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Malfunction and Emergency Response of Qinghai Meteorological HD Video Consultation System

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Abstract: The high-definition video conference system at the provincial level has many subsystems, a wide distribution of network nodes, high frequency of conferences, and strict requirements on clarity (1). The stable and reliable operation of the system is crucial, and it is essential to establish an effective system failure emergency solution. This paper takes the characteristics of the high-definition video conference system in Qinghai Province as the starting point, and deeply explores the establishment of dual backup mechanisms, the design of emergency plans, and the methods of quick fault handling and recovery. The goal is to ensure that the system can be restored to normal operation as soon as possible under any circumstances, thus ensuring the smooth conduct of conference activities.

Keywords: Meteorology; High Definition; Conference; Dual Stream.

1. Introduction

In recent years, with the rapid development of information and network technology and video conferencing technology, traditional telephone communication methods have become increasingly unable to meet the growing demand for "face-to-face" communication (2). The emergence of video conferencing systems effectively solved this problem. For the meteorological department, the construction of the Qinghai Meteorological HD Video Conference System is particularly important in the face of an increasing number of severe weather and meteorological disasters. The system achieves the highest standard of full-network high-definition video conferencing at 1080P, and the audio uses a combination of analog and digital mixing control technology to ensure the clarity and quality of sound. In addition, the core equipment of the system adopts a dual-machine hot standby mode, fundamentally guaranteeing the stability and reliability of the system. The application of the HD video conferencing system not only makes every detail of the conference process perfect, but also builds a more humanized and efficient conference environment, greatly improving the learning and exchange efficiency of meteorological business and the level of meeting service support.

2. The Characteristics of High-definition Video Conference System in Qinghai Meteorology

As a provincial control center for video conference, the high-definition video conference system in Qinghai Meteorology plays an important role in connecting with the China Meteorological Administration and linking with prefecture-level and county-level meteorological bureaus. It is an important link in the meteorological video conference system. The high-definition video conference system in Qinghai Meteorology can seamlessly connect with the high-definition video conference system of the China Meteorological Administration, enabling effective interconnection between the Qinghai Meteorological Bureau and the Central Meteorological Observatory, prefecture-level meteorological bureaus, and county-level meteorological bureaus. The system can transmit high-definition video, high-resolution PC signals, and audio signals in both directions, enabling distant and realistic audio-visual communication. It integrates audio, video, graphics, text, and data, providing instant messaging, video playback, video recording and storage, and playback, enabling a comprehensive real-time multimedia conference, meeting the business needs of daily weather forecast conference, TV telephone conference, academic exchange and technical training, and emergency command. The system's many features affect its stability and reliability.

2.1. Multiple Network Terminals

The Qinghai Meteorological HD Consultation System mainly includes three levels of high-definition consultation systems: provincial, municipal, and county. It mainly consists of one provincial consultation control center, one provincial station consultation main venue, three provincial directly affiliated unit venues, nine city and state meteorological bureau venues, and 45 county-level station terminal venues. The network nodes are distributed in various cities, prefectures, and counties throughout the province, with very high requirements for network connectivity and broadband. Each node needs to maintain a stable network connection to ensure the smooth progress of consultations. The system often needs to implement four tiered consultations at the national, provincial, municipal, and county levels to achieve information transmission and communication between superiors and subordinates. This multi-level consultation requires the system to have strong cascading capabilities and flexible control and management functions. Sometimes it is necessary to hold multiple meetings at different levels at the same time, which puts higher demands on the resource allocation and management of the system. The system must be able to efficiently schedule resources to ensure the independence and stability of each meeting.

2.2. Multiple Integrated Subsystems

The Qinghai Meteorological HD Consultation System mainly consists of 9 subsystems: Consultation Network

Subsystem, MCU Conference Management Subsystem, HD Terminal Management Subsystem, DVI Matrix Control Subsystem, Audio Matrix Control Subsystem, Large Screen Display Subsystem, Recording and Broadcasting Subsystem, CMA Management Subsystem, and Dual Stream PC Subsystem. Each subsystem has independent devices, but they are tightly integrated together to form a complete consultation system. This design ensures the professionalism and efficiency of each subsystem while achieving overall collaborative work of the system. Due to the numerous subsystems, the internal circuits of the system are very complex and require careful design and maintenance to ensure smooth signal transmission and data exchange between each subsystem. Any subsystem failure will directly affect the normal operation of the entire system. Therefore, special attention is paid to the stability and reliability of each subsystem during system design, and multiple redundancy and backup mechanisms are adopted, such as dual machine hot backup, redundant lines, etc., to reduce the risk of failure.

2.3. High Frequency of Consultation

Due to the special nature of the meteorological department's business, at least one national and one provincial/city level video conference are held every day, and around 1300 meetings are held annually, with a very high frequency of use. Especially during the flood season and major weather events, several sessions may be held in a day, with a daily operating time of nearly 6 hours. The system must have high stability to ensure that there will be no failures under long-term and high-frequency use. Therefore, the system adopts multiple backup mechanisms such as dual machine hot backup and redundant lines to ensure rapid switching in case of single point failure and reduce downtime. Keeping it in good condition at all times places extremely high demands on the stability of the system's operation.

2.4. High Video and Audio Quality Requirements

At present, the provincial, municipal, and county levels follow the H.264 protocol high-definition standard, and the entire network achieves dual stream H.269 data. The system adopts the standard 1080P of high-definition video conferencing system, which is commonly known as high-definition television. The effective display format of picture resolution is 1920 pixels × 1080 pixels. The provincial, municipal, and county level consultations achieve 1080P video image effect, significantly improving the clarity of daily consultations/meetings. At the same time, the audio system adopts digital audio matrix technology to ensure high-quality transmission and processing of audio signals. The digital audio matrix can flexibly manage and switch audio signals, ensuring clear and delay free audio quality for each venue.

3. Design of Emergency Backup System for Qinghai Meteorological HD Video Consultation System

An excellent system not only requires good network and operational stability, but also strong backup and emergency capabilities (3). Based on the system operation and business characteristics, a dual backup emergency plan design was mainly adopted for the network, core servers, and terminals. The network subsystem adopts core network dual link, dual routing hot backup core server MCU and Xiaoyu Yilian as backups for each other, which can achieve rapid re invitation of attendees and continue to hold meetings; The attending terminals adopt a mutual primary backup design, ensuring that attendees can quickly participate in emergency meetings, thereby achieving stability, reliability, and rapid emergency response of the entire system.

3.1. Network Design of Qinghai High Definition Video Consultation System

The high-definition video conferencing system in Qinghai Province relies on the existing meteorological information bandwidth network. Currently, there is an 8M SDH link between the Qinghai Provincial Meteorological Bureau and the China Meteorological Administration, and a 4M SDH link between provinces, cities, prefectures, and counties. Due to the large traffic of the high-definition video and audio transmission network, a secure and stable network and a certain bandwidth must be ensured. And backup is implemented on the link, improving the reliability and scalability of the system, ensuring reliable transmission of data traffic, and achieving network link emergency.

3.2. Design of MCU Emergency Backup System for High Definition Video Consultation System

Figure 1. Emergency Response Operation Diagram for High Definition Video Terminal Consultation Malfunctions in Provincial Control Centers

At present, the MCU of the provincial bureau is RMX2000 and RMX1800. RMX1800 has been debugged and configured for backup. In the event of a failure, the backup RMX1800 will be immediately activated and the meeting will be restarted within 1 minute. The provincial consultation control center is equipped with two Huawei terminals and two two Baolitong terminals. When participating in national consultations, the high-definition Huawei terminal one and Huawei terminal two serve as backup for each other. When one terminal is unable to attend, the backup terminal is

activated to communicate with the national main station in a timely manner and call the backup terminal to hold a meeting. When a provincial conference is held, Baolitong Terminal 1 and Baolitong Terminal 2, which forwards the national conference, serve as backups for each other. When one terminal is unable to attend, the backup Baolitong terminal can be used as an emergency backup to achieve emergency response for node attending terminals. The high-definition video conference emergency response operation diagram of the provincial control center is shown in Figure 1.

3.3. Design of Audio Backup System for High Definition Video Consultation System

3.3.1. Emergency Backup of Microphone

Provincial and municipal branch venues generally use directional microphones, and emergency backup microphones should be equipped at the speech location to input sound simultaneously with the main microphone. Regardless of which microphone has a problem, ensure that one microphone inputs sound normally; Consider using a video conferencing terminal equipped with an omnidirectional microphone as a hardware emergency measure. In case of microphone issues, connect the omnidirectional microphone to the terminal to ensure sound input; For the provincial bureau consultation hall, it is possible to consider building suspended ceiling microphones as an emergency backup measure.

3.3.2. SoundStructure Emergency Backup

The provincial bureau consultation hall is equipped with 2 SoundStructureC16s for dual machine hot standby. The main and backup machines are connected to the same cable through a rectangular connection. When the main machine cannot be used, the backup machine can be immediately activated and the signal can be switched to the backup machine using a matrix, allowing the backup machine to work on behalf of the main machine. The emergency backup diagram of SoundStructure in the provincial control center is shown in Figure 2.

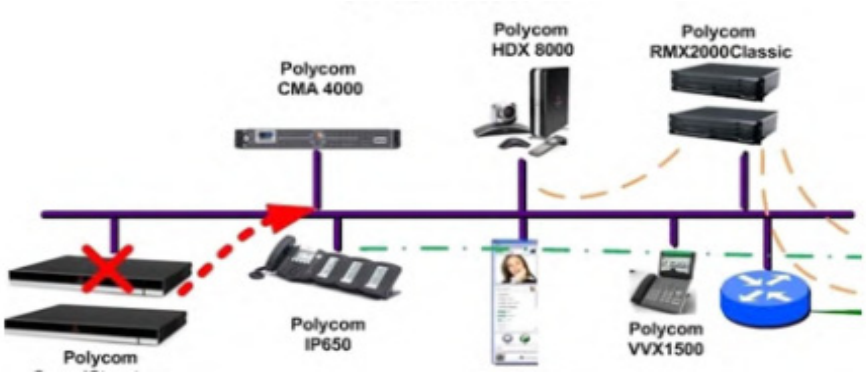

Figure 2. Emergency Response Operation Diagram for SoundStructure Fault in Provincial Control Center

4. Implementation of Fault Handling and Rapid Emergency Response

Due to the multiple factors affecting the operation of the provincial consultation system, the types of faults involved are complex, mainly including 9 major subsystem faults such as video network, MCU server, video and audio processing terminal, and display. The system has made a good design in emergency plan, fundamentally solving the problem of 3 major faults in video network, MCU server, and video terminal, realizing automatic routing and backup switching of the system, ensuring that the main equipment and network of the system can quickly respond to emergencies, and ensuring stable and reliable system operation. On the user end of video conferencing systems, the system commonly displays faults in three aspects: video, audio, and dual stream. In terms of video sources, the system uses dual cameras to achieve mutual backup function; In terms of audio, the system integrates and is compatible with both digital and analog mixing consoles to achieve mutual backup functionality; In terms of dual video streaming, the system also uses two laptops to achieve mutual backup. Below is a step-by-step quick diagnosis and handling of three types of faults: video, audio, and dual stream, to achieve rapid emergency response.

4.1. Audio Fault Handling and Emergency Response

4.1.1. When There is no Sound at All During the Meeting

Check the volume settings of the conference terminal to ensure that the volume is not turned off or set to the lowest level. If there is sound on the terminal, try to cancel the mute state and ensure that the microphone and speaker of the terminal are turned on. Check network connectivity by using network testing tools (such as ping command) to ensure normal network connection. If network connectivity is interrupted or poor, immediately switch to the backup network line. On the premise of confirming that the connection has been made and there is sound from the other party, the terminal sound can be directly output to the emergency sound system for fault emergency handling. If there is any, it belongs to a sound equipment fault; If not, the terminal is faulty and can be restarted or a backup terminal can be activated. On the premise of confirming the malfunction of the digital mixing console, the terminal sound can be directly output to the analog mixing console for emergency handling of the malfunction.

4.1.2. When There is No Sound in the Local Speech During the Meeting

Test the quality of the microphone and whether the local sound is intact, determine whether there is a malfunction in the microphone or speaker, and adopt a backup microphone or speaker. Check if the voice of the MCU speaker is turned on. If not, click unmute. Check network connectivity, and use backup network lines if connectivity is interrupted or poor. Directly transmit the microphone sound to the terminal. If there is still no sound, it is confirmed that the terminal has malfunctioned. The terminal can be restarted or a backup device terminal can be activated for emergency handling; If there is sound output directly to the terminal, it can be judged as a malfunction of the mixing console equipment. On the

premise of confirming the malfunction of the analog mixing console, the microphone sound can be directly input to the terminal for emergency handling of the malfunction. On the premise of confirming the malfunction of the digital mixing console, the analog mixing console can be directly input to the terminal for emergency handling of the malfunction.

4.2. Video Fault Handling and Emergency Response

4.2.1. When There is no Video Footage at All During the Meeting

Check and test network connectivity. If it is not working, use backup network lines and terminals for emergency response. Check the local display device. If it is confirmed that there is a fault in the local display device or circuit, check the connection line or switch to the large screen display for fault handling and emergency response. When the other party has video input, check whether the MCU conference management page sets them as speakers or returns their video.

4.2.2. When There is no Local Video Image in the Meeting

Check if the camera can display normally locally. If it cannot display locally, check the connection cable or activate the backup camera for troubleshooting and emergency response. Check and test network connectivity, otherwise use backup network lines and backup terminals for emergency response.

4.3. Dual Stream Transmission Fault Handling and Emergency Response

4.3.1. Unable to See Remote Dual Stream or Dual Stream with Black Screen, Blue Screen, Etc.

Confirm whether the video output devices (such as monitors, projectors, etc.) are connected correctly and set up correctly; Check if the video output cables (such as HDMI, VGA, etc.) are loose or damaged, unplug or replace the cables. If it is confirmed that the local display device has a fault, check the connection line and switch the dual current output again. If the display device is broken, switch to a large screen display for fault handling and emergency response.

Check if the MCU conference management page has set it as the speaker and contact the other party to see if they have sent dual streams. If there is a problem with the other party's dual stream transmission, you can check whether the computer resolution settings, output lines, sending and terminal devices are intact, and whether the network connectivity is intact; If the other party successfully sends but cannot receive, there may be a local display or terminal malfunction. Emergency measures such as switching displays, restarting the terminal, or using a backup terminal can be taken.

4.3.2. Local Dual Stream Transmission Failure or Black Screen, Blue Screen, Etc.

When discussing weather conditions in provinces, cities, and states, if the dual stream transmission fails, you can choose to use web remote control or backup software to send the dual stream; During the national weather conference, if the dual stream transmission fails, the backup remote control transmission can be selected. Check the video and dual stream input of the conference terminal. If the input fails to send correctly, there is a fault in the terminal or network. Check if the network connectivity is intact and use backup network lines, backup terminals, or restart terminals. If it cannot be displayed locally, you can check the computer resolution settings, whether the output circuit is intact, and use a backup computer to send.

5. Conclusion

The Qinghai Meteorological HD Video Consultation System has built a dual link network, dual machine hot backup for MCU servers, and dual backup for video and audio processing terminals as a whole. Technically, it has effectively implemented routing for network line failures and backup emergency for servers and terminals. This design not only ensures high reliability and stability of the system, but also significantly enhances its operational reliability and maintenance convenience. For common video, audio, and dual stream faults, the system provides excellent fault process judgment methods and quick emergency response plans, which effectively enhance the system's ability to quickly handle faults and ensure the continuity and efficiency of meetings. Through these technologies and management methods, the Qinghai Meteorological HD Video Consultation System not only provides solid technical support for meteorological consultations, but also provides valuable reference and inspiration for other similar application scenarios.

In summary, the successful implementation of the Qinghai Meteorological HD Video Consultation System fully demonstrates the importance of high reliability and technical support, providing valuable experience for future system construction and optimization.

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