

## Original Research Article

# Campus Network Planning and Design

Huichao Ma,Guoliang Lv,Chunyu Wu

School of Computer and Information, Hefei University of Technology, Anhui, China

### ABSTRACT

With the rapid development of computer network, the construction of campus network is the inevitable choice of the development of information network. The campus network system is a very large and complicated system. It is not only for modern teaching, integrated information management and office automation series of applications to provide basic operating platform, but also to provide a variety of application services, so that information can be timely and accurate delivery. The campus network construction in the application of network technology is the important branch of LAN technology to build and management. This paper introduces the goal of campus network design and the selection of network technology, network equipment selection and so on, and gives the concrete network topology diagram through the example of the campus network design and construction process. The study also explains how to plan the formation of campus network efficiently and safely.

**KEYWORDS:** Campus network;Equipment type;Server

## Introduction

Internet technology began to spread in the campus, the Internet and our campus life has been closely linked together. As a campus to cultivate the talents of the century, to achieve network management, teaching is very important.

So the campus network is a very interactive and professional LAN. Multimedia teaching software development platform, multimedia presentation classrooms, teacher preparation system, library access system, test database, etc., can work through the network. If a school includes a number of professional disciplines, you can also form a number of local area networks, and through wired connection.

Campus network should have teaching, management and communication three functions. For the current campus network construction, the main focus on teaching and communication, it is difficult to achieve the digital campus as the core of the management area.

## 1. Demand analysis

### 1.1. Network requirements

Jinling Middle School, in order to hot pursuit of the pace of the times, development and inter-school, static resource sharing, dynamic information release, distance learning and collaborative work stage, the development of school education modernization, decided to build their own campus network, strive for early realization of education informatization. After the completion of the campus network, the computer into the teaching of all aspects, which can lead to teaching methods, teaching methods, teaches tools of major reforms. To improve the quality of teaching, and promote the development of China's education modernization plays an immeasurable role. The network also provides an effective way for schools' managers and teachers to acquire resources and work together. Campus network will be the school to improve the management level, work efficiency, improve the quality of teaching a powerful means, that is, to solve the information age education problem of the basic tools.

Through the school information construction professionals to communicate, due to participate in network applications more teachers and students, and contains a large number of multimedia information, so large-capacity, high-speed data transmission is an important requirement for the network. Campus network construction needs are as follows:

1. Teaching building, dormitory, laboratory building, canteen and so on the campus network, browse the WEB page, INTERNET visit the corresponding routing strategy.

2. The campus network there are a number of export needs, the campus network at least to provide China Education and Research Network (CERNET) and INTERNET two exports.

3. The campus network security requirements are higher, the campus network also has a lot of teaching and file management on the important data, whether it is damaged, lost or stolen, will bring great losses. The device is required to enable user identification and dynamic binding functions such as identification of users through the dynamic binding of the 'IP + MAC + port' triplet, such as the authentication of the access user, the security of the access computer's computer equipment, The security of the network switch and the control of the server cluster access.

4. The campus network WEB page can achieve the following functions: resource sharing, information exchange, collaborative work, user Web self-service function, the user can Web self-service page, personal information query, password modification, Internet details query.

5. The campus network requirements for each user's use can be audited afterwards, to locate the IP address and the user connected to the port and login user name, limit the use of the account port.

6. The campus network requirements to achieve the dynamic control of user bandwidth.

7. The campus network to achieve multicast services.

8. The campus network requirements in the school scale continues to expand, the number of users continues to increase, requiring the network has a very good scalability, according to the need to gradually smooth upgrade to 10 Gigabit backbone connection.

9. Network management platform to achieve the management of network resources, network security access control. And on the platform can easily develop the required network applications.

10. After the completion of the campus network will achieve the following basic functions:

- Computer teaching, including multimedia teaching and distance learning;
- Network downloads, mailbox login, network chat, etc. .;
- E-mail system: mainly with peer exchanges, technical cooperation, academic exchanges and other activities;
- File transfer ftp: the main use of ftp services to obtain important scientific and technical information and technical documents;
- Internet service: schools can set up their own home page, the use of external web pages for school publicity, to provide various types of consulting information, the use of internal web pages to manage, such as issuing a notice to collect student opinions.
- Library access system for computer query, computer search, computer reading and so on;

## **1.2. Network environment**

The school has 3 student dormitories, 5 floors per building, 10 students on each floor, each room to provide a network node; teacher quarters 3 (126) households, a total of 7 layers, each household provides a network node ; Teaching building 5, a total of 5 layers, each layer has 10 classrooms, each classroom to provide a network node; library and electronic reading room in the same building, a total of 1 electronic reading room, each electronic reading room needs 10 network nodes; training building a total of 7 layers per layer requires 20 nodes. It requires campus network backbone using 1000Mb / s fiber, 100Mb / s exchange to the desktop.

## **1.3. Design goals**

The implementation of this project will greatly improve the teaching and research conditions of the school. After the completion of system, it will achieve the following objectives: (1) To establish a connection to multimedia classrooms, libraries and other places of the campus network, the backbone of the network rate of 100Mb / s; (2) To establish a VPN server to support the teacher's mobile office; Teachers in any place, through the Modem dial-up, in the case of authorization can access the information inside the school; (3) To establish the school's own WWW server, to provide the school's home page; (4) To provide online library number of online inquiries; (5) The establishment of e-mail server for teachers and students to provide e-mail service. (6) To provide file transfer services.

## 2. Design of campus network structure

The construction of the campus network will design based from the actual situation and characteristics of school. In the design process, pay attention to the practicality of the campus network and the combination of advanced, and the use of mature network technology to ensure the practicality of the campus network.

### 2.1. Principles for overall design

As the campus network started late, and the school funds are not very adequate, cannot be in one step. On the other hand, the level of application of the school is more uneven, some systems even if the installation is not used, therefore, in the construction of the campus network process, the system should always implement the application-oriented, pragmatic approach, the principle of economy.

The school network needs to complete, including the book information, school administrative office and other integrated business information management system for the majority of faculty and students to provide a network environment for teaching and research work of the advanced platform. The campus network covers the entire campus, and the network design follows the following five basic principles:

Reliability and high performance networks must be reliable, including network-level reliability such as routing, switching aggregation, link redundancy, and load balancing. The network must be of sufficient performance to meet the needs of the business.

Scalability and scalability of the system to be scalable and scalable, with the business growth and application level, the network of data and information flow will grow exponentially, the need for good network scalability, and can continue to upgrade with the development of technology. Equipment should be used in line with international standards of systems and products to ensure that the system has a long vitality and scalability to meet future requirements of the system upgrade.

Easy to manage, easy maintenance as the campus backbone network system is large, rich and complex application, the need for network management system has good manageability, network management system with monitoring, fault diagnosis, fault isolation, filtering settings and other functions to facilitate the management of the system and maintain. At the same time as far as possible to choose a high degree of integration, the module can be a common product for easy management and maintenance. Here we use the equipment is Cisco switches, firewalls.

Security, confidentiality of the network system should have good security. As the campus backbone network for multiple user intranet to provide interconnection and support a variety of business, requiring flexible and effective security control, but also should support the virtual private network to provide multi-level security options. In the system design, not only consider the full sharing of information resources, but also pay attention to the protection and isolation of information, so the system should be different for different applications and different network communication environment, take different measures, including system security mechanisms, data access the authority of the control. In the secondary campus network erection, it may through subnet and the switch of VLAN to achieve network security.

Through the use of structured, modular design forms with flexibility and comprehensive, to meet the system and difference needs from users to adapt to changing requirements. To meet the system goals and functions as the goal, to ensure that the overall program design is reasonable to meet the needs of users, while maintaining the use of the system maintenance, as well as the future system of secondary development and transplantation.

### 2.2. Hierarchical model of campus network design

The so-called 'hierarchical' model is to divide the complex network design into several levels, each of which focuses on certain specific functions, which can make a complex big problem into many simple small problems. Hierarchical model can be applied to both LAN design and WAN design.

In order to understand the importance of hierarchical design more clearly, it is best to understand the OSI (Open Systems Interconnection) reference model. The OSI model simplifies the communication requirements between computers. Similarly, the use of a hierarchical model to design a network can simplify the requirements of networking.

### 2.3. Hierarchical network design

#### 1. Easy savings

In the use of hierarchical model, the various levels of their duties, no longer in the same platform to consider all the things. Hierarchical model the modular nature of the network to make every layer can make good use of bandwidth, reducing the waste of system resources.

2. Easy to understand

Hierarchical design makes the network structure clear, can be implemented at different levels of different difficulty management, reducing management costs.

3. Easy to expand

In the network design, modularity has the characteristics of network growth so that the complexity of the network can be limited to the subnet, and will not spread to other parts of the network. And if the use of flat and mesh design, any node changes will have a great impact on the entire network.

4. Easy to troubleshoot

Hierarchical design can break down the network topology into easy-to-understand subnets, and network managers can easily determine the range of network failures, simplifying the troubleshooting process.

### 3. Solution

According to the distribution of the buildings between the schools, the central room can be set in the training building, because the building has 6 layers, can be set in the middle floor, for example, 2 to 5 floor in a layer. The remaining building blocks are connected to the core switch of the central room via fiber.

#### 3.1. Network topology

According to the network environment, we can draw the campus network topology. Among them, we use the router to connect with the Internet, and choose a hardware firewall to protect the network. In the network topology diagram, you can see that more than one server is divided into a VLAN. The campus network topology is shown in Figure 1

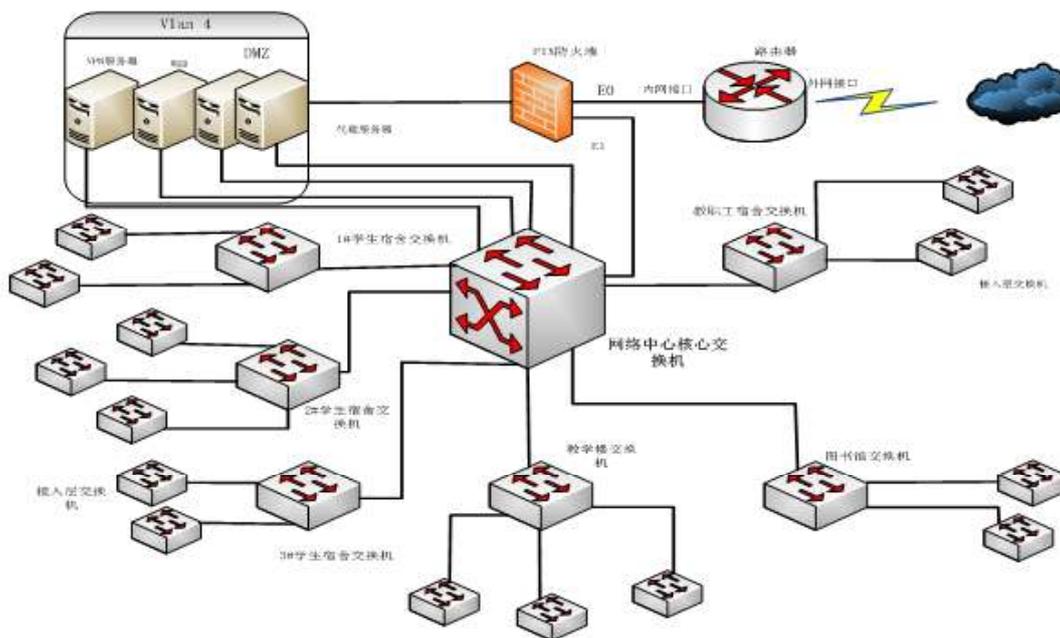


Figure 1. Campus network topology

#### 3.2. Campus building information needs

1000 BASE-LX: 1000 BASE-LX is usually used to support long-distance transmission of multi-mode fiber and single-mode fiber, fiber connected to each floor wiring between the convergence layer switch. The design of each floor is as follows:

1. Student dormitory

Student dormitory a total of five, each layer of eight dormitories, each bedroom an information node. Click here to install an access layer on each floor of the switchboard, the floor selection of floating rack. Select Cisco Access Layer Switch Catalyst 2924. Wiring set at first floor, the cable selection on ultra-five unshielded twisted pair (UTP).

## 2. Staff dormitory

For teacher dormitory 2 blocks with 18 floors, each layer of 12 units in total of 84 households, each household will provide a network node. Choose 5 Cisco access layer switches Catalyst 2924 in every 4 layers of a switch to achieve the purpose of saving cable. There is no extra room on the household floor to set the wiring closet, and the wiring closet can be set in the basement.

## 3. Library and electronic reading room

Library and electronic reading room in the same building, a total of 1 electronic reading room, each electronic reading room needs 10 network nodes, the same use of an access layer switch.

## 4. Teaching building

Teaching building 3, a total of 4 layers, each layer have 10 classrooms, each classroom provides a network node, a total of 200 information nodes. Each layer is configured with an access layer switch, and the wiring closes on the first floor, and the convergence layer switch is placed. The cable also selects the ultra-five unshielded twisted pair.

## 5. Training building

A total of 7 layers of each building needs 20 nodes, because the network center in the training floor, two convergence layer switches to do cascade, each layer only need to configure an access layer switch. Cable selection of ultra-five UTP twisted pair.

### 3.3. Description of the program

Campus network system is divided into core layer, convergence layer and access layer. The core layer function is mainly to achieve the optimal transmission between the backbone networks, backbone layer design task is usually the focus of redundancy, reliability and high-speed transmission. Due to the school there is a lot of voice and video transmission, consider that the convergence layer has good support for QoS and can provide large bandwidth. The access layer device is the most straightforward device of the end user, and it should have plug-and-play features and easy-to-maintain features.

## 4. Network equipment selection

### 4.1. Switches

The campus network uses Gigabit Ethernet switching network. Configure a central switch and seven secondary switches. Each switch supports fiber expansion ports with expansion module slots. Campus network backbone for the Gigabit network, Fast exchange to the desktop, to protect all users at the same time call the service resources can be fast and smooth, give full play to the role of multimedia classroom teaching; at the same time to ensure that all users at the same time smooth Internet, the campus network function most vividly.

The number and basic performance requirements of this network engineering switch are shown in Table 1

The Catalyst 2948G-L3 switch is a three-tier L3 Ethernet switch that provides wire-speed switching for IP protocols, Internet packet-switched protocols, IPX, and IP multicast. This new Catalyst switch provides the required high performance for a medium-sized park backbone with the appropriate port density. It is ideal for aggregating multiple wiring closets or workgroup switches (such as Catalyst 2900, Catalyst 1900, Catalyst 3500, Catalyst 4000, or Catalyst 5000 switches). The Catalyst 2948G-L3 switch not only provides non-blocking routing and switching for IP, IPX, and IP multicast, but also provides wire-speed Layer 2 switching for non-routable protocols such as NetBIOS and DECnet Local Transport (LAT). This feature allows network administrators to extend their multi-protocol backbone through the Catalyst 2948G-L3 without having to build a parallel network as if only IP switches were used.

Its characteristics are:

48 dedicated 10 / 100Mb / s Ethernet ports, and two 1000Base-X Gigabit Ethernet ports that support Gigabit Interface Converter (GBIC), all ports have Layer 3 switching capabilities. High performance: 10Mb / s Layer 3 switching and routing over IP, IPX switches and IP multicast. 24 GB / s non-blocking switching matrix. High performance CPU with CISCO IOS system software.

Quality of Service (QoS): Multiple arrays with weighted polling (WRR) scheduling based on the standard CISCO WORKS 2000, an application of a comprehensive management tool. It is an optional redundant external power supply with line speed third layer switch.

CISCO Catalyst 2950 Series Workgroup Switch:

The Catalyst 2950 Series switches are part of the Fast Ethernet Desktop Switch CISCO Catalyst 2900 Series, which provides excellent performance and functionality for local area networks (LANs). The independent, 10 / 100Mb / s adaptive switch provides enhanced Quality of Service (QoS) and multicast management features, all of which are made up of the easy-to-use, Web-based CISCO cluster management suite (CMS) and integrated CISCO IOS software To manage. The CISCO Catalyst 2950 Gigabit copper wire with 10/100 / 1000Mbase-T uplinks provides an ideal solution for mid-sized corporate and corporate branch offices to enable them to take advantage of existing 5-class copper Line from Fast Ethernet to a higher-performance Gigabit Ethernet backbone.

Catalyst 2900 series of common products include: 12 10 / 100M port standalone, 24 10/100 port independent, 24 10 / 100M port plus two 100Base-FX port, 12 ports plus two GBIC ports, 24 10/100 ports plus two 10/100 / 1000Base-T ports.

To sum up, supports all Cisco IOS features.

## 4.2. Server

Network center configure 2 department-level servers respectively, to process application server and Web server. Its configuration and performance are as follows:

## 4.3. Other equipment

Other equipment technical requirements see Table 4

# 5. Network device configuration

The network center forms the backbone of the campus network, and provides connectivity to the WAN and dial-in services. In the backbone system using Ethernet structure, the main advantages of using this approach are:

Gigabit Ethernet can provide 1Gb / s bandwidth for each port, fully meet the user's need for speed; use of the economy, with a high cost; Gigabit Ethernet has been widely supported; from the existing Traditional Ethernet can smoothly transition to Gigabit Ethernet, eliminating the need for new configurations, and management technologies; Gigabit Ethernet technology has good interoperability and backward compatibility.

In the program, the central office room to prevent the central switches, servers, routers and other network equipment, these devices to the central switch as the center, with a star topology through unshielded feet cable together. The connection between the network center and the subnet is based on the distance from the subnet, through the fiber box unshielded feet cable to the central switch and subnet switches connected.

## 5.1. Configuration of switch

VLANs in Cisco 2948G-L3 core switches in the network management center, Cisco2950 switches for student dormitories, Cisco2950 switches in teaching buildings, Cisco2950 switches for educational buildings, Cisco2950 switches for faculty dormitories, and Cisco2950 switches for libraries.

The switch is through the super terminal into the configuration state. The name is defined as follows:

1 student dormitory: 1xs

2 student dormitory: 2xs

3 student dormitory: 3xs

1 comprehensive teaching building: 1zhl

2 comprehensive teaching building: 2zhl

Library: tsg

Teaching building: jxl

1 staff dormitory: 1jzg

2 staff dormitory: 2jzg

Other student dormitory switch configuration is similar to student house 1

Teaching Suite Cisco 2950 switch configuration

PIX is Cisco's hardware firewall, hardware firewall has the work speed, easy to use and so on. PIX has many models, the number of concurrent connections is an important parameter PIX firewall. PIX525 is a typical device.

PIX common interfaces in the firewall are: Console, Failover, Ethernet, USB.

Internal network: Inside

External network: Outside

Intermediate area: called DMZ (cease zone). Place the open server.

Firewall configuration rules:

No connection status (no handshake or handshake unsuccessful or illegal packets), any packet cannot pass through the firewall.

(An internally initiated connection can be backed up. A server that is open by an ACL allows an external connection to be initiated).

Inside can access any Outside and DMZ areas.

Inside access DMZ need to cooperate with Static (static address translation).

Outside access to the DMZ requires an ACL (access control list).

## Conclusion

With the advent of the Internet age, the impact of our education is unprecedented, and it also provides a rapid leap for education opportunities, education should be oriented towards modernization, facing the world, facing the future, we must first facing the network. Education can only make a combination with network in order to keep up with progress and development of times. The premise of network education is the construction of the network, and as the construction of the campus network is not only the construction of the network hard environment, but also must include the campus network maintenance and security, campus network resources and the effective application of the campus network and other three Link. Only the full and effective application of the campus network in order to make the entire teaching model and the educational concept of a complete change in order to apply the new century to cultivate high-quality creative and complex talents needs for the campus network construction, not applicable to all schools program, even for a school, it is impossible to have the best program, only the better program.

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