Design and Implementation of Aircraft Measurement Data Monitoring and Analysis Software under Linux

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Abstract. Due to the platform change, the measurement data monitoring software under the Windows platform has no running environment. In order to solve the data monitoring blind zone between the data distribution server and the router link, this paper proposes to use port mirroring technology to solve this problem. And research and development of a set of Linux platform measurement data monitoring and analysis software.

1. Introduction
During the aircraft flight preparation process, the central computer mainly performs various types of interactive data formats and contents inspection. In the measurement of the ship's mode, simulation software can be used to simulate the information interaction center to monitor and check various types of data interacting with the information interaction center. [1] However, in the mode of interaction with the information center, the central computer can only monitor and check various types of data that interact with the measurement device. The various types of data interacting with the information exchange center can only be monitored by remote monitoring software, and each server is monitored to data distribution. Data between server segment links, data between the data distribution server to the router link cannot be monitored. To solve this problem, the mirroring technology can be used to solve the problem. [2] The specific idea is to copy the port on the router that interacts with the information exchange center, so that various types of data interacting with the information interaction center can be obtained, and the data is transmitted to the data through the dedicated line. The central machine, write special data monitoring software for monitoring and analysis, and the information exchange link diagram is shown in Figure 1. The focus of this solution is on the need for a dedicated set of mirrored data monitoring and analysis software.
In the early stage, the central computer was based on foreign advanced software and hardware platforms, and relied heavily on foreign software and hardware technologies, standards and products. From the perspective of hardware and software platforms and production environments, the entire system is highly dependent on foreign IT vendors. Product. In order to solve the security problem of the platform and improve the information security capability of the whole system, all the related equipments, operating systems and application softwares all adopt the technology under the Linux platform after the localization of the central computer. Due to the change of the platform, the measurement data monitoring software under the original Windows platform has no running environment. In order to solve the data monitoring blind zone between the data distribution server and the router link, research and development of a Linux platform Aircraft measurement data monitoring and analysis software is necessary.

2. Necessity analysis
The main uses of the aircraft measurement data monitoring and analysis software under the Linux platform are as follows:

(a). Under the Linux platform, the data monitoring blind zone problem between the data distribution server and the router is solved.

(b). Provide solutions to troubleshooting network problems. For example, in the original mode, if the interactive information is dropped, only the data can be compared with the information interaction center to determine which type of data has dropped frames. The data distribution server of the measurement ship cannot communicate with the information exchange center. Determine which node the data is lost on. In the case of port mirroring, it is possible to determine whether data frame loss occurs in the measurement ship or in satellite communication through comprehensive information monitoring and analysis software, which provides a new solution for network problem troubleshooting.

(c). Reduce the surveillance staff's monitoring pressure during long-term measurements of the aircraft. In the case of a large number of measurement cycles and a long monitoring time, the personnel monitoring pressure is relatively large. At the same time, due to long hours of work, personnel may be under monitoring in the case of fatigue, and the aircraft monitoring data monitoring and analysis software under the Linux platform can solve the problem of inadequate monitoring caused by personnel fatigue, and receive important data and data. In the case of sending and receiving interrupts or data drop frames, the system gives a voice reminder to remind the monitoring personnel. At the same time, the system has a log function to record key events for post-mortem analysis.
(d). The system has the function of recording the mirrored data according to a certain format, which is convenient for data analysis and troubleshooting.

(e). In the process of data exchange with the information exchange center, check the stability, correctness and correctness of the data format of the interactive information channel from the far end of the transmission channel as much as possible, and verify the correctness of various types of interaction data between the measurement ship and the information interaction center.

3. Key technology research

According to the above requirements analysis, the key technologies to be solved in this paper mainly include:

(a). Receive various types of interactive data through multicast mode, and record the interactive data according to the specified format, and data analysis can be performed through dedicated software.

(b). Play audio files in qt for voice prompts. Currently there is a phonon library in qt4.8.5, which can be used to play audio files, but in order to support audio files of multiple formats, a specific player needs to be installed, and the audio file is called by qt.

(c). Call the bash script in qt and analyze the returned results.

The following is a brief introduction to the key technologies adopted.

3.1. Port mirroring

(a). Concept

Port Mirroring is a method of mirroring data from one or more ports of a switch to another port or ports. In order to ensure the security of the network, it is necessary to monitor network traffic. However, it is quite difficult to monitor all traffic in the widely used switching network. Therefore, it is necessary to configure the switch to forward data of one or more ports to a certain port. Listening to the network. In this paper, the port for information exchange between the central computer and the information exchange center is forwarded to another port for data monitoring and analysis.

(b). How port mirroring works

The role of SPAN is mainly to provide network data flow to a network analyzer. It can realize that several source ports in a VLAN can mirror data to one monitoring port, and can also mirror data from several VLANs to one monitoring port. For example, all data streams flowing on port 5 of the source port are mirrored to port 10, and the data analysis device or software receives all data streams from port 5 by monitoring port 10. Moreover, SPAN does not affect the data exchange of the source port. It simply sends a copy of the packet sent or received by the source port to the monitoring port. The source port and the mirror port are generally located on the same switch.

During the SPAN task, the user can use parameter control to indicate the type of data flow that needs to be monitored. One or more ports, ports, and one or more VLANs can be used as source ports, and will be sent or received from these ports. The one-way or two-way data stream is transmitted to the monitoring port.

The SPAN task does not affect the normal operation of the switch. When a SPAN task is established, the task is activated or deactivated depending on the state or operation of the switch, and the system logs it. The current status of SPAN can be displayed by command. The source port can also be called a monitored port. In a SPAN task, there can be one or more source ports, and can be set to input direction, output direction or bidirectional according to user needs, but in either case, in a SPAN task, all source ports are monitored in the same direction. Must be consistent.

In the configuration of some SPAN tasks, multiple copies of the same SPAN source port packet are sent to the SPAN monitoring port. As mentioned earlier, in a two-way SPAN task, a1 and a2 are assumed to be source ports, and d1 is the destination port. If there is packet transmission between a1 and a2, the packet transmitted to a2 in a1 will be it is transferred to d1 twice and vice versa.
3.2. Object oriented

Object-Oriented is a world view that recognizes the objective world. This world view regards the objective world as having many different kinds of objects. Each object has its own internal state and movement law. The interconnection and interaction between different objects the role constitutes a complete objective world. "Object-Oriented" is a method of simulating the objective world from the perspective of structural organization, which makes the solution space and problem space expression methods consistent. The schematic diagram is shown in Figure 2.

![Object-oriented schematic](image)

**Figure 2.** Object-oriented schematic

Object: The objective world consists of various objects. Object-oriented software systems are also made up of objects; any complex software is composed of simple objects. An object is an abstract representation of an individual or thing in the real world, and is a wrapper around its properties and related operations. Attributes represent the nature of an object, and attribute values specify all possible states of the object. The operation of an object refers to the external service that the object can exhibit.

Class: All objects can be divided into different object classes; each object class has its own specific data and methods. A class is a representation of the common characteristics of certain objects, and it describes how these objects are constructed internally. Objects of the same class have the same definition in both their operations and their information structure. In an object-oriented system, each object belongs to a class. An object belonging to a particular class is called an instance of that class. Therefore, objects and instances are often treated as synonyms. An instance is an object created from a class.

Inheritance: Object classes have a hierarchy; upper-level classes are called "parent classes" or "base classes", and lower-level classes are called "subclasses" or "derived classes." With inheritance, you can express similarities between classes and describe them in a class that other classes can inherit. Therefore, it is possible to reuse a common description. Inheritance is often advocated as a core idea of reuse in the software industry. Inheritance also facilitates software maintenance.

Message mechanism: Objects are connected to each other by passing "messages".

3.3. IGMP multicast

The IGMP protocol runs between the host and the multicast router directly connected to the host. The function implemented by IGMP is two-way. On the one hand, through the IGMP protocol, the host
notifies the local router that it wants to join and receive information about a specific multicast group. On the one hand, the router periodically queries whether a member of a known group in the LAN is active through the IGMP protocol, and collects and maintains the membership of the connected network group. Through IGMP, the information recorded in the router is whether a multicast group has a group member locally, rather than a correspondence between the multicast group and the host.

So far, IGMP has three versions. The basic group member query and reporting process is defined in IGMPv1 (RFC1112). Currently, IGMPv2 is defined. It is defined by RFC2236. The mechanism for fast leave of group members is added on the basis of IGMPv1. The main function added in IGMPv3 is that members can specify Receives or specifies packets that do not receive certain multicast sources. The following focuses on the principle of the IGMPv2 protocol.

When there are multiple multicast routers in the same network segment, IGMPv2 elects a unique querier through the querier election mechanism. The querier periodically sends a general group query message for membership relationship query; the host sends a report message to respond to the query. The time when the host sends the report message is random. When other members in the same network segment are detected to send the same message, the response message is suppressed. If a new host wants to join the multicast group, it does not have to wait for the querier's query message, but actively sends a report message. When leaving the multicast group, the host sends a leave group message; after receiving the leave group message, the querier sends a specific group query message to determine if all group members have left. For routers that are members of a group, the behavior is the same as that of a normal host, responding to queries from other routers.

Through the above mechanism, a table is established in the multicast router, which records which group members are on the subnet corresponding to each interface of the router. After receiving a data packet from a group G, the router forwards data packets only to the interfaces of members with G.

The version used in this document is IGMPv3, which specifies source multicast.

4. System design and implementation

4.1. The whole frame

The system uses C/S architecture and uses Qt object-oriented technology for programming. The main functions of the system include system configuration, interactive information monitoring configuration, disk setting, data clearing, log files, etc., as shown in Figure 3. The system has the function of reading the operating system time and calculating the relative time. When receiving important data, data transmission and reception interruption or data loss frame, the system gives different types of voice reminders.

![Figure 3. System function chart](attachment:image.png)
4.2. Play voice files
In this article, Phonon is used to play audio for voice prompts. The implementation code is:

```cpp
QString filename;// Audio file location and name
Phonon::MediaObject *music = Phonon::createPlayer(Phonon::MusicCategory,
Phonon::MediaSource(filename));
music->setParent(this);
music->play();
```

4.3. Call bash script
The text is implemented using QProcess, and the implementation code is:

```cpp
QString commandProgram;// Script path and name
QProcess *pProcess = new QProcess();
pProcess->start(commandProgram,QIODevice::ReadWrite)
```

5. Conclusion
Due to the platform change, the measurement data monitoring software under the Windows platform has no running environment. In order to solve the data monitoring blind zone between the data distribution server and the router link, this paper proposes to use port mirroring technology to solve this problem. Research and development of a set of monitoring and analysis software for aircraft measurement data under the Linux platform, after testing and verification and trial operation, to meet the design requirements.

References
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[2] Wang Qianxiang Wu Qiong. An object-oriented domain engineering method, Journal of Software. 2002, 13 (10): 1977-1984.