 9              | Move right to the next horizontal tab |
| LF                 | 10             | Move vertically down to the next line |
| VT                 | 11             | Move down to the next tab position |
| FF                 | 12             | Move to the top of the next page  |
| C                  | 13             | Move to the left boundary of the current line |

In fact, both parties send each other negotiation option data for initialization operation before starting normal communication. The use of the negotiation option takes into account the possibility that the services provided by the host computer are beyond the scope of virtual terminal services. The method of negotiation is that one end issues a request command to make an option effective to the other end, while the other end can receive or reject the request by sending a response command. If this option is accepted, it will take effect immediately at both ends of the connection; if rejected, both sides will remain the same. In particular, for requests for various options of the sender, the receiver has the right to receive the request or reject the request. For a request to prohibit a negotiated option, the recipient must agree.

Figure 1. Typical connection between telnet client and server.

1.2. Basic characteristics of Telnet
Telnet is a standard application that provides remote login function, which is mainly used to configure and manage switches, routers, firewalls and some devices that support telnet remote login. Remote login adopts client-server mode. In practical programming applications, the protocol has the following characteristics:

1) The Telnet client process interacts with the end user and the TCP/IP protocol module at the same time. Usually, any information we type is transmitted through a TCP connection, and any return information from the connection is output to the terminal.

2) The Telnet protocol can work between any host or any terminal. RFC 854 defines the specification of the protocol, and also defines a general character terminal network virtual terminal NVT. NVT is a virtual device, and both sides of the connection, namely, the client and the server, must convert their physical terminals and NVT to each other. That is, regardless of the type of client process terminal, the operating system must convert it to NVT format. At the same time, regardless of the type of terminal of the server process, the operating system must be able to convert the NVT format into a format that the terminal can support. The term VT ASCII stands for the 7-bit ASCII character set, and the internetwork protocol family uses NVT ASCII. Each 7-bit character is sent in an 8-bit format, with the highest bit being 0.

3) It is defined in RFC856 that there is a binary option in Telnet that allows data to be transmitted
in 8 bits. This is used when sending control information.

4) The Telnet client accesses port 23 on the server, using only one TCP connection. Therefore, in-band signaling is used in both directions of Telnet communication, namely: Control commands and data are transmitted in the same connection. Therefore, when the party of the communication receives the 255 data message in byte decimal, the message will be interpreted as a command.

Byte 255 is called IAC, meaning "interpreted as a command". The byte after this byte is the command byte, which represents the action to be taken. This action is one of WILL, DO, WONT and DONT. The last ID byte indicates the activate or disable option. If you want to send data 255, you must send two consecutive bytes 255.

5) In practical application, the first interaction information between the two sides of the Telnet connection is the option negotiation data. Now, there are more than 40 options that can be negotiated. Sub-option negotiation mechanisms such as how to represent terminal types are defined in RFC1091.

6) By default, Telnet communicates one character at a time: Each character typed is sent separately to the server process. The server process echoes most characters unless the application on the server process side removes the echo feature.

2. The necessity of computer laboratory network management tool based on telnet protocol

At present, the widely used network data acquisition protocols are SNMP protocol, TELNET protocol, FTP protocol, NETFLOW and so on. The advantage of TELNET protocol data acquisition compared with other protocols is that the speed of data acquisition is faster, and the disadvantage is that the versatility and reusability of data acquisition system using TELNET protocol is relatively poor. At present, most of the mainstream network management software are developed based on SNMP protocol. Most of the networks managed by these network management software are designed and developed for large local area networks, and the devices managed must also support the SNMP protocol. Due to the time of the emergence of SNMP and the support of equipment manufacturers to SNMP protocol, some bottom access switching devices do not support SNMP protocol, so these devices can not be included in the management scope of these network management software. Even if these devices are added to the management scope, they can only be used as a host to make a simple on-off judgment, but it is impossible to monitor the downlink port status and traffic of these devices. For the management of these devices, most network administrators still use telnet protocol to connect to these devices and type in various commands to query and control these devices. Therefore, the network management software using TELNET protocol still has a very wide application value for the management of small local area networks in which most network devices do not support SNMP protocol.

Through big data statistics module, students can get the maximum number of feedback and personal feedback per month, the maximum number of theoretical knowledge feedback and personal feedback in each knowledge unit, and the maximum practical operation problem feedback times and personal feedback times in each knowledge unit.

Teachers log in using PC, and the roles are divided into ordinary teachers and administrators. After logging in, using the user management module, ordinary teachers can view student users and personal information, and administrators can view, add, modify and delete student and teacher information. The administrator has the authority to operate the course management module, which can be used to set up courses, knowledge units, knowledge points and feedback scoring items. Ordinary teachers and administrators have the authority to operate the data management module, which can be used to view the feedback on the mastery of each knowledge point, theoretical knowledge problems and practical operation problems, and add read and like marks and other operations. Ordinary teachers and administrators have the authority to operate the data statistics module, which can be used to view monthly system visits, course feedback times, knowledge sheet feedback times and knowledge point feedback times and so on.

In addition, in the teaching of various universities, more and more courses are taught directly in the computer laboratory, that is, the classroom teaching is transferred from the ordinary classroom or
multimedia classroom to the computer laboratory. This teaching mode is convenient for students to operate in real time under the guidance of teachers, and helps students to learn more operable software. Especially for art majors, many courses are taught in computer laboratories. However, due to the current students' self-control ability is relatively poor, students' sense of self-discipline is weak. In the computer laboratory class, students often chat on the Internet, browse the web or play online games, which will seriously affect the teaching effect of the classroom. Therefore, in addition to strengthening guidance and management, teachers are also very important to create a pure teaching environment, such as blocking games and chat software.

3. Implementation of computer laboratory network management tool based on telnet protocol

Taking C# language as an example, the purpose of this study is to achieve a visual network device management program that can be developed, so as to achieve the purpose of managing and operating remote network devices with visual programs.

3.1. UserTelnet class member

The members of the UserTelnet class include the IAC command code and option code defined in the Telnet protocol, where the specific ASCII code values of the command code and option code are expressed by constants. In addition, class members define various parameter constants and temporary variables in the process of Telnet communication.

3.2. The realization of the method

The main function of the method is to realize the communication processing in the process of Telnet connection. The two public methods and one event contained in this class implement the external interface, thus the visual management program based on this class can be realized.

3.3. Realization of visualization operation

When managing a network device, a network administrator usually needs to log in to the network device with a password and then manually enter multiple commands to complete a management operation. Due to the needs of classroom teaching, it is often necessary to carry out some specific operations on network equipment. For these frequent and repetitive operations, it is not necessary to debug the network equipment too much, just to enable or close some rules saved in the network device. Therefore, these operations can be done by the teacher. The teacher does not necessarily use these commands. If the above operations can be made visible and simple, the teacher only needs to click the corresponding command button in the visual network management program to complete a specific network equipment management operation. This will greatly improve the efficiency of network equipment management, provide a flexible and simple means of network equipment management for teaching needs, and reduce the workload of network administrators at the same time.

Therefore, it is necessary to compile a visual program and provide a visual operation interface. In practice, the UserTelnet class is compiled into a DLL file, which can be called by other development tools when compiling visual management programs. In the visualization program, the command to complete a certain management function is encapsulated into a function module in advance and triggered by the command button of the visual interface. Teachers only need to select the trigger button of the corresponding function module in the visual interface and click execute to complete the corresponding network equipment management operation without knowing the specific details of the implementation of the module. In this way, the general teachers (ordinary managers) hide the specific configuration information of the network equipment and protect the configuration information of the network equipment from being tampered with illegally. At the same time, it also realizes the management of network equipment by multi-users under the set authority.

Through the above we can more clearly understand the interpretation of visual management program is how to realize, this operation is very convenient for both sides, for the teaching, it
provides a very simple and effective for the teaching method, administrators will greatly reduce the workload at the same time, it is a good choice for both sides so that visualization and implementation write very has the vital significance\textsuperscript{[12]}.

4. Conclusion

The automatic management of network equipment based on Telnet protocol has the remarkable characteristics of strong versatility and wide range of network equipment. Using Telnet protocol, through the application of the access control list function of the switch, we can realize the real-time control of network connection and meet the needs of teaching and convenient computer room management. At the same time, it can help schools to achieve scientific and standardized computer laboratory management, and save limited laboratory funds, do not need to buy similar professional management software. This can also improve the technical development ability and management level of laboratory administrators, and develop a new type of software that can manage computer laboratories more flexibly.

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