Journal of Electronic Research and Application

Review Article

Design and Implementation of Control Model in Video Conference System for Large Enterprise

Bing Wu, Zhou Yuan, Zhidong Wu, Yinchang Zhang, Jinjing Gao, Yixi Yang

Technical Support Center, State Grid Information and Telecommunication Branch, Beijing, China

Abstract: To improve conference management and realize self-served control by users, this paper proposes a specific design of tablet-based control software on video conference, incorporating demands of video conference systems in State Grid Corporation of China. The software has been designed and implemented with studies on the system structure and key technologies as the bedrock. With in-depth analysis on various operations' frequencies, streamlined interface, and exquisite designs, the software enables users to independently control regular conferences without on-site professional technicians. Moreover, it meets different demands for different scenarios such as for public conference room and normalized management.

Keywords: *video conference system; conference control; conference terminal; self-served*

Publication date: September 2018

Publication online: 30th September 2018

Corresponding Author: Zhou Yuan, yuanzhou0921@126.com

0 Introduction

Rapid development of the Internet and the progress in multimedia technologies in recent years has fueled the application of video conference systems at home and abroad. Their users have expanded from governments and telecommunication sectors to the financial, education, energy, and medical industries[1].

As video conference systems can boost the overall efficiency of meetings, reduce time, and economic cost, especially for large-scale enterprises with more levels and more extensive region coverage, State Grid Corporation of China (SGCC) attaches great importance to the promotion and application of video conference systems[2]. Two construction and upgrade projects on video conference systems have been carried out consecutively since 2013[3]. With extensive trainings, system tests, and joint trials, the company has comprehensively covered its provincial, prefecture-level and county-level companies with the system, along with standardized management and integrated operation. Statistics shows that the number of the company's video conferences has been increasing by 20% every year since 2013. In 2015 alone, the company has held over 20,000 various video conferences, joint negotiations, and trainings, accounting for over half of the total. It has offered a favorable guarantee to lower office costs and improve management efficiency[4-6].

SGCC has deployed thousands of terminals for video conferencing, with hundreds of meetings being held within SGCC every day. Due to complicated operation and unfriendly interface of video conference controls, non-professionals can hardly organize and execute video conferences on their own, leaving SGCC's management requirements and conference norms unfulfilled. Moreover, the company has to spend a lot of money hiring a team of professional technicians to ensure the normal operation of the system and a successful convening of every meeting. To adapt to the growing demands, promote self-served conference organization, and develop user-friendly interface, this paper designs a tablet-based conference control software to upgrade and optimize the control and operation interface for simple design, easy control, fully-fledged functions, and efficient organization.

1 Demand analysis

Combining preliminary user research results with opinions from maintenance personnel and experts,

this paper presents the following business functions of tablet-based video conference system:

1. The designed software communicates with terminals at the main conference venue through tablets and controls the conference by operating the tablet;
2. Unify the operating interface according to SGCC's VI design;
3. Reduce the menu level and operation steps and provide main functions for conference control, such as called-on speaker, rotating presider, intervenue communication, intervenue disconnection, conference prolongation, volume control, camera control and PPT transmission;
4. Display the online status, conference time, and headcount of each unit in a plain manner;
5. Add functions like "search" and "tips;"
6. Provide customized templates and operation functions for normalized management requirements (such as routine conference consultation and professional organization management).

2 System architecture and technical solution of the conference control software

HD video terminal (hereinafter referred to as "terminal") is an important equipment in the video conference system. To facilitate the user to control the terminal in the customized operation interface, the terminal provides a large number of application programming interface (API) command line interfaces, mainly including ASN data, Hypertext Transfer Protocol (HTTP) API interface, message definition, and error code. The user can control the terminal by calling these interfaces.

API interfaces enable the user to complete a series of operations such as modifying the terminal data, initiating a call, starting a conference, operating conference control, querying the terminal status, and adjusting the visual and sound.

API interfaces interact with the terminal through HTTP and the exchange is completed by requesting and corresponding.

2.1 System architecture

The entire system architecture is shown in Figure 1.

By operating the software on the tablet, the system calls the Huawei eSDK (ecosystem Software Development Kit) interface to control the conference terminal, thus to oversee the entire conference. The main functions of different layers are described as follows:

1. Business presentation layer: Basic functions are grouped in the form of APP and deployed on the tablet. Thus, the basic controlling functions have

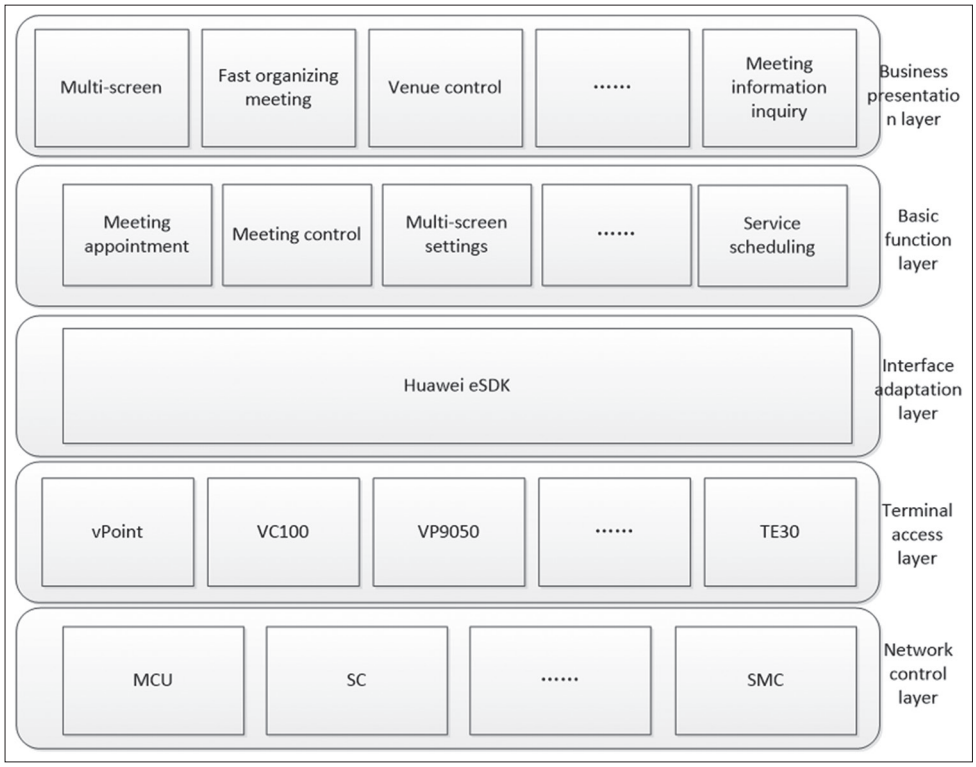

Figure 1. System architecture diagram

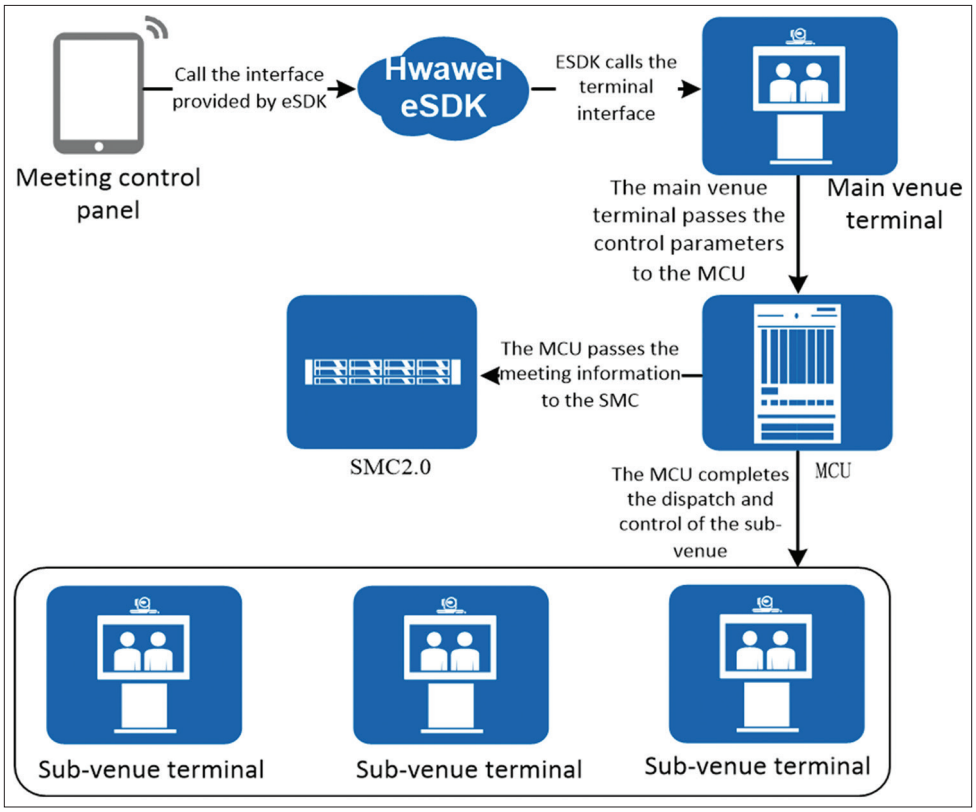

Figure 2. Technical architecture diagram

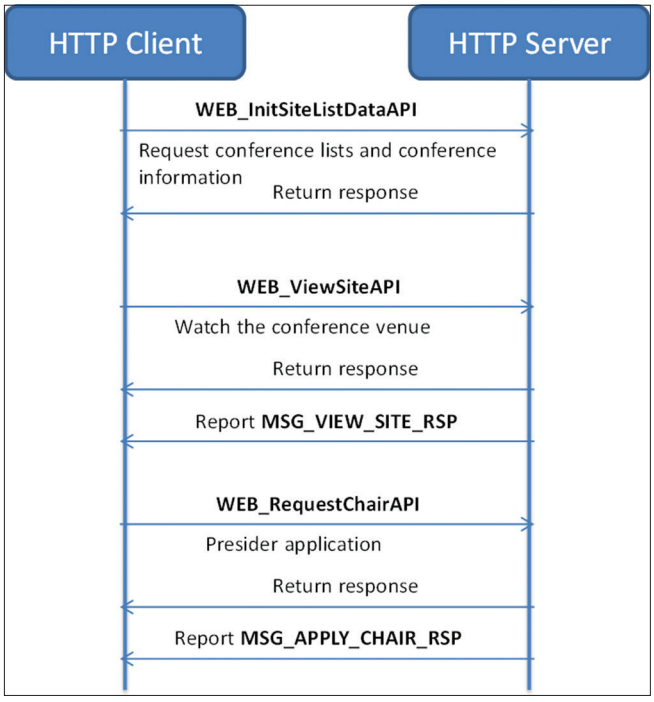

Figure 3. Hypertext Transfer Protocol application programming interface conference control flow

been realized, such as called-on speakers, rotating presider, intervenue communication, intervenue disconnection, conference prolongation, volume control, camera control and PPT transmission.

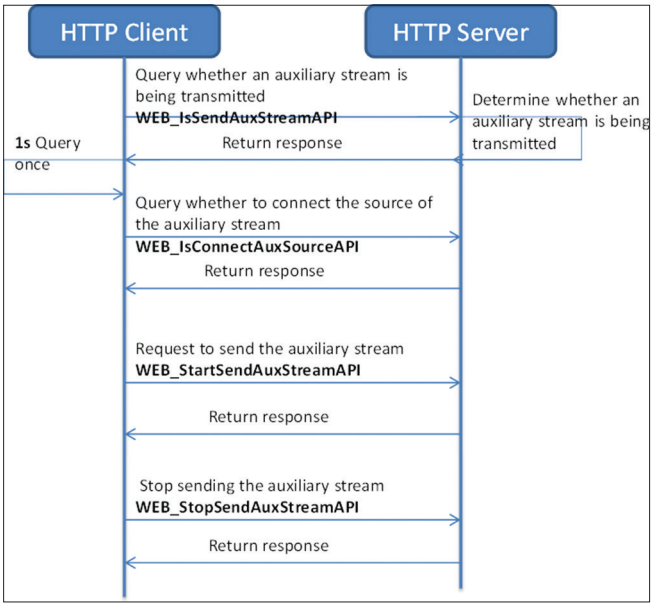

Figure 4. Visual and sound flow chart

2. Basic function layer: The interface adaptation layer facilitates the package and docking of the interfaces and realizes basic functions such as user authentication, user communication, and user log-in. The basic interface function is integrated on the terminal, providing fundamental communication and control for the entire system.

3. Interface adaptation layer: Communicate with conference terminals at the terminal access layer through Huawei eSDK, adapt to the hardware devices of the terminal access layer and the network control layer.
4. Terminal access layer: Access to the conference terminal at the main venue.
5. Network control layer: MCU, SC, SMC, and other equipment are the basis of video conferencing group.

2.2 Technical solution

Video conferencing tablet-based control system takes system upgrade and extendibility into consideration. Its main technical architecture is as follows:

The system uses advanced architecture to ensure the consistency of the data and the normal operation of business operations. It takes future vertical and horizontal smooth expansion capacity into consideration and applies WebService, jQuery, XML, HTML5.0, and other application technologies and norms to design and construct.

2.3 Key technologies

2.3.1 HTTP key technology

HTTP, an application layer protocol, is suitable for distributed and cooperative hypermedia information systems due to its simple and fast approach. Since 1990, HTTP has been applied to WWW global information service system.

HTTP allows a free reply to indicate the purpose of the request, which is based on the reference principle provided by the uniform resource identifier, as an address (uniform resource locators [URL]) or a name (uniform resource name [URN]) to indicate which method to use. The message is delivered in the format of the webmail and multipurpose internet mail extensions.

2.3.2 JavaScript object notation (JSON) key technology

JSON is a lightweight data exchange format. It is based on a subset of JavaScript (Standard ECMA-262 3rd Edition - December 1999). JSON is a text format that is completely language independent but uses conventions that are familiar to programmers of the C-family of languages including C, C++, C#, Java, JavaScript, Perl, Python, and many others. These properties make

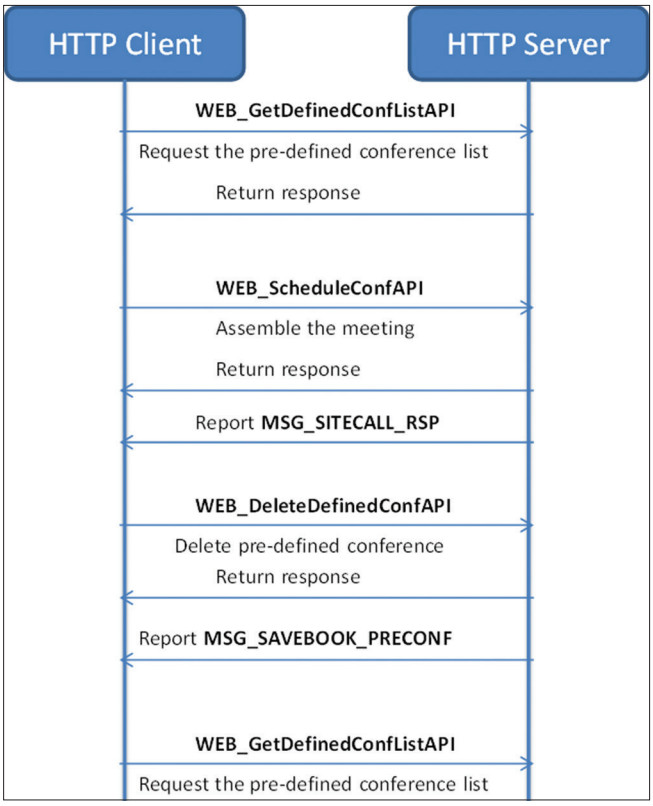

Figure 5. Conference assembling flow chart

JSON an ideal data-interchange language. It is easy for humans to read and write and easy for machines to parse and generate.

JSON is built on two structures. One is a collection of name/value pairs. In various languages, this is realized as an object, record, struct, dictionary, hash table, keyed list, or associative array. The others are an ordered list of values. In most languages, this is realized as an array.

JSON can convert a set of data represented in a JavaScript object into a string, and then, it can easily pass the string between functions or pass the string from the Web client to the server in an asynchronous application. JSON can represent more complex structures than name/value pairs. For example, it can represent arrays and complex objects, not just a simple list of keys and values.

3 Conference control flow

3.1 HTTP API conference control flow

Conference control is based on the premise that the local venue in a multipoint conference. Otherwise, the conference control cannot be implemented.

1. HTTP Server will request the conference list and conference information to determine whether there

will be multipoint conference. If this is the case, the server will send the information together to HTTP Client. The conference list will be shown after data are interpreted.

2. Take presider application as an example to illustrate the processing flow of the conference control. When a general application for the presider is made, the venue sends WEB_RequestChairAPI to get an asynchronous response, which only indicates the result of the communication between the client and the server. It does not represent a success or failure in the actual application. When the application in the presider succeeds or fails, the result is reported through MSG_APPLY_CHAIR_RSP or can be obtained through the mailbox request WEB_GetMailBoxDataAPI.
3. The processing flow of watching the venue is similar to the presider application. However, the request of watching the venue WEB_ViewSiteAPI needs to include parameters, which have a structure like {'M': 1, 'T': 2}. After the server analyzes the parameters, it will notify other underlying modules.

3.2 Visual and sound flow

1. HTTP Client calls WEB_IsSendAuxStreamAPI to query HTTP Server on whether it is sending an auxiliary stream.

If not:
{"success":1,"data":"{\"isSendAux\":\"auxClose\"}"}
If yes:
{"success":1,"data":"{\"isSendAux\":\"auxOpen\"}"}

2. If the query comes back that there is not an auxiliary stream, then the user can click on the button to send it. HTTP Client calls the back-end WEB_IsConnectAuxSourceAPI to query HTTP Server on whether to connect the source of the auxiliary stream.

If connected:
{"success":1,"data":"{\"isSrcConnect\":\"unconnect\",\"errorId\":100667739,\"errorStr\":\"INVALID_VI_DVI_SEND\"}"}
If not connected:
{"success":1,"data":"{\"isSrcConnect\":\"connect\",\"errorId\":100663298,\"errorStr\":\"EMPTY\"}"}

3. If currently the secondary video source is connected, HTTP Client triggers WEB_StartSendAuxStreamAPI through UI_MSG_IS_SENDING_BLUE_SCREEN to request HTTP Server to send the auxiliary stream.

Success: {"success":1,"data":""}
Failure: {"success":0,"error":{"id":100666995,"code":33558532,"params":[]}}

4. If currently the auxiliary stream is being sent, HTTP Client triggers WEB_StopSendAuxStreamAPI through UI_MSG_IS_SENDING_BLUE_SCREEN to stop sending the auxiliary stream to HTTP Server.

Success: {"success": 1, "data": ""}
Failure:
{"success": 0, "error": {"id": 100666995, "code": 33558532, "params": []}}

3.3 Conference assembling process flow

The precondition of assembling conference is that the terminal is idle.

1. Request the predefined list of conferences, WEB_GetDefinedConfListAPI. HTTP Server will packet the predefined list of conferences and send them to the HTTP Client, which will analyze the list and show the predefined conference record.
2. To assemble a conference, the user can choose a predefined conference record to initiative the call, WEB_ScheduleConfAPI to get back an asynchronous response, which is only the communication result between HTTP Client and HTTP Server. The success or failure of the conference assembly is reported through MSG_SITECALL_RSP. The message can be obtained through the mailbox request WEB_GetMailBoxDataAPI.
3. After deleting a predefined conference, the user will receive an asynchronous response, which does not represent a successful deletion. If deletion is done, it will report MSG_SAVEBOOK_PRECONF, which indicates that the predefined conference record has been altered. After receiving the message, the user needs to rerequest the predefined conference list and refresh the interface. MSG_SAVEBOOK_PRECONF will also be received when modifying or adding predefined conferences.

4 Conclusion

This paper summarizes the problems in video conferencing control and puts forward the concrete idea of conference controlling software design of tablet-based teleconference system. With discussion on key technologies, it brings the solution to the difficulty to the self-served assembly of superlarge meetings and

the complexity of meeting control, proposing a layered control mode including the headquarter, provincial level (autonomous regions and municipalities), and municipal and county level. The design also establishes a method of privilege separation management based on database mapping technology, and a hierarchical authorization mechanism based on role management to realize an integrated command and one-level centralized control mode with three-level layered conference control mode. The operating pressure on the equipment is lowered by 67%, while the response speed per unit is up by 3 times on the ground of ensuring the conference quality. Small-scale conference can be self-served controlled by adopting independently developed conference control software and remote terminal monitoring technology.

It also designs and deploys tablet-based conference control APP for the conference video system with user-friendly interface. Thus, it meets the specific demands for application in public conference rooms and normalized management scenarios, providing technical guarantee for growing conference demands and promoting self-served conference organization. Right now, the software has been tried out in the internal video conferences in SGCC, giving a strong support to the production, scheduling, consultation, and training in the electric power sector.

In the future, the system can also be promoted to other enterprises and government departments, laying a solid technical foundation for organizations with more video conferencing needs to transit toward self-service conference control. It can also provide guarantees for them to further reduce office costs and enhance their management efficiency.

References

[1] Yanzhi S. Application of video conference system in group enterprise. Inf Technol Inf Technol 2012;2:84-86.

[2] Huibin C. Research on SGCC teleconference system technology and management. Telecommun Electric Power Syst 2007;28:1-7.

[3] State Grid Corporation of China. The Preliminary Design of SGCC Integrated Teleconference System Construction Project; 2013.

[4] Jin-Jing G, Qiao-Mu W, Li-Jun W. Design and application of SGCC main-standby mode teleconference system. Electric Power Inf Commun Technol 2014;12:87-90.

[5] Jin-Jing G, Xiao-Qing X, Xue-Feng C. Application scheme of MCU resource pool in large-scale video conference system. Electric Power Inf Commun Technol 2015;13:97-100.

[6] Xin-Zhi X, Guo-Chun L, Qiao-Mu W. An optimization method of MCU resource pool backup strategy for video conference system in SGCC. Electric Power Inf Commun Technol 2016;14:23-26.