Exploration On the Construction of Smart Campus All-Optical Network

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Abstract: With the rapid development of information technology, the construction of education informatization is urgent, and it is particularly important to promote the gradual development of colleges and universities towards digital transformation. Among them, the construction of smart campus has become an important means to enhance the level of education informatization and improve the quality of education and teaching. As an important part of the new generation of information technology, all-optical network has been widely used in the construction of smart campus. This paper first summarizes the existing network bottlenecks of traditional networks under the trend of digital campus transformation, including the problems of operation and maintenance management, network bandwidth, service expansion and weak current security, then introduces the necessity of all-optical network construction from the aspects of network bandwidth, stability and maintenance cost, and finally demonstrates the construction value of all-optical network through application scenarios. It provides a useful reference for the construction of smart campus all-optical network.

Keywords: All-Optical Network; Colleges and Universities; Campus Network; Basic Network; Information Construction

1. Introduction

According to the Guiding Opinions on Promoting the Construction of New Education Infrastructure and Building a High-quality Support System issued by the Ministry of Education and other six departments (hereinafter referred to as the "Opinions"), it is proposed that by 2025, a new education infrastructure system with optimized structure, intensive efficiency, safety and reliability will be basically formed, and iteratively upgraded, updated and improved, and continuously Achieve constructed. long-term and comprehensive development [1]. At the same time, with the arrival of the era of "light into copper retreat", colleges and universities hope to adapt to the development of The Times, relying on new concepts, new technologies and new programs to promote the new infrastructure construction of school education, consolidate the base of digital transformation, and support the high-quality development of schools in the future.

In the process of education informatization construction and development, campus network, as the digital base of campus informatization construction, carries various digital business systems such as school teaching, management and the Internet of Things, and is an important infrastructure supporting the construction of digital campus and smart campus [2]. The constantly improving campus network and the constantly information improving level are both challenges to the traditional network. To break through the network bottleneck in the development process of the school, it is necessary to use network technology with high bandwidth and low delay, and all-optical network is a network technology with great potential to meet this demand. Let all kinds of business in the school with the help of "light" on the information highway really "run".

2. Existing Network Bottleneck

At present, with the increasing development of information technology in colleges and universities, the requirements for teaching, scientific research, management and life are gradually rising. However, from the aspects of bandwidth rate, wireless coverage point expansion or maintenance, the campus network construction scheme of the traditional network architecture shows obvious fatigue and cannot meet the challenges brought by Wi-Fi 6 wireless coverage and its application to the high performance requirements of the campus network [3]. Mainly reflected in the following points:

2.1 High O&M Management Costs

With the increase of business, the number of information points increases, and the business cannot be flexibly expanded, and each additional service/terminal needs to be rewired from the weak current well, resulting in a large pressure on the bridge space. The service transformation must be arranged from the bridge. The trouble and cost are high, and the direct deployment of new network cables leads to more and more network cables on the bridge, which is not beautiful and the space pressure of the bridge is large. Each network transformation or new business must be the whole network transformation, and the construction often breaks other business network cables, affecting normal business development.

2.2 The Network Bandwidth Rate is Low

With the emergence of large bandwidth service requirements, especially involving some large competitions, it is very likely to need external broadband to ensure the smooth progress of the competition; The upload and download of audio, video and video files will also have problems such as delays and a long time, which shows that the current traditional campus network bandwidth is difficult to meet the digital development of colleges and universities. Secondly, the network upgrade requires the transformation also and replacement of the line, resulting in high cost of network upgrade. In addition, it will also seriously affect the throughput during the connection [4]. In addition, most of the existing campus network adopts the traditional switch networking architecture, and the access bandwidth is difficult to improve. After multi-user data is aggregated, it is easy to generate congestion, and the user bandwidth is difficult to guarantee.

2.3 Business Development and Expansion are Difficult

The expansion of school enrollment, the increase of students' Internet demand, and the increase of bandwidth demand driven by new

applications and technologies. In addition, with the simultaneous operation of wired and wireless devices, the use of terminals such as computers, mobile phones, and pads increases the concurrent requirements for export device authentication. The increasing demand for teachers and students to use the Internet increases the pressure on the export equipment, and the risk of device failure directly affects the network operation of the whole school. Therefore, a more stable export solution is needed, and at the same time, it can flexibly expand the capacity with future business development.

2.4 Weak Electricity Safety Risks

A large amount of active communication equipment is piled up in the weak current room, which has potential fire safety risks. Traditional network deployment requires that access devices be placed in a weak room, which increases security risks. In addition, limited by the weak current room location problem, the weak current room environment generally poor, light will produce is electromagnetic interference, heavy will affect the service life of network equipment. A large number of active equipment not only consumes a lot of manpower in the initial deployment, but also requires a large amount of manpower input in the later daily maintenance and obstacle removal, thus pushing up the maintenance cost.

3. The Necessity of Smart Campus All-Optical Network Construction

3.1 Meet High Bandwidth and Low Latency Requirements

All-optical network uses optical signal as transmission medium. The transmission delay of optical signals is low, which can provide fast response and efficient transmission services [5]. This enables all-optical networks to achieve extremely high data transfer rates to meet the growing demand for data. The high-speed transmission capability greatly improves the efficiency and responsiveness of the network, enabling users to exchange data share information more and quickly, supporting upstream and downstream symmetric 10G, bandwidth adjustment, to achieve 10 gigabit to the classroom, gigabit to the desktop, campus wireless bandwidth

multiplied. Through optical fiber deployment, architecture optimization, all-optical technology application and the development of optoelectronic integration equipment, all-optical networks achieve large-scale and high-speed data transmission, meeting the high-bandwidth urgent demand for communication in today's information society. This provides a strong support for campus innovation development and digital transformation, and provides users with a faster and more efficient communication experience.

3.2 Improve Network Quality and Stability

The all-optical network adopts optical fiber transmission technology, and the optical fiber line has the characteristics of low loss and high speed, which effectively reduces signal attenuation and transmission noise. It provides access to 10 gigabit optical fiber links for each room, and increases the bandwidth rate from the traditional network gigabit (six types of unshielded wiring) to 10 gigabit optical fiber, providing high bandwidth guarantee for the addition or adjustment of user end devices [6]. The anti-interference ability of optical fiber lines is very strong, and it can effectively resist the influence of electromagnetic interference, RF interference and ambient noise and other factors on the signal. This enables the all-optical network to maintain stable transmission performance in a complex electromagnetic environment, provide а reliable communication connection, and ensure the reliability and continuity of communication. In the complex interference environment, all-optical network can transmit signals stably and provide users with stable and reliable communication services.

3.3 Simplify Network Architecture and Reduce Maintenance Costs

All-optical network adopts optical fiber transmission technology, and optical fiber line as transmission medium has the advantages of low loss, high speed and anti-interference. During line deployment, professional construction and maintenance standards are adopted to ensure the quality and reliability of optical fiber lines. At the same time, strict monitoring and inspection of the line, timely detection and repair of potential problems to ensure the long-term stable operation of the line. It has the advantages of simple architecture, which reduces the requirements on the access and aggregation equipment rooms and the number of equipment rooms. Through the all-optical network wiring system can greatly save the amount of horizontal copper cable wiring, the project in construction is more conducive to control investment, cost saving, green and low carbon; In the use stage of the project, the system is more conducive to the university's later variable information function requirements; In the late operation and maintenance stage of the project, it is more convenient for the maintenance of the manager; In line with the "double carbon" target proposed by the state [7]. The all-optical network adopts flat networking mode, which simplifies the network architecture, reduces the failure rate, reduces the complexity of wiring, and reduces the maintenance cost.

3.4 We will Promote IT Application and Modernization of Education

The construction of smart campus is an important direction of education informatization and modernization. As the core smart campus network architecture, of all-optical network can provide high-speed, stable and reliable network support for smart campus, and promote the process of education informatization and modernization, which is of vital necessity for promoting education informatization and modernization. It not only provides a strong network support and resource guarantee for education informatization, but also helps to enhance the ability of education innovation, promote the development of education internationalization, build an intelligent education environment and the security strengthen of education information. By making full use of the performance characteristics of optical network, improve the application construction of school information technology, and gradually further transform and optimize the optical network according to the problems and defects feedbacks in the application [8].

3.5 Improve User Experience and Management Efficiency

The high-speed, stable and reliable characteristics of the all-optical network can ensure the smooth operation of various applications in the smart campus and improve the user experience. At the same time, the flat networking of optical network and the natural advantages of direct service education cloud platform can provide the ultimate experience of intelligent education for education bureaus, schools, teachers and students. In addition, the construction of all-optical network can also reduce the cost of campus network operation and maintenance, and improve the efficiency and level of network management.

4. The Practical Application of All Optical Network in Campus

Through all-optical network technology, we will build an efficient network foundation with large bandwidth, low delay, high speed, low cost, energy saving and green, support the application of innovative teaching modes and teaching tools, broaden learning channels and innovate teaching modes, promote cross-campus cooperation and interdisciplinary research, drive business management innovation, and improve the efficiency and quality of education, teaching, scientific research and management. Promote the modernization of education management and promote the process of campus internationalization.

4.1 Teaching Scene

With the transformation of ordinary classrooms into standardized examination rooms and multimedia classrooms, the school has promoted the continuous increase of classroom information points in the process of business iteration, from the traditional 2-4 information points (multimedia computer, wireless, video surveillance) in a classroom to the current addition of 6-12 information points such as cloud desktop, digital broadcast, large screen/blackboard, electronic class board, and Internet of Things. The teaching network environment of the classroom needs to be continuously transformed and upgraded to support the flexible expansion of business.

The teaching scenario requires fast and stable data transmission to support the real-time sharing of teaching resources and the smooth progress of online classes. For example, teachers can broadcast lectures online through the network platform, and students can watch and interact in real time; At the same time, teachers can also use the network platform for online testing and assignment, to achieve instant feedback and personalized teaching. Interactive functions are designed flexibly to generate interactive data and procedural data, so as to transform teaching into a process of dynamic communication and discussion [9]. Compared with traditional networks, all-optical networks use optical fiber as the medium. transmission with higher transmission speed and bandwidth, and can achieve more rapid and efficient data transmission. And adopt advanced encryption technology and security protection measures to ensure the safety and privacy of teaching data; At the same time, its stable network performance also ensures the continuity and avoids stability of teaching, teaching interruption caused by network problems, and meets the needs of high-speed data.

4.2 Office Scene

With the rapid growth of wireless networks and Internet of Things service terminals, mobile access to terminal locations has become the norm, and flexible service deployment and migration have become a necessity. It is covered by panel AP, and can be deployed in the form of ceiling, wall hanging or 86-box installation according to site environmental conditions [10]. The traditional network planning method based on network location can not meet the current complex business scenarios. The all-optical solution supports the mobile IP network segment of the terminal location, so we only need to apply the policy to the corresponding user group or the specified ip address, so that all the security policies and permissions of the user can be moved. In the face of massive Internet of Things terminals, printers, and mobile PCS entering the network, there is no need to change the configuration of access devices, and the VLAN is decoupled from IP and port through SDN technology.

By binding services to IP network segments, services can be rapidly deployed. Service terminals can be distributed in any area of the whole network to achieve logical isolation between services. In the overall security policy deployment, software-defined network (SDN) technology is used to improve the resource utilization of security devices, improve the overall security performance, and achieve redundancy and hot backup of security devices across brands and models. To facilitate the deployment of security policies, SDN implements IP addresses of users, IP addresses are users, and IP segments are user groups, so that the IP addresses of users accessing the IP address from any place remain unchanged. Because the IP addresses remain unchanged, security policies and permissions do not change.

4.3 Scientific Research Scene

In the modern scientific research scene, the application of network has become an indispensable part. By using the convenience and efficiency of the network, researchers have greatly promoted the progress of scientific research and the production of results. First of all, the Internet plays an important role in the sharing and exchange of scientific research data. Through online databases, cloud storage and other network platforms, researchers can easily share experimental data, research results and literature. This not only helps to avoid duplication of work and save scientific research resources, but also promotes cooperation and exchanges between different research teams. Through search engines, academic websites and online journals, it is easy to access a large number of academic papers, research reports and cutting-edge developments. This information is of great significance for researchers to understand the development trend of the field and grasp the latest research methods and technologies. At the same time, it also provides opportunities for researchers to participate in international academic conferences, seminars and other activities, which helps to broaden their academic horizons and enhance international exchanges and cooperation.

All these have higher requirements for the network, and the rapid rise of all-optical network because of its advantages of high speed, low delay and high bandwidth, so that researchers can discuss research problems and share research experiences through the network more convenient, thus accelerating the progress of scientific research projects.

5. Sum Up

All-optical network is a low-delay, high-performance network, not only to provide teachers and students with a better network learning environment, but also to "advanced, reliability, practicality, standard, economy, scalability, security" as the basic principle, to meet the daily needs of access to online learning resources, participate in remote teaching and tutor guidance, interactive communication, etc., help the school to start a new journey.

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Communication