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The Study of AnHui University Campus Network Architecture: Migration to A Scalable Network

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Chapter 1

1. INTRODUCTION

1.1 INTRODUCTION

Anhui University is a key construction University of the national "211" project, with a long history and profound culture. The school now has four campuses and a university science and Technology Park, with a construction area of 1.25 million square meters. There are about 28000 students, including about 6000 graduate students and 21500 full-time undergraduate and junior college students. Due to the problems of network planning in Longhe campus and Qingyuan campus, it is necessary to re plan the network architecture of the two campuses to ensure the redundancy of the network architecture and meet the needs of all aspects of the campus users. The campus network is a computer network based on modern network technology, multimedia technology and new technology, as a computer network connecting the campus internal teaching building, laboratory building, dormitory area and other campus intranets, and as a carrier connecting the campus intranet and the extranet, providing a good network operation environment for the comprehensive use of teaching, management, and information sharing between multiple campuses. At present, most colleges and universities in our country have implemented multi campus teaching. With the emergence of many new educational means, such as distance teaching, video conference system and so on, these high-efficiency teaching methods have higher requirements for the campus network. They not only realize cross regional campus resource sharing, improve the quality of teaching, but also adapt to the later development and expansion of the network.

Campus network is a typical representative of local area network. Through the network, the communication between Longhe campus and Qingyuan campus of Anhui University is realized, and the resource sharing and information exchange between the two campuses are convenient. With the increasing demand for multi campus network in Colleges and universities, the requirements for network planning in multi campus are more stringent, more network functions need to be realized, and more technologies need to be implemented. Therefore, the pre planning and design of multi campus is very important, which is the premise of the final network structure, which will directly affect the survival time of campus network, As well as the workload of late expansion, good early network planning, will determine the late development limitations of a network structure. Campus network is to promote quality education and meet the needs of the knowledge age. In view of these

problems, the network planning of Anhui University in the early stage has been unable to keep up with the speed of network development, so this topic is to carry out network planning and design according to the current network needs of Anhui University.

1.2 PROBLEM STATEMENT

At present, the campus network construction of Anhui University has been for many years, and there are many problems such as equipment aging. At the same time, due to the establishment of the new campus of Anhui University, the construction scale is relatively large, covering new student dormitories, family areas, office areas and other areas. However, with the increasing enrollment, teachers and students still need to quickly access internal and external resources through the campus network. At the same time, P2P software represented by Xunlei, BT and eMule is becoming more and more popular in the campus network, and a large number of broadband access resources are occupied, which seriously affects the normal Internet network application, resulting in unstable operation of the campus network, sudden failure of the network management center and too slow network speed, The delay is too high and the "broadband is not wide".

i. Reasons for slow network speed: in the previous network construction, the school did not limit the Internet traffic, resulting in some users using P2P software such as Xunlei and BT to forcibly occupy the network bandwidth, and the traffic of other users is reduced to the lowest. The intranet penetration ability of this software is very strong. With the continuous optimization of the software, the phenomenon of occupying resources is becoming more and more serious.

ii. Network hardware problem: due to the expansion of the school, the original server system can not meet the current demand, resulting in instability during the peak period of Internet access.

1.3 PROJECT OBJECTIVES

Starting from the objective demand, combining the actual demand and equipment selection, we design a reasonable scheme to build a campus network that is easy to manage, easy to expand, cross regional resource sharing and safe, so that the buildings in the double campus of Anhui university can conveniently and quickly realize the Internet function, and the campus network administrator can realize the humanized network management, So that students can easily find learning materials through the network, so that teachers and students of the two campuses can query the internal information of the school. The overall design of campus network should have the concept of integration, and scientific planning and design should be carried out.

i. This paper analyses the improvement needs of the original network of Anhui University, which is mainly reflected in the network needs, system needs, user needs and so on.

ii. Propose a network upgrade scheme and use the simulation network tool to simulate the implementation of the scheme.

1.4 PROJECT NOVELTY

In the 21st century, as a representative of the network era, the network technology is steadily rising and developing rapidly. As a place to spread knowledge, the campus should always keep in line with the new technologies, and provide a real-time technology learning environment for the next generation of technology stars in the motherland. Campus network should provide advanced information teaching environment for school teaching and scientific research, which requires a broadband, interactive and professional LAN [2]. In order to increase the core competitiveness of colleges and universities, we should adopt advanced network technology, practice the international network standards, standardize the multi campus network planning and design, and provide a safe, stable and humanized multi campus network platform for campus teachers and students. Network easy to manage and control platform, advanced teaching environment, for multi campus resource sharing, education and teaching, expand regional network management and other campus information applications and services to build to meet the needs of the environment. With a good network platform, the double campus mode of colleges and universities can give full play to its advantages, integrate information technology and teaching, make education keep up with the development of the information age, improve the teaching quality of colleges and universities, and enhance the core competitiveness of colleges and universities.

1.5 PROJECT APPROACH

a) In the early stage, we can complete the collection of multi campus related needs through the network, read the network planning documents through the library, network and other knowledge base, understand the design ideas of the campus network, communicate with the instructor frequently, understand the needs of the topic, and complete the preliminary planning and design.

b) Combined with the preliminary planning and design, the feasibility of using relevant simulators is simulated.

c) Communicate project requirements with instructor and complete related research.

1.6 SCOPE OF THE PROJECT

This topic is to plan and design the dual campus network of Anhui University. Before the completion of the network planning and design, we need to collect data in the early stage, sort out and analyze the needs of the Dual Campus of Anhui University, summarize the functional needs, international standard protocol guidelines, design a perfect cross regional dual campus network planning, and complete the unified management of the dual campus network, Follow up the pace of science education, improve the comprehensive competitiveness of the college.

a) Technical feasibility: for the campus network planning, we will adopt the international standard network protocol, according to the standard network engineering design for network planning.
b) Operational feasibility: we can use relevant simulators to simulate our network planning and design, and improve the improvement scheme.
c) Security feasibility: for the cross regional network connection between the two campuses, we will use VPN technology to realize the safe transmission of network data of the two campuses and reduce the cost.

Chapter 2

2. LITERATURE REVIEW

With the continuous development of the Internet age, as well as the expansion of the scale of higher education in China, the adjustment of the management system and layout of colleges and universities, today most colleges and universities have established new campuses or expanded on the basis of old campuses. On this basis , the network structure of the campus has changed, which has brought many inconveniences to teaching and management. Current network speed and management can no longer meet the needs of teaching. Multi-campus needs timely resource sharing and unified management of student data. But for multiple campuses, a unified campus network needs to be established (Ma et al., 2018). Nowadays, network communication technology is developing rapidly, and VPN technology is becoming more and more mature. By using VPN technology to build a remote virtual private network, you can use the public Internet to connect the school headquarters and branch campuses more effectively and safely at a lower cost. Together, realize the sharing and communication of data in multiple campuses (Alimi et al., 2015).

2.1 The purpose and significance of the multi-campus network upgrade plan

The upgrade planning and construction of the university campus network is an important link in the construction of the public service system of universities, and a good plan and design will lay a good foundation for the construction of digital and information campus (Highlights, 2009). With the development of global informatization, computer networks have also developed rapidly in recent years. The emergence and rapid development of the Internet and its related technologies have provided schools with excellent opportunities for information exchange and management through the network. The quality of network planning and design directly affects the survival conditions of the school's information system. An optimized and efficient network planning and design will promote the school's application architecture and accelerate the flow of information.

2.2 Current status of campus network

Most of the current campus networks were constructed ten years ago or even longer. This has created a certain obstacle to the informationization of campus construction. In addition, most of the hardware is aging, which is not conducive to the scalability and development of the network, and there is also network management.

Irregularities, network security precautions and other issues (Ao, 2015). Nowadays, with the reform of the university system, many universities have expanded their campuses and enrolled students. This has brought great challenges to the campus network. In order to enhance the comprehensive competitiveness of the school, the planning and design of many campus networks is of great significance.

2.3 Network construction goals

The campus network is divided into two kinds of intranet and extranet. The intranet can be used to assist teaching and realize the network support of campus multimedia equipment and electronic library. As far as the campus is concerned, students can receive multimedia teaching, through the self-study of the electronic library's spare time, and the safe management of student-related information by the information system, to achieve convenient, fast and unified management of information resources. For the outside of the campus, it is mainly the interaction of information inside and outside the campus. At the same time, the network planning and design of multiple campuses discussed in this topic should support the synchronization of data between the two campuses and the security of data transmission.

2.4 Network planning and design

i. Network planning

For the network planning and design of multiple campuses, the typical three-tier architecture of the school campus network is adopted, and the school network is divided into the core layer, the convergence layer, and the access layer. According to the actual situation of the multi-campus network, the network is divided into two parts: data center and office building. The office building and the data center are connected by 10 Gigabit fiber (10GE), the core layer and the exit boundary are connected by 10 Gigabit fiber (10GE), the core layer is connected by 1G fiber, and the access layer and the terminal are connected by Gigabit/100 Mega cable (1G/100M) connection. VPN tunnel technology is adopted for the connection between multiple schools to realize network data security and sharing.

ii. Principles of Network Design

Compared with the enterprise network, the campus network is a densely used network, and its functions need to be more perfect. The campus network focuses on the principles of simplicity, reliability, easy deployment, and easy maintenance. For a multi-campus network, the following principles should be followed :

a) Hierarchical: Generally speaking, the campus network is divided into a three-layer structure, namely, the access layer, the convergence layer, and the core layer. This architecture is stable and easy to expand later.
b) Modularization: each area of the campus network is divided into a module separately to reduce the scope of management and control, and the users of the corresponding scope have unified access rights to realize the access control of each area.
c) Security: For the campus network, student information needs to be secured. The security of the campus network can be ensured through both hardware and software (Clark et al., 1978). Devices connected to the network must be authenticated uniformly, and logically separated according to the access user identity and authority. Take physical isolation for particularly important services. The traffic entering and leaving the campus network must be identified and filtered to ensure network security.
d) Redundancy: In the normal sharing of teaching and school resources, the efficient transmission of data links should be improved to ensure the reliability of the link. The key routing and switching equipment should be redundantly configured, and load balancing or trunk links should be used. The key components are also redundantly backed up to improve the reliability of the network link (Umemoto et al., 2006).
e) Manageability and maintainability: In the later development, in order to facilitate management, the entire network management software can be used for management.
f) Scalability: The development of the network is rapid. Many campuses are now two campuses, which are likely to be expanded to multiple in the future. In the current network planning and design, we should consider these achievable factors in advance and do a good job of planed scalability.

iii. Network technology goals

a) VLAN technology: VLAN virtual local area network technology is a technology that realizes a virtual working group by logically dividing the devices in the local area network into network segments. It works in the second and third layers of the OSI reference model. Its advantage lies in limiting the broadcast range, reducing broadcast storms, forming a virtual working group, and dynamically managing each network segment working group. Enhance LAN security and reduce unnecessary waste of traffic.
b) DHCP protocol: DHCP dynamic host configuration protocol is a TCP/IP standard protocol that simplifies the management of host IP address allocation. It can dynamically assign a unique IP address to each device in the network, and provide safe, reliable and simple The TCP/IP network configuration ensures that no address conflict occurs and helps maintain the use of IP addresses. The advantage of this protocol is to avoid configuration errors caused by manually inputting values on each computer, which helps prevent IP address configuration conflicts between devices on the network, and reduces the time spent on configuring and reconfiguring computers on the network. (Younes, 2017).
c) DNS server: DNS domain name system, is a computer and network service naming system organized into a domain hierarchy. DNS naming is used for TCP / IP networks, such as the Internet. Many users like to use the easy to remember name to locate the computer on the network, but the computer uses the digital address to communicate on the network. In order to use network resources more conveniently, DNS provides a method to map the user's computer name to a digital address.
d) VRRP protocol: VRRP virtual routing redundancy protocol is a selection protocol, which can dynamically assign the responsibility of a virtual router to one of the VRRP routers on the LAN. The VRRP router, which controls the IP address of the virtual router, is called the master router and is responsible for forwarding packets to these virtual IP addresses. Once the primary router is not available, this selection process provides a dynamic fail over mechanism, which allows the IP address of the virtual router to be the default first hop router of the terminal host. Is a LAN access device backup protocol. All hosts in a local area network are set with default gateway, so that the message sent by the host whose destination address is not in the

network segment will be sent to the layer 3 switch through the default gateway, thus realizing the communication between the host and the external network . VRRP protocol can be used as a backup route. When one line fails, another line becomes a repeatable route immediately, which ensures the stability of the network.

e) Link aggregation technology: link aggregation technology refers to bundling multiple physical ports together to form a logical port, so as to realize the load sharing of outgoing / incoming traffic in each member port. The switch decides which member port the message is sent from to the opposite switch according to the port load sharing strategy configured by the user. When the switch detects a link failure of one of the member ports, it stops sending messages on this port, and recalculates the sending port in the remaining links according to the load sharing strategy, and recalculates the sending port after the failure port is recovered. Link aggregation is an important technology in increasing link bandwidth, realizing link transmission flexibility and redundancy. Different from VRRP technology, link aggregation technology is that multiple lines become forwarding lines at the same time to improve forwarding efficiency. The same thing is that when one line fails, data can be forwarded from another line.

f) STP protocol: STP spanning tree protocol, logically disconnect the loop to prevent the broadcast storm of layer 2 network.

g) HSRP protocol: HSRP dual machine hot standby protocol is carried on vgmp (VRRP group management protocol) message for transmission, and the backup of key configuration commands and session table state information between master and backup firewall is a dual machine hot standby protocol (Li et al., 1997).

h) ACL Technology: ACL access control list is a list of interface instructions between routers and switches, which controls the flow in and out of ports . The list can control network traffic, restrict access, and can also be used in combination with other protocols. Realize the superposition of functions(Zheng et al., 2017).

i) VPN Technology: VPN virtual private network, that is, the use of special encryption communication protocol in the Internet connected to two or more networks in different physical locations between the dedicated channel. This

technology is to encrypt and encapsulate the data on the public transmission network to form a dedicated channel of the public network, which is cost-effective, safe and convenient(Source and Description, n.d.).

2.5 Generic cabling

Generic cabling system (PDS) is a set of pre-set information transmission channels for computers, communication facilities and monitoring systems in buildings or between buildings. It connects voice, data, image and other equipment with each other, and enables the above equipment to connect with external communication network. Generic cabling system meets the requirements of office automation and computer network for cabling system. It is the medium channel of network transmission and the basis of network planning. The planning of generic cabling system also needs to meet the network design principles. The most important thing for the generic cabling system is the cable, including optical cable and twisted pair. During the on-site construction, there may be damage between the cables, and there may be problems such as wrong connection of cables during the termination. Based on these reasons, it is necessary to test the cable after it is deployed and terminated.

2.6 Summary

The planning and design of multi campus network is mainly divided into demand analysis, scheme design, scheme implementation and management maintenance. Each step is crucial. With detailed and perfect demand analysis, the goal of network construction can be determined, that is, the final effect of network planning. Therefore, the goal can be integrated into the scheme design to ensure the feasibility of network design. In the scheme design, we need to consider many factors, such as IP address and VLAN according to the reasonable regional planning, data transmission security hardware design and software design, campus expansion and increase campus scalability considerations. Every step is closely linked, and every link can not be relaxed, so as to design a more reasonable network planning for the two campuses, give full play to the advantages of network resource management and application, and provide a high-speed and stable support platform for the development of the school.

Chapter 3

3. RESEARCH METHODOLOGY

3.1 Literature research method

Literature research method is a method to obtain data by investigating literature according to a certain research purpose or topic, so as to comprehensively and correctly understand and master the problems to be studied. Literature research quilt is widely used in various disciplines. Its functions are:

a) to understand the history and current situation of relevant problems and help determine research topics.
b) It can form a general impression about the research object and contribute to observation and interview.
c) Comparative data that can obtain realistic data.
d) It helps to understand the whole picture of things.

The research on references shows that the planning and design of multi campus network is mainly divided into demand analysis, scheme design, scheme implementation and management maintenance. We need to complete the planning and design scheme of school network according to the analysis of network planning theory, including complete demand analysis Logical network design and topology, VLAN planning and IP allocation scheme, physical network design and hardware list.

3.2 Investigation method

Investigation method is one of the most used methods in scientific research. It is a purposeful, planned, and systematic method to collect materials about the actual or historical situation of the research object. Survey method is a basic research method commonly used in scientific research. It comprehensively uses historical method, observation method and other methods as well as scientific methods such as conversation, questionnaire, case study and test to have a planned, careful and systematic understanding of educational phenomena, and analyses, synthesizes, compares and summarizes a large number of data collected in the survey, so as to provide people with regular knowledge. The most used survey method is the questionnaire survey method. It is a research method to collect data by asking questions in writing, that is, the investigators prepare a table for the survey items, distribute or mail it to relevant personnel, ask for instructions, fill in the answers, and then recycle, sort out, count and study.

i Target Population

This project adopts the form of questionnaire to investigate and analyse the needs of students, teachers and school network administrators for the whole campus network. At the student level, students mainly consider whether they can normally complete teaching tasks and the demand for network in daily learning. Teachers mainly consider the network needs to develop teaching content. School managers mainly consider the coverage scale of the school network, network function requirements and the requirements of each demand for network performance.

ii Sample Size

The samples are mainly from students, teachers and staff of the information management center of Anhui University, as shown in Table 1. For more information about the questionnaire, please refer to the appendix.

Target Respondent	Student	Teacher	Information Center staff
Method	Sampling Survey	Questionnaire survey and sample interview	Sample interview
Survey Data Volume	100	20	6
Effective data volume	71	17	5

Table 1. Sample size

iii Data Collection Method

The questionnaire is created through the questionnaire star and sent to the respondents through the sample group established by social media.

iv Data analysis

a) Basic information on student coverage

Among the students who participated in the questionnaire survey, 55% were male students and 45% were female students, of which 38% were first-year students, 30% were sophomores, 25% were juniors, and 4-years were seniors 7%, 20% live on old

campuses, 70% on new campuses and 10% in other locations. It can be seen that the coverage rate of this survey is comprehensive and the data is referenced. According to the data, nearly 80% of students spend more than 3 hours a day online, as shown in Figure 3-1. In their study life, most students will use the Internet to learn, consult materials, entertainment, online shopping, etc., which shows that their demand for the Internet is very large, so having a good network environment and experience is crucial to their university life.

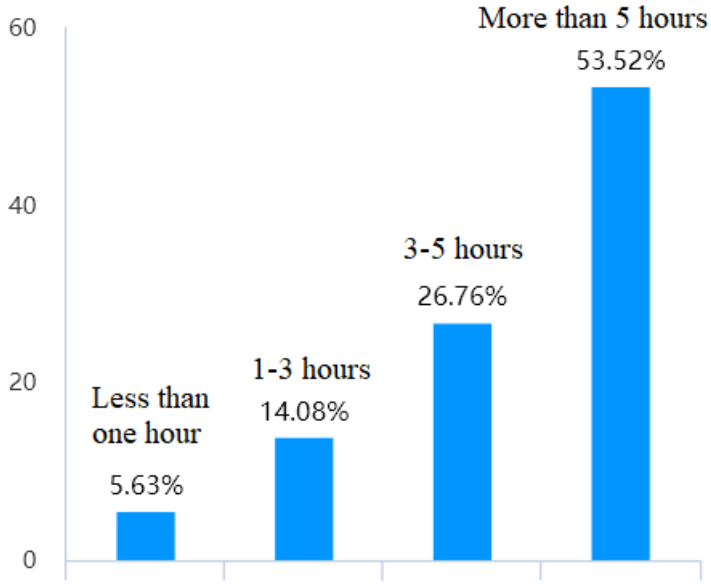

Figure 3-1 Students' daily Internet time

b) Students' evaluation of the quality of the campus network

As shown in Figure 3-2, only 4.23% of students feel that the school's internet speed is fast, 49 3% of students feel that the school's internet speed is average, and nearly half of the students think that the internet speed is slow or very slow. 90% of the students feel that the school's network is unstable, and most of the students think that the cost of the campus network is expensive, and the speed of business during the period is relatively slow. It can be seen that the school's broadband is relatively unstable, the network speed is slow, the cost is expensive and other factors cause the students' satisfaction with broadband to be relatively low.

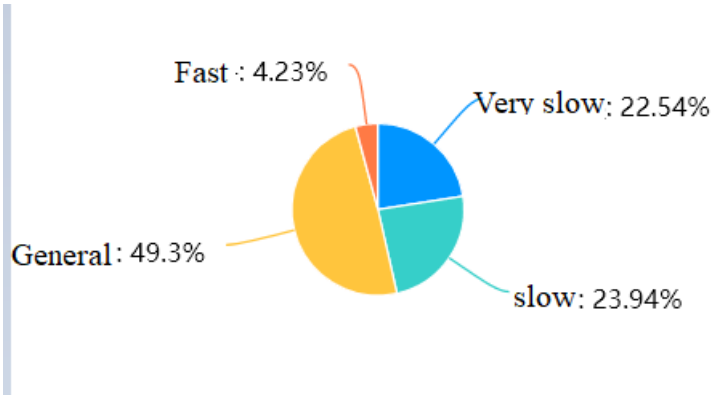

Figure 3-2 Students' evaluation of campus network speed

c) Students' attitudes towards campus network upgrades

Most of the students believe that the current campus network needs to be upgraded, mainly to investigate the two sections of the campus network wireless network coverage and learning resources, about 95% of the students support the school to carry out wireless network coverage, so that learning and life have brought convenience, nearly 80% of students believe that the current campus network to provide network resources and literature query is lacking, need to be improved.

d) Teacher’s evaluation of the network speed of the current campus network

As shown in Figure 3-3, 41.18% of teachers are very dissatisfied with the current network speed of the campus network, and 23.53% of the teachers feel that it is average and have no feelings, which can be seen that most of the teachers need to upgrade the school’s network speed.

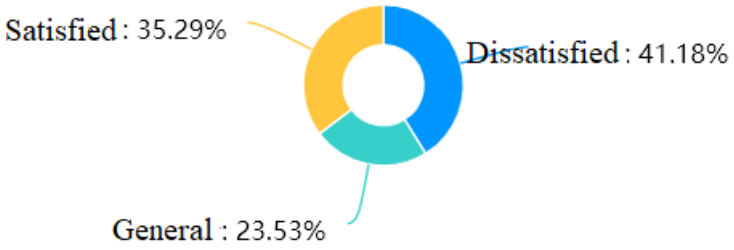

Figure 3-3 Teacher satisfaction with the speed of the campus network

e) Teacher's suggestions for campus network upgrades

As shown in Figure 3-4, the teachers believe that the priority issues in the development of the network in our school are to improve the bandwidth and speed of the education network, strengthen network security, and then increase the coverage of network terminals and add network applications. At the same time, 47% of teachers

believe that conditions should be created for students to use information technology in campus construction, and 35% of teachers believe that it is necessary to increase hardware investment, upgrade the campus network, and update old equipment. 88% of teachers believe that it is necessary to establish a learning website for an online teaching platform, focusing on the resource function, communication and cooperation function, online assessment and testing function. It can be seen that the upgrading of the campus network is imminent, mainly reflected in the network speed, learning resources and hardware equipment of the campus network.

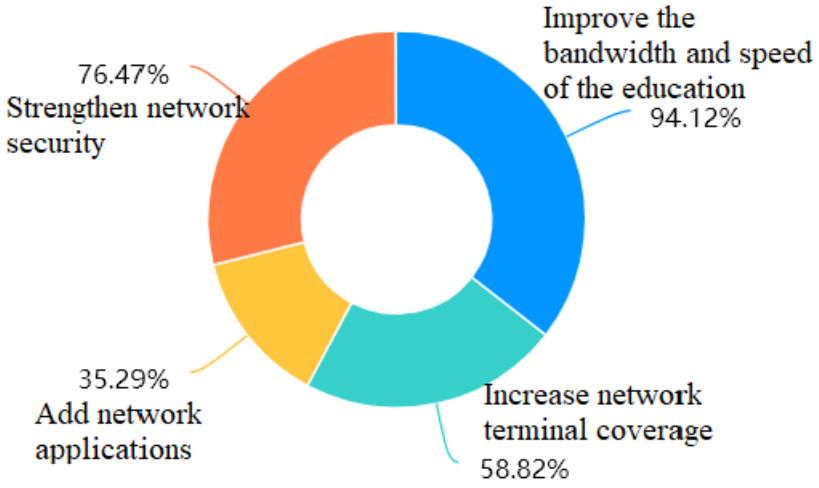

Figure 3-4 Teacher's priority consideration for problem solving

f) Evaluation of our campus network by the staff of the Information Center

The staff of the information center believes that the problems with the campus network are as follows: network access control cannot be carried out. Online behavior monitoring is not possible. Access devices in the same local area are at risk of mutual attack. The current network redundancy is not enough, the user increases more, the network can not be used, the typical performance is unstable, and there is no improvement for powerful users. The hardware and software are backward. Can not meet the peak period of Internet speed fluctuations, such as centralized course selection and other extraordinary time, will be exposed - some series of problems, such as management difficulties, poor user experience, should increase more equipment and personnel to maintain.

The staff of the information center believes that the campus network needs to be upgraded, which is mainly reflected in the following aspects: - the equipment can be centrally purchased for large batches of router switches, etc., and the second is for

network security problems, but also to do a good job of firewall measures to avoid security vulnerabilities. However, in the process of improvement, you need to pay attention to security risks.

v Conclusion

According to the questionnaire survey data, the following problems exist in our campus network:

a) Insufficient network coverage. With the expansion of the new campus, the completion of the gymnasium and the transformation of the experimental building, the original campus network can not meet the existing needs.
b) The network performance is unstable. The original network bandwidth, main switch switching capacity and server configuration have been unable to meet the needs of multimedia teaching and distance education.
c) Network management is difficult. With the increase of network users, the maintenance of network equipment and the management of network users are becoming more and more difficult.
d) The network security system is poor. There is no complete network security system; The performance of the original firewall is poor, which greatly limits the speed of external network access.
e) The export bandwidth is low, and a single dedicated line is connected to the Internet, which is far from meeting the demand. The interconnection between the education and scientific research network and the public network is unsatisfactory, and the network performance is not very stable.

3.3 Simulation method (model method)

Simulation method is a descriptive method to create a similar model according to the main characteristics of the prototype, and then indirectly study the prototype through the model.

Through the simulation method, create a model to simulate and realize the realization of the whole network design. This study mainly uses Eve virtual machine simulation, mainly including the construction of network topology, the application of related equipment, the realization of related technologies, test, and maintenance, etc.

In the whole project implementation process, the specific timeline is shown in Table 2.

Week	**Description**

Week 1-2	● Conduct detailed demand analysis of the project according to relevant survey data. ● Complete the requirements analysis report. ● Carry out the preliminary design of campus network planning according to the demand analysis report.
Week 3-4	● The detailed design of campus network planning is carried out according to the demand analysis report. ● Complete relevant design documents.
Week 5-6	● According to the design documents, the relevant functions are realized on the simulator Eve. ● Complete function implementation document.
Week 7-8	● Carry out system test to verify the realization of the function ● Edit test document
Week9-10	Organize all contents and complete relevant reports.
Week11-12	Prepare submission reports and project presentations.

Table 2. Timeline

Chapter 4

4. REQUIREMENT ANALYSIS

4.1 Construction objectives

According to the analysis of questionnaire data and relevant information documents provided by the school, starting from the objective needs, integrating the actual needs and equipment selection, designing a reasonable scheme, and building a campus network that is easy to manage, easy to expand, cross regional resource sharing and safe, so that each building in the Dual Campus of Anhui university can easily and quickly realize the Internet function, and the campus network administrator can realize humanized network management, so that students can easily find learning materials through the network, so that teachers and students in the two campuses can query the internal materials of the school. The overall design of campus network should have the concept of integration, and should carry out scientific planning and design.

With the rapid development of network, all kinds of network attacks have sprung up to ensure the security of network export and realize the safe and efficient transmission of data in multi campus. The real-time performance of network data is also very important. The core network equipment shall be well designed for redundancy to ensure the smooth transmission of network data in real time.

4.2 School network coverage

According to the records of the school library, the school is mainly composed of two cross regional campuses, namely Qingyuan campus and Longhe campus. As an old campus, the number of teachers and students in Longhe campus is not large, and only some undergraduate and graduate students are in school; Qingyuan campus is the new campus of Anhui University. All undergraduate students are in this campus. Compared with Longhe campus, the campus has a larger population of teachers and students. Therefore, most of the office and teaching of Anhui University are completed in the new campus.

As the main campus of Anhui University, Qingyuan campus is now divided into Mingqing square, Qingyuan square, wendiange library, gymnasium, erudite building, Duxing building, Shizhi building, Xingzhi building, Zhicheng Avenue, Duxiu Avenue and student dormitory. The buildings requiring network planning in Qingyuan campus are: erudite South Building a, B, C, D and E, erudite North

Building a, B, C and D, Duxing south building, Duxing North building, Shizhi building, Xingzhi building, wendiange library and student dormitory.

The layout of Longhe campus is the main teaching building, Shaw library, Wenjin building, audio-visual building and several dormitory areas. The two campuses need to plan the network access areas as teaching area, library and dormitory area. Longhe campus needs network building as the main teaching building, administrative building, Yifu Library, Wenjin building, audio-visual building and multiple dormitory areas.

4.3 Network demand analysis

As a dual campus network with large population density, we need to consider not only the high-speed forwarding of the network, but also the needs of network users. The network carrying capacity is combined with the network needs on campus and the actual planning of the dual campus network of Anhui University.

i. Intranet bandwidth requirements

As a campus network, the network objects are divided into students, teachers and outsiders, so as to ensure the network connection of teaching buildings, experimental buildings, libraries and dormitory areas and meet the basic Internet needs of campus users. According to the needs of users, the campus backbone network needs to adopt 10 Gigabit bandwidth connection. The core layer equipment adopts hot standby technology to support uninterrupted service in case of IP transmission failure [4]. The core network uses optical fiber for equipment interconnection, and the access layer is connected with the terminal by network cable.

ii. Backbone network demand analysis

As the operation core of a network, the backbone network supports the high-speed data forwarding of the whole Dual Campus Network and carries the data processing of the whole network. At the same time, as the outlet connecting the campus network, there is a large amount of data. Therefore, as a backbone network, it must also have the principles of high reliability, high-performance forwarding, high security and low delay to facilitate the convenient management of administrators. The backbone network has scalability, can be compatible with novel technologies and has multi service capability.

iii. Campus network export demand analysis

Firstly, as the exit of campus network, it is necessary to ensure the safe forwarding and receiving of network data, isolate external attacks and ensure the security of intranet. At the same time, the network outlet needs to process all kinds of data, access control all kinds of data, and control the request to access internal data. Therefore, it is necessary to use the corresponding traffic strategy for reasonable traffic control. Two operator lines are used, and both outlets have a bandwidth of 40 megabytes to ensure network reliability.

Secondly, as the connection port connecting the two campus networks, in order to ensure the safe data transmission between the two campuses and save the cost of special lines, it is necessary to use VPN virtual special line technology and use the public network to carry special line data to ensure data security and reap high benefits at low cost.

4.4 System requirements analysis

The dual campus network of Anhui University is a large-scale local area network with multi-user and high density. There are a large number of terminals, wired users and wireless users in a relatively fixed campus space. The Dual Campus Network Planning of colleges and universities focuses on the easy deployment, simplicity, reliability and easy maintenance of the network. The following principles should be followed in the network planning and design of Dual Campus of colleges and Universities:

Hierarchy: during network planning and design, the campus network is divided into access layer, convergence layer and core layer according to the three-tier structure. Each layer realizes the corresponding data transmission function, which is progressive. This architecture is stable, convenient for later network maintenance and easy for campus expansion planning.

Modularization: divide each physical area in the internal network of each campus into independent modules. For example, the teaching building is divided into erudite South Building and erudite North building, erudite south building is divided into a, B, C, D and E, and erudite North building is divided into a, B, C and D. here, each physical building can be divided into a module, and the functions in each independent module can be different, so as to reduce the management area, Controlling the network scale is helpful for troubleshooting, easy to manage multiple areas, and accurate positioning and determination of network problems in the later stage. According to the user access requirements between regions, formulate

reasonable access control restrictions, curb unreasonable access, realize the access control requirements of each module, and enable the module end users with access requirements to access the corresponding module end users,

Redundancy: for the network, it is very important to ensure the real-time, efficiency and reliability of data transmission. Therefore, in network planning, it is necessary to ensure the real-time communication of the network. Redundancy design must be done for the core key network equipment, such as link binding or load sharing, to realize the uninterrupted data forwarding of multiple physical lines and a virtual line. The redundant backup of key equipment is used to meet the availability requirements of the network and improve the high reliability of network data transmission.

Security: for the cross regional network connection of the dual campus network of Anhui University, we need to better consider the security issue, access the user identity to determine the access authority, and conduct logical partition isolation. For special important areas such as data centers, physical security isolation must be adopted to control network access traffic in real time and filter illegal access to ensure network security.

Scalability: in the early network planning of double campuses of Anhui University, the expansion of campus physical area in the later stage should be considered, and sufficient planning network segments should be reserved for the later development to facilitate the later network management statistics.

Advanced nature: for the rapid development trend of information age, planning equipment at different levels in the early stage of project design, not only can support the current stable basic technology, but also support advanced technology in the late stage, ensure the advanced nature of the network, and achieve the cost saving and the high-performance price ratio characteristics of the equipment with the development of Internet era.

Manageability and Maintainability: in the early network planning of the Dual Campus of Anhui University, it should be considered that in the later development process of the campus, appropriate network management software can be selected to manage the whole network, so as to facilitate the convenient management of the network administrator.

4.5 User demand analysis

The use of Dual Campus Network of Anhui university can be divided into teachers, students, administrators of school information center and external visitors according

to the operation authority of data. The network needs of different users need to be considered in the early network planning.

Students: in the teaching area, such places as erudite building, Benedictine building, appropriate building, Xingzhi building, library, canteen and dormitory, students need to provide wired and wireless internet access. In terms of wireless, the largest user that can be accommodated in a certain area should be considered to ensure that the planned network can provide the best platform for the teaching network. In the dormitory area, each student in each dormitory needs to have a wired interface. Wireless should meet the high-density Internet access needs. Both wired and wireless can access the corresponding server, as well as the access to external network resources.

Teachers: the teachers' office provides wired and wireless networks, enjoys ordinary Internet access rights, can access the corresponding servers in the data center, and has the corresponding operation permissions such as writing and modifying students' learning data in the relevant database.

Information Center administrator: carry out operation and maintenance management on the internal server and various databases of the school, and assign permission settings for accessing corresponding data.

External personnel: they can access the official website of the Dual Campus of Anhui University and have the function of querying and reading the public information of the campus. They cannot modify or enter the information. The administrator of the school information center sets the permissions for external visitors to restrict external access to prevent illegal access and follow the principle of secure access.

4.6 IP address transition requirements

The next generation Internet implemented in China is developing, and IPv6 technology is only used in some limited areas, but it is an inevitable trend for the transition from IPv4 to IPv6 address planning. In the scheme design, it is necessary to consider whether the equipment supports IPv4 and IPv6 at the same time. In addition to the basic network interconnection equipment, the support for IPv6 and hardware of network security and network management must also be considered. Because even if there is no IPv6 requirement for the current campus network, we must consider the trend of later network development to ensure the advanced nature of the network.

For the network development trend, IPv4 and IPv6 will coexist in the later stage of the campus network, and this transition period is bound to last for a long time. Therefore, ensuring the smooth communication between IPv4 and IPv6 hosts in the campus network is the IP address demand that must be considered in the early planning of the campus network.

Chapter 5

5. PRELIMINARY THEORETICAL DESIGN OF THE SYSTEM

5.1 Topology design

Anhui University has two campuses, one Longhe campus and one Qingyuan campus. Both campuses are distributed with teaching buildings, libraries, student dormitories and other outdoor venues for student activities. The two campuses are connected across regions, so we use GRE VPN for the connection of the two campuses to conduct virtual private channel on the public network line, so as to save costs and ensure exit safety. Qingyuan campus is the new campus of Anhui University. Most of the teaching and office work are completed here. The campus has a greater density of teachers and students, and the server is set up in Qingyuan campus. The coverage of medium and large campus LAN is very wide, with large number and density of terminals. Therefore, the equipment with excellent performance and powerful function must be adopted to ensure the stable, safe and reliable operation of the whole system. As shown in Figure 5-1， 5-2.

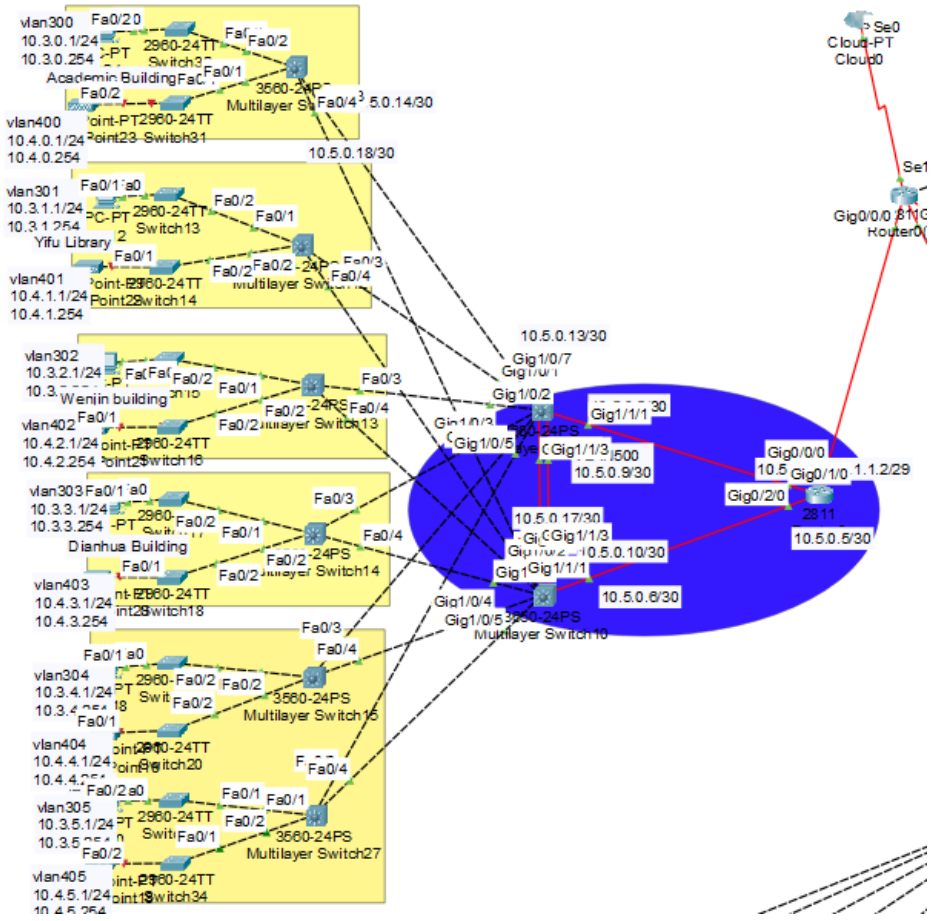

Figure 5-1 Longhe Campus network topology design diagram

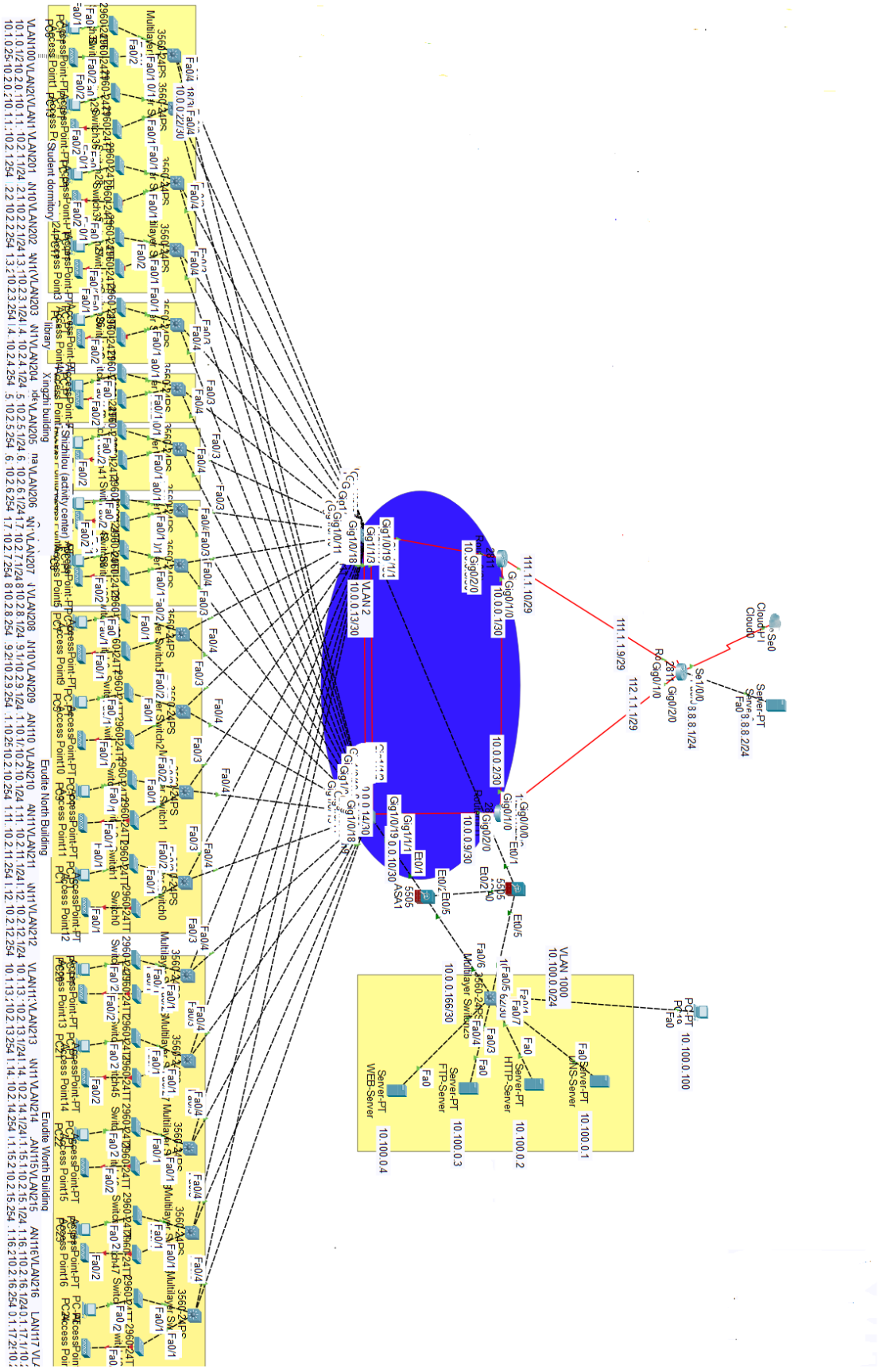

Figure 5-2 Qingyuan Campus network topology design diagram

Note: due to the bearing capacity and equipment limitations of Cisco Packet Tracer simulator, all fast Ethernet ports in the network topology diagram represent Gagibit Ethernet ports.

5.2 Wired network structure planning and design

Fully consider the current situation and practical needs of the network layout of new and old campuses, and design a campus network architecture with reasonable layout, clear level, safety and reliability. The large-scale LAN adopts a flat, two-tier structure design, which is divided into three parts: access layer, aggregation layer and core layer. The highest core layer of the three-tier structure is generally composed of two high-performance core switches, which are load balanced and redundant to each other, so as to realize the reasonable data forwarding of the two core switches, improve the reliability of data forwarding, ensure the high-speed forwarding characteristics of the network, and provide uplink convergence for the convergence layer of all independent buildings of each school area wired network; Install convergence equipment in each building and important venues to provide a convergence point for each building for convergence data forwarding; The access layer is composed of independent building main access switch to realize the connection between end users. In the planning and design of the dual campus of Anhui University, the three-story structure is shown in Figure 5-3.

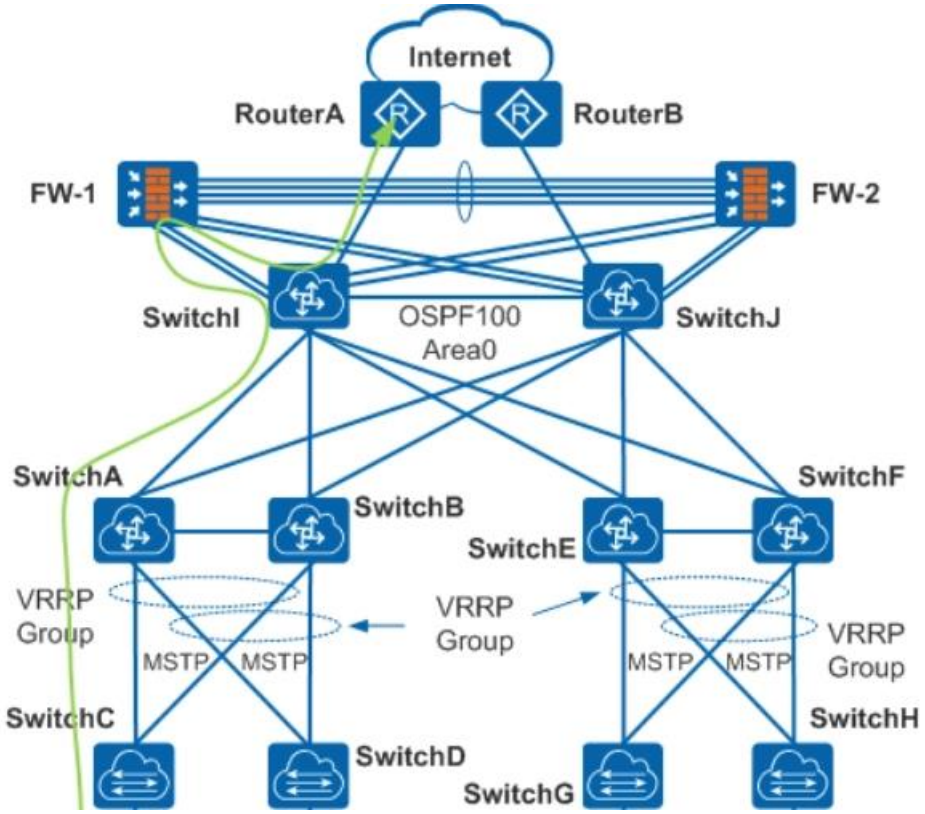

Fig. 5-3 Three-layer structure diagram

5.2.1 Core layer network design

The core layer is at the highest level of the three-tier topology structure. It is the core equipment of the campus network. It must have reliable, high-performance, non blocking forwarding capability, provide strong switching capability and redundant backup, and facilitate management and expansion. The core layer connects all convergence layer switches of each campus to forward the end-user traffic of each teaching building or dormitory area between campuses. As the core equipment of the campus network, in order to reduce the delay and ensure the network availability, the core layer mostly needs to adopt redundant design technologies such as port binding or load balancing, so that the two core equipment can exchange evenly, ensure the uninterrupted and backup of the network, and improve the flexibility and availability of the network. As the data forwarding layer of campus network, the core layer needs to have high bandwidth and high forwarding performance, keep the device configuration as simple as possible, and support the high-speed forwarding of internal and external traffic on campus. Therefore, the core layer equipment should choose the equipment with the highest configuration and the best performance to support the high reliability and high forwarding of the campus network. 10Gb / s optical cable is used between the core layer equipment and the aggregation layer equipment to ensure the high-speed network forwarding of users in the campus. Therefore, when selecting core equipment, switches supporting high bandwidth and high performance should be selected to ensure network reliability.

5.2.2 Convergence layer network design

In the large-scale LAN such as campus network, the aggregation layer is a connection point between the core layer and the access layer of the network. The convergence layer of the campus network is the convergence point of a teaching building or a student dormitory. The equipment of the convergence layer is used to forward the data of the lower access layer to other convergence layers and the data sent to the upper core layer. The convergence layer connects a large number of end users to the interconnected network and modularizes the number of users accessing the core layer equipment. The aggregation layer needs to have the characteristics of high bandwidth, high port density, high forwarding, etc. to support the flow

transmission between the devices in the next access layer of the aggregation layer. Link bundling technology and virtual routing redundancy technology can be used in the aggregation layer. Link aggregation is that multiple ports can run one service, so that one active and one standby can be put into operation. When the main device runs the service, The backup device cannot run the service. When the main device goes down, the virtual device immediately wakes up and the backup device is put into operation, which can ensure the uninterrupted work of the network. Various protocols ensure the efficiency and reliability of network operation and improve the forwarding efficiency of aggregation layer. The aggregation layer switch undertakes efficient forwarding traffic, connecting the core layer switch and the access layer switch. Therefore, the link bandwidth between the aggregation layer equipment and the core layer equipment is planned as Gigabit bandwidth, and the link bandwidth between the aggregation layer equipment and the access layer equipment is planned as Gigabit bandwidth. For areas with high Internet density such as dormitory area and library, better three-tier equipment should be selected.

5.2.3 Access layer network design

The access layer is the lowest layer of the three-tier structure and the network closest to the end users. It provides various access modes for the end users. The switch has low-cost, high-density and high-speed ports to support more terminals to access the campus network. The equipment connected with the information point can select the equipment with relatively low performance. Generally, each information point in the building is connected to the access switch port through class 5 twisted pair with bandwidth of 100MB / s. At present, many terminals support 100MB / s and 1GB / s adaptation. Therefore, for some areas with high network requirements, access layer switches with slightly better functions and 1GB / s ports can be set, and the two can be connected with twisted pair capable of supporting 1000mb / s.

5.3 Campus network exit network design

As the connection between the campus intranet and the outside, the campus exit network uses ACL access control list technology and NAT address translation technology to realize advanced access control and ensure exit security in order to limit the mutual access authority of the internal and external networks and restrict the flow of data in and out of the network. At the same time, in terms of hardware,

firewall equipment is used. The so-called firewall is to form a protective barrier between the internal network and the external network. It is a combination of computer hardware and software. Generally, double protection is used for network exports. When connecting the external network outlet, ensure the smooth line. When designing the network outlet of the dual campus, the outlets of Qingyuan campus are telecom operators and mobile operators respectively, and Longhe campus is a single operator outlet. For the exit address, a public network segment with a small number of available IPS is allocated as the exit translation address pool, which is used as the address pool that can be converted when the intranet accesses the external network.

5.4 Wireless network planning and design

With the development of wireless network, WLAN has been used more and more widely. In the network planning of double campuses of Anhui University, almost every area requiring network planning needs to build wireless network. Now most of them use professional wireless devices such as wireless AP and ac. wireless AP is the wireless access point to realize the coverage of wireless network; Wireless AC is the controller, which is used for unified control and management of AP. It is the core of wireless network. It uses wireless network technology to move in some areas of the campus and keep the network uninterrupted. The advantage of wireless network is that it adopts wireless networking technology and has a high degree of spatial freedom and network flexibility.

There are two modes of wireless AP: fat AP mode. Each AP controls itself. Each AP is an independent individual and can work independently to achieve wireless area coverage. In the thin AP mode, compared with the fat AP, a wireless controller needs to be added in the network center to uniformly manage each independent AP to form a centrally managed wireless control area.

For the campus network, there is little demand for wireless functional diversity. We need to ensure that users can flexibly access wireless and provide wireless internet access function. Considering comprehensively, selecting fat AP mode can meet this demand and save equipment cost.

5.5 Network security planning and design

Longhe campus and Qingyuan campus of Anhui University are connected across regions. We need to consider not only the security of public network transmission connection, but also the security challenges faced by campus users connecting to the external network. Today is an era of big data. All kinds of data of network users are recorded in the network. Ensuring network security is a process that must be considered in every network planning. Access control list entries are configured on the exit equipment to isolate some illegal traffic, and firewall equipment is set up at important data center connections. The so-called firewall refers to a protective barrier composed of software and hardware equipment and constructed on the interface between intranet and extranet, private network and public network. The combination of software and hardware isolates illegal access.

5.6 IP and VLAN planning and design

Anhui University has Longhe campus and Qingyuan campus. The following building areas of Qingyuan campus need network planning: buildings a, B, C, D and e of boxue South Building and buildings a, B, C and D of boxue North building; Benedictine building (experimental building) is divided into Benedictine South Building and Benedictine North building; Student activity center; Shizhilou (Modern Educational Technology Center); library; The student dormitory is divided into one group of Gui Garden, Feng Garden and Huai garden, two groups of pine garden, bamboo garden and plum garden (three friends of winter), three groups of peach garden, Li Garden and orange garden, and four groups of jujube garden, durian garden and Apricot Garden. VLAN division and IP address allocation are designed according to the actual situation of the campus.

The existing building areas of Longhe campus need network planning: main teaching building, Yifu Library, Wenjin building, audio-visual building and many student dormitories.

The number of IPv4 addresses is limited, so it is in the campus network IP address planning adopts subnet division technology to scientifically and reasonably allocate IP address and save address space.

The rational division of VLAN can effectively reduce the management area. This campus network planning will divide the VLAN of campus network based on area and service.

The IP address and VLAN planning of each area of Qingyuan campus are shown in table 5-1.

Table 5-1 IP and VLAN planning of each area of Qingyuan Campus

Area	Wired / wireless services	IP segment	VLAN
Student dormitory group 1	wired	10.1.0.0/24	VLAN100
	wireless	10.2.0.2/24	VLAN200
Student dormitory group 2	wired	10.1.1.0/24	VLAN101
	wireless	10.2.2.0/24	VLAN201
Student dormitory group 3	wired	10.1.2.0/24	VLAN102
	wireless	10.2.20/24	VLAN202
Student dormitory group 4	wired	10.1.3.0/24	VLAN103
	wireless	10.2.3.0/24	VLAN203
library	wired	10.1.4.0/24	VLAN104
	wireless	10.2.4.0/24	VLAN204
Xingzhi building	wired	10.1.5.0/24	VLAN105
	wireless	10.2.5.0/24	VLAN205
Comfortable building	wired	10.1.6.0/24	VLAN106
	wireless	10.2.6.0/24	VLAN206
Tuhang building north building	wired	10.1.7.0/24	VLAN107
	wireless	10.2.7.0/24	VLAN207
Tuhang South Building	wired	10.1.8.0/24	VLAN108
	wireless	10.2.8.0/24	VLAN208
Erudite North Building A	wired	10.1.9.0/24	VLAN109
	wireless	10.2.9.0/24	VLAN209
Erudite North Building B	wired	10.1.10.0/24	VLAN110
	wireless	10.2.10.0/24	VLAN210
Erudite North Building C	wired	10.1.11.0/24	VLAN111
	wireless	10.2.11.0/24	VLAN211
Erudite North Building D	wired	10.1.12.0/24	VLAN112
	wireless	10.2.12.0/24	VLAN212
Erudite South Building A	wired	10.1.13.0/24	VLAN113
	wireless	10.2.13.0/24	VLAN213
Erudite South Building B	wired	10.1.14.0/24	VLAN114
	wireless	10.2.14.0/24	VLAN214
Erudite South Building C	wired	10.1.15.0/24	VLAN115
	wireless	10.2.15.0/24	VLAN215
Erudite South Building D	wired	10.1.16.0/24	VLAN116
	wireless	10.2.16.0/24	VLAN216
Erudite South Building E	wired	10.1.17.0/24	VLAN117
	wireless	10.2.17.0/24	VLAN217

Table 5-2 shows the IP network segment planning of equipment interconnection between the convergence layer and the core layer of Qingyuan campus.

Table 5-2 IP network segment planning of equipment interconnection between convergence layer and core layer in Qingyuan Campus

Area	IP segment
QY-HJ-SW1---QY-HX-SW1	10.0.0.16/30
QY-HJ-SW1---QY-HX-SW2	10.0.0.20/30
QY-HJ-SW2---QY-HX-SW1	10.0.0.24/30

QY-HJ-SW2---QY-HX-SW2	10.0.0.28/30
QY-HJ-SW3---QY-HX-SW1	10.0.0.32/30
QY-HJ-SW3---QY-HX-SW2	10.0.0.36/30
QY-HJ-SW4---QY-HX-SW1	10.0.0.40/30
QY-HJ-SW4---QY-HX-SW2	10.0.0.44/30
QY-HJ-SW5---QY-HX-SW1	10.0.0.48/30
QY-HJ-SW5---QY-HX-SW2	10.0.0.52/30
QY-HJ-SW6---QY-HX-SW1	10.0.0.56/30
QY-HJ-SW6---QY-HX-SW2	10.0.0.60/30
QY-HJ-SW7---QY-HX-SW1	10.0.0.64/30
QY-HJ-SW7---QY-HX-SW2	10.0.0.68/30
QY-HJ-SW8---QY-HX-SW1	10.0.0.72/30
QY-HJ-SW8---QY-HX-SW2	10.0.0.76/30
QY-HJ-SW9---QY-HX-SW1	10.0.0.80/30
QY-HJ-SW9---QY-HX-SW2	10.0.0.84/30
QY-HJ-SW10---QY-HX-SW1	10.0.0.88/30
QY-HJ-SW10---QY-HX-SW2	10.0.0.92/30
QY-HJ-SW11---QY-HX-SW1	10.0.0.96/30
QY-HJ-SW11---QY-HX-SW2	10.0.0.100/30
QY-HJ-SW12---QY-HX-SW1	10.0.0.104/30
QY-HJ-SW12---QY-HX-SW2	10.0.0.108/30
QY-HJ-SW13---QY-HX-SW1	10.0.0.112/30
QY-HJ-SW13---QY-HX-SW2	10.0.0.116/30
QY-HJ-SW14---QY-HX-SW1	10.0.0.120/30
QY-HJ-SW14---QY-HX-SW2	10.0.0.124/30
QY-HJ-SW15---QY-HX-SW1	10.0.0.128/30
QY-HJ-SW15---QY-HX-SW2	10.0.0.132/30
QY-HJ-SW16---QY-HX-SW1	10.0.0.136/30
QY-HJ-SW16---QY-HX-SW2	10.0.0.140/30
QY-HJ-SW17---QY-HX-SW1	10.0.0.144/30
QY-HJ-SW17---QY-HX-SW2	10.0.0.148/30
QY-HJ-SW18---QY-HX-SW1	10.0.0.152/30
QY-HJ-SW18---QY-HX-SW2	10.0.0.156/30

The IP address and VLAN planning of each area of Longhe campus are shown in table 5-3.

Table 5-3 IP and VLAN planning of Longhe Campus

Area	Wired / wireless services	IP segment	VLAN
Main building of teaching building	wired	10.3.0.0/24	VLAN300
	wireless	10.4.0.0/24	VLAN400
Yifu Library	wired	10.3.1.0/24	VLAN301
	wireless	10.4.1.0/24	VLAN401
Wenjin building	wired	10.3.2.0/24	VLAN302
	wireless	10.4.2.0/24	VLAN402
Electrochemical building	wired	10.3.3.0/24	VLAN303
	wireless	10.4.3.0/24	VLAN403
Student dormitory group 1	wired	10.3.4.0/24	VLAN304
	wireless	10.4.4.0/24	VLAN404
Student dormitory group 2	wired	10.3.5.0/24	VLAN305
	wireless	10.4.5.0/24	VLAN405
Administration	wired	10.3.6.0/24	VLAN306

building	wireless	10.4.6.0/24	VLAN406

Table 5-4 shows the IP network segment planning of equipment interconnection between convergence layer and core layer in Longhe campus.

Table 5-4 IP network segment planning of equipment interconnection between convergence layer and core layer in Longhe Campus

Area	IP segment
LH-HJ-SW1---LH-HX-SW1	10.5.0.12/30
LH-HJ-SW1---LH-HX-SW2	10.5.0.16/30
LH-HJ-SW2---LH-HX-SW1	10.5.0.20/30
LH-HJ-SW2---LH-HX-SW2	10.5.0.24/30
LH-HJ-SW3---LH-HX-SW1	10.5.0.28/30
LH-HJ-SW3---LH-HX-SW2	10.5.0.32/30
LH-HJ-SW4---LH-HX-SW1	10.5.0.36/30
LH-HJ-SW4---LH-HX-SW2	10.5.0.40/30
LH-HJ-SW5---LH-HX-SW1	10.5.0.44/30
LH-HJ-SW5---LH-HX-SW2	10.5.0.48/30
LH-HJ-SW6---LH-HX-SW1	10.5.0.52/30
LH-HJ-SW6---LH-HX-SW2	10.5.0.56/30

5.7 Wiring system design

5.7.1 Cabling system selection

As the perfect foundation of LAN network, cabling system has become an indispensable and important part. The cabling system of computer network can be divided into two types: one is structured cabling system and the other is unstructured cabling system. Structured cabling system refers to the safe transmission lines in buildings or building groups. These transmission lines are used to connect all voice equipment, data communication equipment, image processing and safety monitoring equipment, switching equipment and other information management systems, and form a whole system according to a certain order and internal relationship. The transmission medium, cabling equipment and connection components used in the structured cabling system are standardized.

Structured cabling system can support comprehensive applications and has many advantages. For example, structured cabling system adopts modular design, which is easy to expand and maintain; Good compatibility; It has good adaptability to different systems; The standardized design is more scientific, economical and practical. Therefore, the structured wiring system is to reasonably plan the design of system wiring, so that the wiring system in the building is easy to manage.

5.7.2 Composition of wiring system

The structured cabling system consists of work area subsystem, horizontal trunk subsystem, vertical trunk subsystem, management room subsystem, equipment room subsystem and building group subsystem.

Work area subsystem: it is composed of computer, network printer, telephone and other terminal equipment through the connection between RJ-45 socket, image information socket and jumper.

Horizontal trunk subsystem: it is the connecting line between the distribution frame of the subsystem in the management room and the information socket of the subsystem in the work area. It is the plane branch system of each floor of the building. The transmission medium generally adopts optical cable and twisted pair. Considering the problem of line safety, the transmission medium is directly connected between the subsystem distribution frame in the management room and the information socket. When the coverage of the system is too large, the transfer point can be set appropriately.

Vertical trunk line subsystem: corresponding to the horizontal trunk line subsystem, it is the horizontal trunk line subsystem connecting each plane floor vertically downward through the transmission medium. It is an important part of the whole structured wiring system. It is placed in the shaft of each floor by using the vertical installation method and connected with the management room subsystem in each floor.

Management room subsystem: it is used to connect the horizontal trunk subsystem and the vertical trunk subsystem, and can flexibly adjust the line connection relationship of each working area.

Equipment room subsystem: it is a machine room in a building used to install large-scale communication equipment, terminals, servers, convergence layer equipment or access layer equipment. The core part of the system has a strict installation

environment, and UPS (uninterruptible power supply) must be equipped in the machine room to ensure the uninterrupted operation of the system and network links.

Building group subsystem: it connects and extends the cables in the building and connects with the devices or communication equipment of other buildings. The lines exist outdoors to realize the orderly connection between various buildings in a building group.

5.8 Physical network scheme

5.8.1 Information point layout

Qingyuan campus includes 9 teaching buildings, 2 experimental buildings, 1 library, 1 student activity center, 1 modern educational technology center, library, 3 canteens and 4 groups of dormitory areas.

Qingyuan campus has 12 dormitory buildings, each of which has 5 floors and 30 rooms. The dormitory of the school is a six room dormitory, with one information point in each room and a total of 180 Ethernet wall jacks in each dormitory building. The wiring system of the campus adopts a structured wiring scheme, and the management room subsystems on each floor of the building are constructed separately, The statistics of Ethernet wall jacks in the dormitory area are shown in table 5-5.

Table 5-5 dormitory Ethernet wall jacks of Qingyuan Campus

Floor	Ethernet wall jacks	Total
1	30×1	30
2	30×1	30
3	30×1	30
4	30×1	30
5	30×1	30
6	30×1	30
Total	180	

The South Building of erudition in Qingyuan campus has the same architectural pattern as the North Building of erudition. Each building has five floors, 15 classrooms on each floor, 2 Ethernet wall jacks in each classroom, and a total of 100 Ethernet wall jacks are required in each building of erudition building. The statistics of Ethernet wall jacks of erudite building are shown in table 5-6.

Table 5-6 Ethernet wall jacks of erudite building in Qingyuan Campus

Floor	Ethernet wall jacks	Total
1	15×2	30
2	15×2	30

3	15×2	30
4	15×2	30
5	15×2	30
Total	150	

The construction pattern of tuhang South Building in Qingyuan campus is the same as that of tuhang North building. Each building has 5 floors, 10 classrooms on each floor and 4 Ethernet wall jacks in each classroom. Each building needs a total of 200 Ethernet wall jacks. The statistics of Ethernet wall jacks in tuhang building are shown in table 5-7.

Table 5-7 Ethernet wall jacks of Duxing building in Qingyuan Campus

Floor	Ethernet wall jacks	Total
1	10×4	40
2	10×4	40
3	10×4	40
4	10×4	40
5	10×4	40
Total	200	

Other buildings use the same method above to estimate statistics, and the results are as follows:

Qingyuan campus suitable building: 1 * 3 * 11 * 2 Ethernet wall jacks.

Xingzhi building of Qingyuan Campus: 1 * 3 * 2 * 10+1 * 3 * 5 * 5 Ethernet wall jacks.

Wendiange Library of Qingyuan Campus: there are 600 Ethernet wall jacks in total.

Main teaching building of Longhe Campus: 1 * 5 * 15 * 2 Ethernet wall jacks.

Yifu Library in Longhe Campus: 500 Ethernet wall jacks.

Wenjin building of Longhe Campus: 1 * 5 * 10 * 2 Ethernet wall jacks.

Electrification building of Longhe Campus: 1 * 5 * 10 * 2 Ethernet wall jacks.

Dormitory building of Longhe Campus: 10 * 4 × 20 * 2 Ethernet wall jacks.

5.8.2 Wiring scheme

In the planning and design of the physical network scheme, the structured wiring scheme is selected. In the preliminary design, the wiring design is carried out according to the six subsystems of the building, such as the work area subsystem, the horizontal trunk subsystem, the management room subsystem, the vertical trunk subsystem, the equipment room subsystem and the building group subsystem, so as

to make the operation of each module independent. In the preliminary design of structured cabling scheme, the following steps shall be referred to:

i. Determine the campus building layout and summarize the wiring requirements of each subsystem;
ii. Draw the construction drawings of buildings in the campus;
iii. Determine the cable direction during wiring according to the building construction drawing;
iv. Determine the materials and quantity required for wiring

5.9 Equipment selection

5.9.1 Export equipment selection

Export equipment We select a high-performance router to support a large number of data forwarding routes, select Huawei AR2240C-S, the relevant parameters of this model device are shown in Table 5-6.

Table 5-6 AR2240C-S parameter table

The router type	Enterprise-class routers
Transfer rate	10/100/1000Mbps
Port structure	Modularization
Other ports	3 Ge (2 combo) 2 USB2 0 port 1 Mini USB console port 1 serial auxiliary / console port
Extensions	4 SIC slots + 2 WSIC slots + 2 XSIC slots + 1 EXSICslot + 3 DSP slots

5.9.2 Core equipment selection

The core layer device selects a layer 3 switch to support high-speed forwarding of data in the intranet, and the selected device model is Huawei S7706, and the relevant parameters of the device model are shown in Table 5-7.

Table 5-7 S7706 Parameter Table

The product type	Routing switches, POE switches
Application hierarchy	Three floors
Transfer rate	10/100/1000Mbps
Interchange mode	Store-forward
Backplane bandwidth	3.84Tbps/5.12Tbps
Packet forwarding rate	1152Mpps/2880Mpps
Port structure	modularization
Extensions	6 business slots

5.9.3 Aggregation equipment selection

Aggregation layer equipment selects a layer 3 switch to support intranet downlink data sent uplink, and uplink data sent downlink data high-speed forwarding, the selected device model is Huawei S5720-32X-EI-AC, the relevant parameters of this model of equipment are shown in Table 5-8.

Table 5-8 S5720-32X-E-ACI parameter table

The product type	Gigabit Ethernet switch
Application hierarchy	Three floors
Transfer rate	10/100/1000Mbps
Product memory	RAM:2048MB,FLASH:340MB
Interchange mode	Store-forward
Backplane bandwidth	598Gbps/5.98Tbps
Packet forwarding rate	252Mpps
MAC address table	64K
Port structure	Non-modular
The number of ports	32
Port description	24 x 10/100/1000Base-T Ethernet ports, 4 x 100/1000 SFP, 4 x 10 Gigabit SFP+, 2 QSFP+
Transfer mode	Full-duplex/half-duplex adaptive

5.9.4 Access layer device selection

The access layer device selects the Layer 2 switch to forward the terminal data and the reception of the terminal data, and the selected device model is Huawei S5720-52X-PWR-LI-AC, and the relevant parameters of the model device are shown in Table 5-9.

Table 5-9 S5720-52X-PWR-L-ACI parameter table

The product type	POE switch
Transfer rate	10/100/1000Mbps
Backplane bandwidth	336Gbps/3.024Tbps
Packet forwarding rate	144Mbps/166Mbps
MAC address table	16K
The number of ports	52
Port description	48 10/100/1000Base-T Ethernet ports 4 10 Gigabit SFP+

5.9.5 Firewall device selection

Hardware security needs based on dual-campus campus networks. Firewalls are installed to protect against threats and intrusions from outreach networks. The model selected for the firewall device is USG6550, and the relevant parameters of the device of this model are shown in Table 5-10.

Table 5-10 USG6550 Parameter Table

Device type	Next-generation firewalls

Network port	8GE+4SFP
VPN support	Support rich and high reliability VPN features, such as IPSec VPN, SSL VPN, L2TP VPN, MPLS VPN, GRE, etc
Intrusion detection	Attack detection and defense against more than 5000 vulnerability characteristics. Get the latest threat information the first time to accurately detect and defend against vulnerabilities. Protects against a variety of web-targeting attacks, including SQL injection attacks and cross-site scripting attacks.
manage	Preset common protection scenario templates to quickly deploy security policies and reduce learning costs. Automatically assess the risks of security policies and intelligently give optimization suggestions; Support policy conflict and redundancy detection, discover redundant and long-term unused policies, and effectively control policy scale;

Chapter 6

6. FEATURE IMPLEMENTATION

The simulation experiment uses the Cisco Packet Tracer simulator to design the overall topology map and implement the requirements function according to the campus network planning requirements of Anhui University's Lingyuan Campus and Longhe Campus.

6.1 Network egress function implementation

The egress location of the dual-campus network uses router equipment, and the following technologies are used in the egress device to realize the egress equipment demand function. Take the configuration document of the Exit Router 1 (QY-R1) of the Lingyuan Campus as an example.

i The up interface related to the egress device has the function of data routing and forwarding

```
interface GigabitEthernet0/0/0
ip address 111.1.1.10 255.255.255.248
interface GigabitEthernet0/1/0
ip address 10.0.0.1 255.255.255.252
interface GigabitEthernet0/2/0
ip address 10.0.0.5 255.255.255.252
```

ii GRE VPN technology enables the secure transmission of network data between two campuses through the virtual private network line of the public network line between the two campuses.

```
interface Tunnel1
ip address 10.200.0.2 255.255.255.252
tunnel source GigabitEthernet0/0/0
tunnel destination 111.1.1.2
ip route 10.3.0.0 255.255.0.0 10.200.0.1
ip route 10.4.0.0 255.255.0.0 10.200.0.1
ip route 10.5.0.0 255.255.0.0 10.200.0.1
```

iii ACL + NAT technology, access control function plus public and private network address translation.

```
access-list 100 permit ip any any
interface GigabitEthernet0/0/0
ip nat outside
interface GigabitEthernet0/1/0
ip nat inside
interface GigabitEthernet0/2/0
ip nat inside
ip nat pool nat 111.1.1.10 111.1.1.14 netmask 255.255.255.248
ip nat inside source list 100 pool nat overload
```

iv Access the External Network Routing Function.

```
ip route 0.0.0.0 0.0.0.0 111.1.1.9
```

v OSPF performs direct route announcement function.

```
router ospf 1
log-adjacency-changes
redistribute ospf 2 subnets
network 10.0.0.0 0.0.0.3 area 0
network 10.0.0.4 0.0.0.3 area 0
default-information originate
```

6.2 Core layer function implementation

The core layer equipment of the dual-campus network uses the layer three switch to complete the function of high-speed data forwarding, and the following technologies are used on the device to realize the device requirements function of the core layer of the campus network. Take the Core Switch 1 (QY-HX-SW1) of the Lingyuan Campus as an example.

i First create a loopback port, specify the corresponding service, even if the specific physical interface is down, it can also be accessed through other channels.

```
interface Loopback0
ip address 10.10.1.1 255.255.255.255
```

ii In the connection between the core device and the aggregation layer device, we use the interface routing function, which is the corresponding up interface with the routing function. Take port 1-2 of the YQ-HX-SW1 switch as an example.

```
interface Loopback0
ip address 10.10.1.1 255.255.255.255
interface GigabitEthernet1/0/1
no switchport
ip address 10.0.0.17 255.255.255.252
interface GigabitEthernet1/0/2
no switchport
ip address 10.0.0.25 255.255.255.252
```

iii Enable the route announcement function.

```
ip routing
```

iv Use link aggregation technology to realize communication line bundling. Bundling two physical lines into a single virtual line increases link bandwidth and stability.

```
interface GigabitEthernet1/1/2
switchport trunk allowed vlan 2
switchport trunk encapsulation dot1q
switchport mode trunk
channel-group 1 mode on
interface GigabitEthernet1/1/3
switchport trunk allowed vlan 2
switchport trunk encapsulation dot1q
switchport mode trunk
channel-group 1 mode on
interface Port-channel1
switchport trunk allowed vlan 2
switchport trunk encapsulation dot1q
switchport mode trunk
interface Vlan2
mac-address 000a.f361.1901
ip address 10.0.0.13 255.255.255.252
```

v Set up a DHCP address pool to automatically assign IP addresses to terminals, making the use and allocation of IP addresses more user-friendly.

```
ip dhcp pool vlan100
network 10.1.0.0 255.255.255.0
default-router 10.1.0.254
dns-server 10.100.0.1
ip dhcp pool vlan200
network 10.2.0.0 255.255.255.0
default-router 10.2.0.254
dns-server 10.100.0.1
```

vi Use OSPF technology to declare a direct network segment.

```
router ospf 1
log-adjacency-changes
auto-cost reference-bandwidth 2100000
network 10.0.0.4 0.0.0.3 area 0
network 10.0.0.12 0.0.0.3 area 0
network 10.0.0.16 0.0.0.3 area 0
network 10.10.1.1 0.0.0.0 area 0
network 10.0.0.24 0.0.0.3 area 0
network 10.0.0.32 0.0.0.3 area 0
network 10.0.0.40 0.0.0.3 area 0
network 10.0.0.48 0.0.0.3 area 0
network 10.0.0.56 0.0.0.3 area 0
network 10.0.0.64 0.0.0.3 area 0
network 10.0.0.72 0.0.0.3 area 0
network 10.0.0.80 0.0.0.3 area 0
network 10.0.0.88 0.0.0.3 area 0
network 10.0.0.96 0.0.0.3 area 0
network 10.0.0.104 0.0.0.3 area 0
network 10.0.0.112 0.0.0.3 area 0
network 10.0.0.120 0.0.0.3 area 0
network 10.0.0.128 0.0.0.3 area 0
network 10.0.0.136 0.0.0.3 area 0
network 10.0.0.144 0.0.0.3 area 0
network 10.0.0.152 0.0.0.3 area 0
network 10.0.0.160 0.0.0.3 area 0
```

6.3 Aggregation layer function implementation

The aggregation layer equipment of the dual-campus network uses the layer three switch to complete the aggregation layer data forwarding function, and uses the following technologies on the device to realize the campus network aggregation layer

device requirements function. Take the core switch 1 (QY-HJ-SW1) of the Lingyuan Campus as an example.

i The connection between the aggregation layer and the core layer device adopts the interface routing function, and the connection between the aggregation layer and the access layer will use the interface trunk mode.

```
interface FastEthernet0/1
switchport trunk allowed vlan 100
switchport trunk encapsulation dot1q
switchport mode trunk
interface FastEthernet0/2
switchport trunk allowed vlan 200
switchport trunk encapsulation dot1q
switchport mode trunk
interface FastEthernet0/3
no switchport
ip address 10.0.0.18 255.255.255.252
interface FastEthernet0/4
no switchport
ip address 10.0.0.22 255.255.255.252
```

ii Enable the route announcement function.

```
ip routing
```

iii Enter the VLAN to add an interface, which is the trunk of the aggregation switch as a DHCP address assignment host.

```
interface Vlan100
ip address 10.1.0.254 255.255.255.0
ip helper-address 10.10.1.1
ip helper-address 10.10.1.2
interface Vlan200
mac-address 00e0.a310.ac02
ip address 10.2.0.254 255.255.255.0
ip helper-address 10.10.1.1
ip helper-address 10.10.1.2
```

iv OSPF announces the direct connection route.

```
router ospf 1
network 10.0.0.16 0.0.0.3 area 0
network 10.1.0.0 0.0.0.255 area 0
network 10.0.0.20 0.0.0.3 area 0
network 10.2.0.0 0.0.0.255 area 0
```

6.4 Access layer function implementation

The access layer equipment of the dual-campus network uses ordinary Layer 2 switches to complete the data access function, and the following technologies are used on the device to realize the campus network access layer equipment requirements function. Take the Core Switch 1 (QY-JR-SW1) of the Lingyuan Campus as an example.

The connection between the access layer and the terminal device adopts the access interface mode to receive terminal data, and the connection between the access layer and the aggregation layer adopts the trunk interface mode for data forwarding.

```
interface FastEthernet0/1
switchport access vlan 100
switchport mode access
interface FastEthernet0/2
switchport trunk allowed vlan 100
switchport mode trunk
```

Chapter 7

7. FUNCTIONAL TESTING

7.1 Test environment

This simulation experiment uses the Cisco Packet Tracer simulator to test the functionality in this simulator environment.

7.2 Test results with screenshots

i Terminals on campus send DHCP requests to core devices through aggregation layer relays and automatically obtain IP addresses, as shown in Figure 7-1.

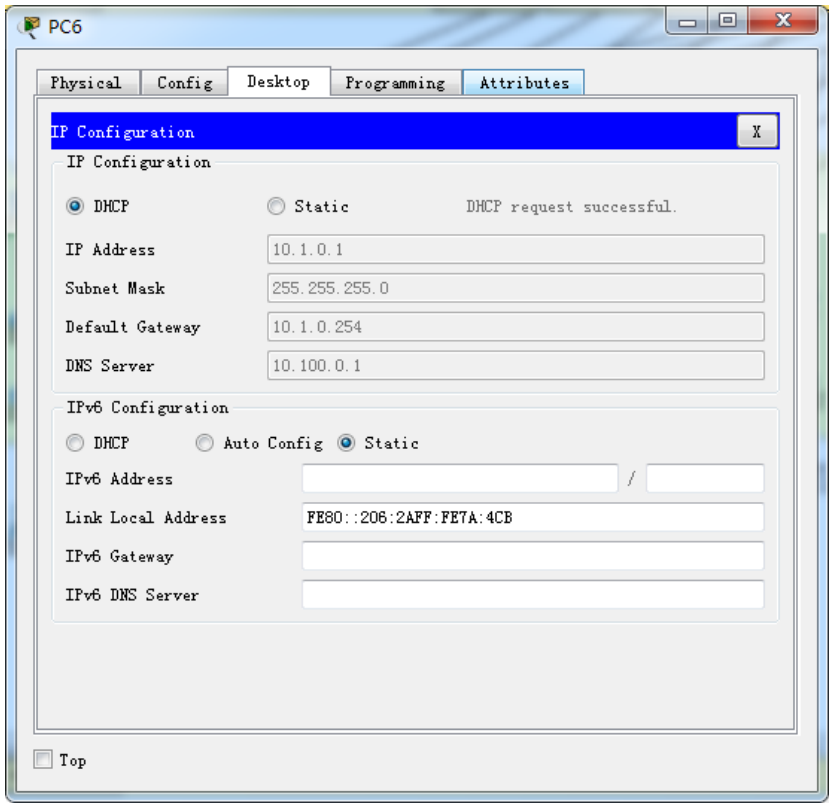

Figure 7-1 DHCP address acquisition diagram

ii Mutual visits can be realized in the campus, taking the dormitory building of the Lingyuan campus as an example, the host of the first ward of the dormitory, VLAN100, and the IP address of 10.1.0.1 can access the second ward of the dormitory, VLAN101, IP The host with the address 10.1.1.1 is shown in Figure 7-2.

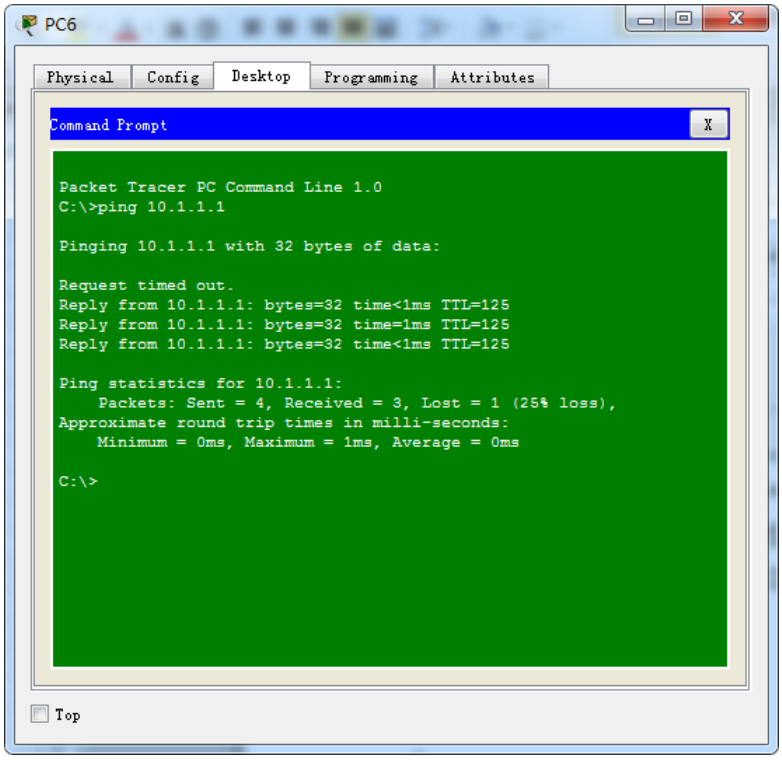

Figure 7-2 Mutual visit map with the same campus

iii Taking the dormitory building of the Lingyuan Campus as an example, the host with VLAN100 in the first area of the dormitory and the IP address of 10.1.0.1 accesses the DNS server for address resolution, as shown in Figure 7-3 as shown.

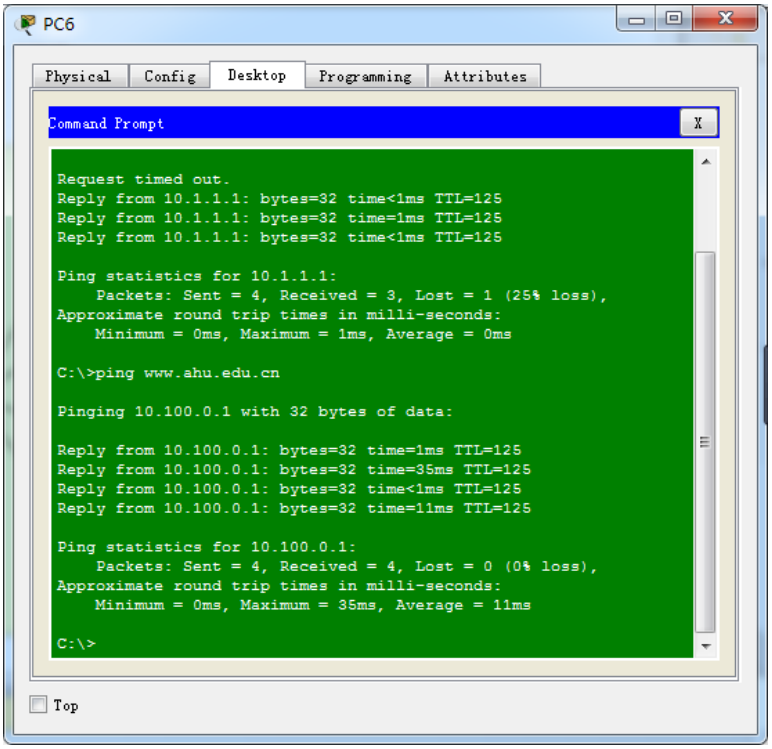

Figure 7-3 DNS domain name address resolution

iv Taking the dormitory building of the Lingyuan Campus as an example, the host with VLAN100 in the first district of the dormitory and the IP address of 10.1.0.1 accesses the FTP server, as shown in Figure 7-4.

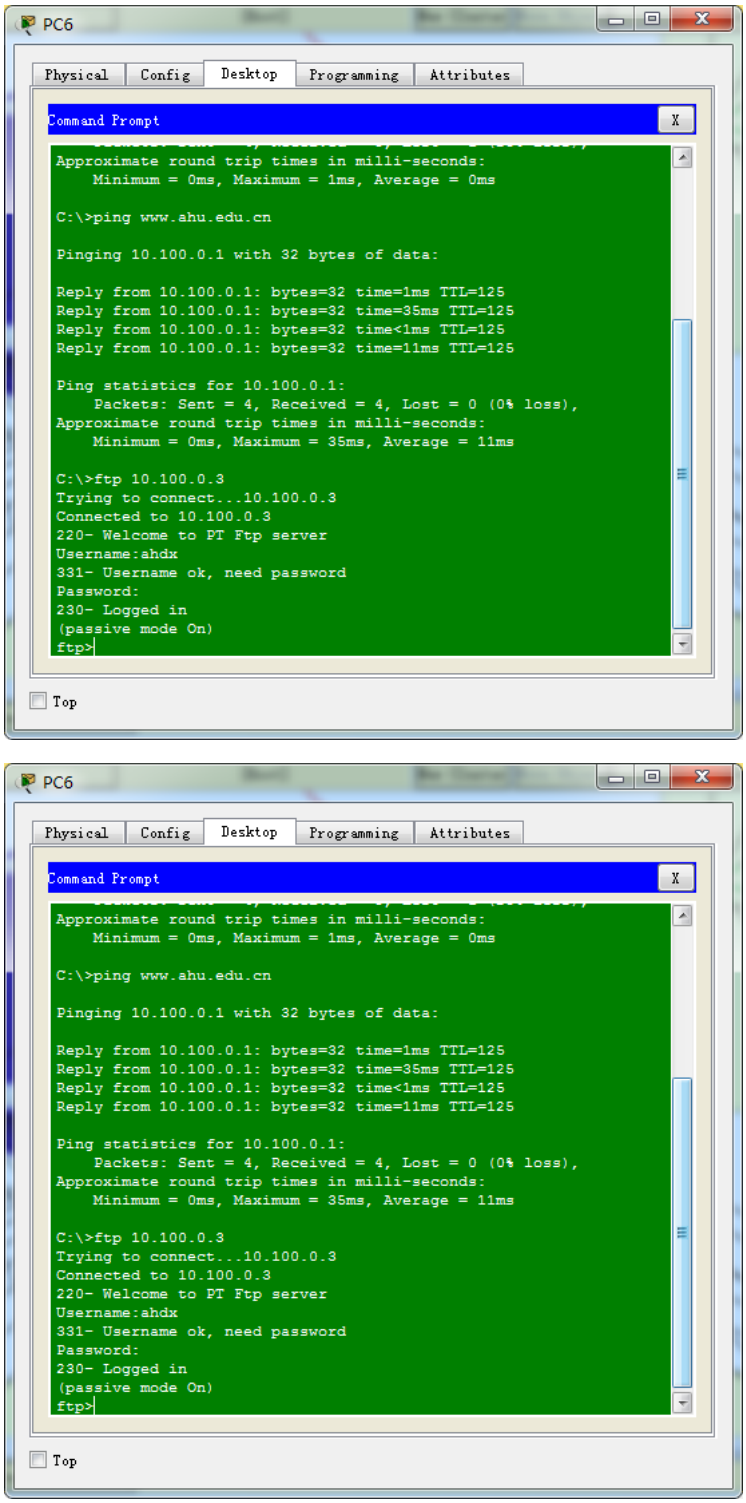

Figure 7-4 FTP server access diagram

v Verify the wireless network, taking the dormitory building of the Lingyuan campus as an example, and a host in the VLAN200 in the first area of the

dormitory is connected to the wireless as an example. This is shown in Figure 7-5.

Figure 7-5 Wireless connection diagram

vi Verify the intranet access extranet function, taking the dormitory building of the Lingyuan campus as an example, the host with VLAN100 in the first area of the dormitory and the IP address of 10.1.0.1 access the extranet server 8.8.8.2 is an example, as shown in the figure 7-6 shown.

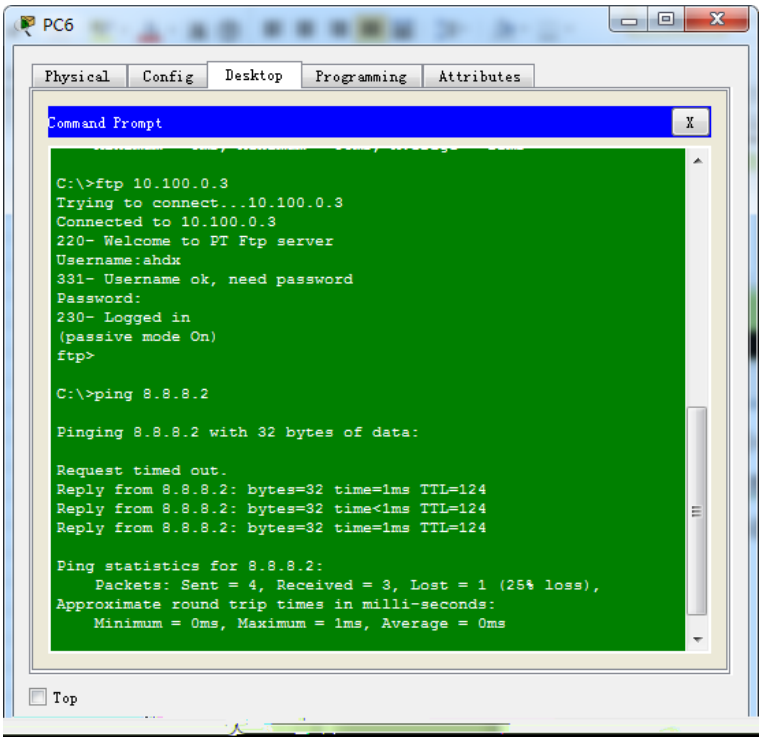

Figure 7-6 Extranet access diagram

vii Any terminal that can access the extranet can be allowed to access the intranet with the internal network, and the NAT conversion record can be viewed on the egress router, as shown in Figure 7-7.

```
Router#show ip nat translations
Pro  Inside global     Inside local       Outside local      Outside global
icmp 111.1.1.10:11     10.1.0.1:11        8.8.8.2:11         8.8.8.2:11
```

Figure 7-7 NAT conversion record diagram

viii The network connection between the Longhe Campus and the Longhe Campus is verified through VPN, and the host of the Teaching Building VLAN300 of the Longhe Campus and the IP address 10.3.0.1 is used to access the dormitory area 1 of the Lingyuan Campus VLAN 100, ip address 10.1.0.1 host as an example, as shown in Figure 7-8.

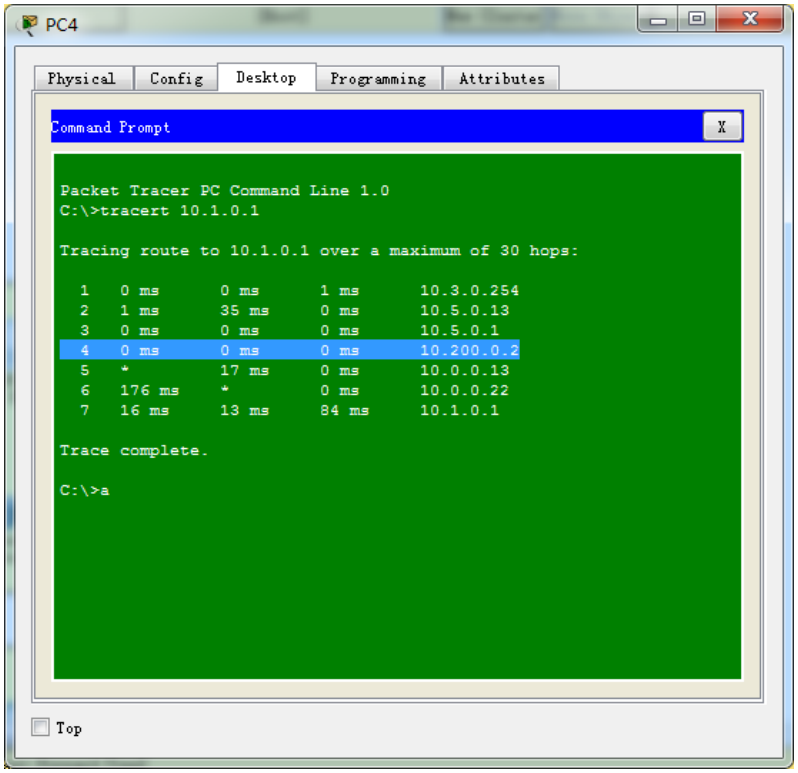

Figure 7-8 Cross-campus communication diagram

ix OSPF route test, taking the core switch 1 of the Lingyuan Campus as an example, view the device routing and achieve network-wide interoperability, as shown in Figure 7-9.

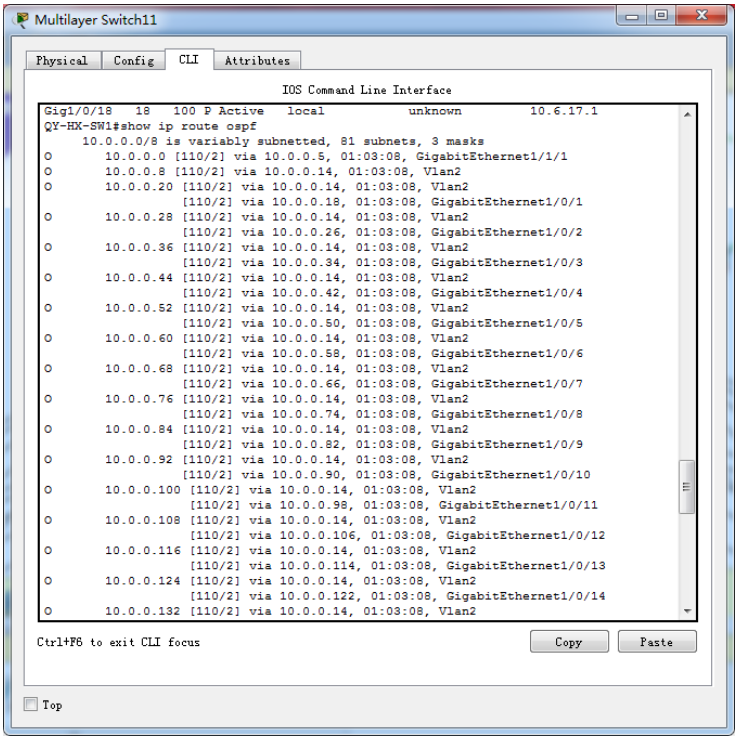

Figure 7-9 OSPF routing infographic

7.3 Test Conclusion

NO.	Testing procedure	Correct result	Conclusion
1	The endpoint automatically acquires the IP address	Displays the IP address, subnet mask, default gateway, and DNS server	Successfully
2	Mutual access within the campus Use the ping command: ping the destination IP	A packet reply is received from the destination address	Successfully
3	DNS server resolution Use the ping command: Ping the target domain name	Received a packet reply from the ip address corresponding to the destination domain name	Successfully
4	Access the FTP server Use the FTP command: ftp destination server address	Display the welcome to FTP server, enter your username and password, and log in	Successfully
5	Connect to a Wi-Fi network	Open Network Settings to view the network address of the connection	Successfully
6	Internal and external access to the extranet Use the ping command: Ping Internet IP	Receive a packet reply from an Internet IP address	Successfully
7	View the NAT translation record for the egress router Show ip nat translation	Displays the inside and outside translations of ICMP packets	Successfully
8	View network visits using the GRE tunnel between two campuses Use the tracert command to trace the route	There is the IP address of the GRE tunnel in the routing record	Successfully

Chapter 8

8. CONCLUSION / RECOMMENDATION

The construction of campus network is a very important part of the infrastructure construction of China's colleges and universities, and it is to meet the requirements of the development of the information age. For the technical level of scientific research, teaching and management of the school, a modern platform is established for the research and development and training of high-level talents, so as to establish a high-speed multimedia campus network based on Internet/Intranet technology, and realize the networking and informatization of teaching, management, office affairs and other services. In addition to the necessary hardware equipment and operating system platform, the campus network should also have a relatively advanced level, reflect modern educational ideas, and unify the planning of building a campus network with the long-term development plan of the school, and at the same time take service teaching as the focus and foothold of network construction.

This project mainly expounds the structure and characteristics of the new generation of campus network, analyzes the design of campus network in depth, and studies the core technologies and characteristics commonly used in campus network. In the design process of the campus network, the principle of hierarchical design is followed. Networks designed in this way are excellent in terms of performance and scalability. After introducing the network design method and common network technology of the three-layer architecture, the preliminary design of the campus network upgrade of Anhui University is given. However, the construction of campus network is not an easy task for each school, the campus network is not only involved in technical aspects, but includes network facilities, application platforms, information resources, professional applications, personnel quality and many other components of the integrated, information management system. Therefore, the design and construction of each campus network must go through careful argumentation and prudent decision-making. From the perspective of the architectural structure of the campus, generally based on buildings, each building is composed of multiple floors, the entire building can be considered as a relatively independent network application unit, and multiple buildings with similar functions form a building complex, which is the case of student dormitory buildings. This architectural distribution is ideal for the application of Ethernet technology. First of all, Ethernet uses

packet switching, a switch is a switching center, can easily form a star or tree network structure. Inside the building, each floor is connected to the information points of the layer by a layer 2 switch, and the entire building is aggregated by a layer 2/3 switch, and multiple buildings are then converged on the core backbone switch. The tree structure of floors, buildings, buildings and Ethernet access, aggregation and core has a good correspondence, and the network structure is clear. Secondly, the transmission medium is also suitable for the needs of network construction. The use of 1000M optical fiber between buildings ensures the stability and reliability of the backbone network, is not disturbed by the external electromagnetic environment, covers a large distance, and can cover all campuses.

The planning and design of the campus network has the following characteristics:

1. Practicality and advancement

According to the actual situation, in the design, special emphasis is placed on the combination of practicality and advancedness, and mature network technology is adopted to ensure the practicality of the campus network; tracking the new development of international network technology, and designing a network with advanced technology. On the basis of ensuring that the campus network is reliable, practical and advanced, it can provide a scientific research environment for researching advanced network technology and facilitate the scientific research and development of the school.

2. Openness and standardization

The design of the entire campus network adopts an open network system to facilitate the upgrading, expansion and interconnection of the network. At the same time, when selecting server and network products, emphasize the international standardization of network protocols supported by products.

3. Reliability and safety

In the design of the campus network, two levels are mainly considered: First, the reliability and security of the entire network, using a highly reliable and high-security network architecture, including the reasonable design of the access control of the WAN and the access control of the internal LAN, and the backup of the external network access link; The second is the reliability and security of network equipment, mainly using live pluggable modules, configuring dual power supplies, port redundancy, setting user tables and password restrictions for network equipment.

4. Economy and expandability

Under the premise of meeting the needs of the school, cost-effective network equipment (mainly Huawei network equipment) and servers are selected.

The network architecture and equipment used should fully take into account the ease of upgrading, and can maximize the protection of the original hardware equipment and software investment when upgrading.

Although the structure and common techniques of the campus network were theoretically studied and elaborated, and the construction of the campus network of Anhui University was completed on the basis of research theory, due to the limitations of the Cisco simulator, the actual implementation test of the project was not well verified, and there was no condition for pressure verification, and the security and stability of the network needed to be further improved. At the same time, there is no in-depth study of network security issues such as identity authentication and network behavior management of users within the campus. Therefore, the next step in the research work is how to build a safer and more inclusive campus network. In addition, the necessary research on IPv6 should be carried out in preparation for the next step of popularizing IPv6.

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Appendix

Questionnaire for students

1. What's your gender?
    - A. Boys
    - B. Girl
2. What is your current grade?
    - A. Freshman
    - B. Sophomore
    - C. Junior
    - D. Senior
3. Where do you live?
    - A. Old campus
    - B. New campus
    - C. Other
4. How many hours do you surf the Internet every day?
    - A. Less than one hour
    - B. 1-3 hours
    - C. 3-5 hours
    - D. More than 5 hours
5. How do you evaluate the network speed of campus network?
    - A. Very slow
    - B. Slow
    - C. General
    - D. Fast
6. How do you evaluate the stability of campus network?
    - A. Dissatisfied
    - B. General
    - C. Satisfied
    - D. Very satisfied
7. What is your comment on the charge of campus network?
    - A. Cheap
    - B. General
    - C. A little high
    - D. Very high

8. What is your attitude towards the campus network upgrade?

- ○ A. The upgrading of campus network has brought us convenience
- ○ B. The upgrading of campus network leads to frequent network interruption and inconvenience.
- ○ C. The campus network is upgraded. I feel that it is the same whether I am promoted or not. There is no change
- ○ D. The campus network is upgraded, the network is completely impractical, and the computer becomes like garbage.

9. What's your opinion on the coverage of Chinanet on campus this time?

- ○ A. Support, WiFi coverage on campus, not only saves money, but also brings us convenience
- ○ B. Neutral, no opinion
- ○ C. No, Chinanet is not only a card, but also unstable, which is equivalent to furnishings

10. How do you evaluate the network resource service and literature query of the campus network at this stage?

- ○ A. Dissatisfied, the network resources provided are few, the literature is few, and the query is troublesome
- ○ B. Generally, I don't feel much
- ○ C. Satisfied, able to meet our network needs
- ○ D. Very satisfied. It provides many network resources and convenient literature query

11. You usually need to use the network. Which of the following accounts for a large proportion?

- ☐ A. Study and consult relevant materials
- ☐ B. Drama, variety show, online shopping, etc
- ☐ C. Game, game, or game
- ☐ D. Other

12. Why do you think the problems related to campus network are difficult to solve?

- ☐ A. Low efficiency of Telecom personnel
- ☐ B. Price problem
- ☐ C. Students don't pay much attention to it or don't take the initiative to solve problems
- ☐ D. Other

13. What kind of campus network maintenance methods do you know?

- ☐ A. Find your classmates and friends for help
- ☐ B. Telephone repair
- ☐ C. Business Hall maintenance
- ☐ D. Other

14. Which of the following measures would you like the telecom business office to strengthen for the "campus network"?

- ☐ A. If possible, provide network repair service
- ☐ B. Provide direct registration and repair service at the dormitory repair office
- ☐ C. On site service of technicians
- ☐ D. Other

Questionnaire for teachers

1. What's your gender?
   - ○ A. Boys
   - ○ B. Girl

2. How do you rate the current network speed of the campus network?
   - ○ A. Satisfied
   - ○ B. General
   - ○ C. Dissatisfied

3. In your opinion, the priority problems to be solved in the network development of our university are:
   - ☐ A. Improve the bandwidth and speed of the education network
   - ☐ B. Increase network terminal coverage
   - ☐ C. Add network applications
   - ☐ D. Strengthen network security
   - ☐ E. Others:

4. What do you think should be more efforts in the construction of campus network?
   - ○ A. Increase hardware investment, upgrade campus network and update old equipment
   - ○ B. Increase investment in software, purchase or introduce all kinds of online education resources
   - ○ c. Create conditions for students to use information technology and create a good campus culture
   - ○ D. Formulate specific measures to encourage teachers to actively use information technology and encourage communication and sharing

5. In the case of limited funds, which of the following projects do you think is the priority
   - ○ A. Building a wireless campus network
   - ○ B. improving the network teaching platform and teaching resource database
   - ○ C. Strengthen the construction of network security
   - ○ D. Others:

6. Do you think it is necessary to establish a wireless campus network
   - ○ A. Necessary
   - ○ B. General
   - ○ C. No need

7. Do you think it is necessary to establish a learning website of online teaching platform:

- ○ A. Necessary
- ○ B. General
- ○ C. No need

8. What functions do you think the school's online teaching platform should focus on:

- ☐ A. Resource function
- ☐ B. Communication and cooperation function
- ☐ C. Online evaluation and test function
- ☐ D. Achievement display function
- ☐ E. Others:

9. Do you think it is necessary for everyone to get online through user name and password authentication

- ○ A. Necessary
- ○ B. General
- ○ C. No need

10. What is your demand for network bandwidth?

11. What do you think are the main factors restricting the network development of our university?

12. Do you have any suggestions for the network development of our university?

An interview questionnaire on network management

1. What management problems do you think exist in our campus network?

2. Do you think the current campus network can meet the teaching and daily work of the two campuses? What are the specific aspects?

3. Do you think the current network system needs to be upgraded? What are the specific aspects?

4. Do you think there are potential security risks in the current network system that need to be improved?