RESEARCH ARTICLE

A Study on the Design and Implementation Plan of Computer Network Architecture in Education and Teaching

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Abstract: With the rapid development of information technology, computer network has penetrated all aspects of education and teaching and become an indispensable infrastructure in modern teaching. On the one hand, the reasonable design and effective implementation of network architecture provide teachers with rich and diverse teaching means and platforms, greatly widening the teaching space and improving teaching efficiency; on the other hand, it also provides students with a more open and independent learning environment, making the time and space for learning greatly extended. However, it is an extremely challenging problem to design and implement a scientific and reasonable, safe, and reliable education and teaching computer network architecture to meet the growing diversified educational needs. Based on this, the article discusses in depth the design and implementation plan of computer network architecture in education and teaching, to provide some useful references and ideas for the construction of education informatization.

Keywords: education and teaching; computer network; architecture design; implementation plan

Introduction

In recent years, the informatization process in China's education field has been accelerating, in which computer networks play a crucial role in many aspects such as improving teaching methods, enhancing education quality, and achieving educational equity. However, as a key support tool for education and teaching, it is a challenging task to design and implement a computer network architecture that adapts to educational needs, is easy to manage and maintain, secures data, and is efficient and stable. Therefore, there is an urgent need to study the design and implementation plan of computer network architecture in the education field, explore and build a reliable, efficient, and secure computer network architecture to meet the special needs of universities, and achieve the goal of effective teaching and learning.

1. Basic theory and technology of computer network architecture

1.1 Connotation of computer network architecture

Computer network architecture refers to the way of organizing and designing computer networks, including the physical and logical composition of the network. This architecture defines how the parts in the network interact with each other, how to transmit data, and how to realize network services. Among them, the physical architecture focuses on the hardware components of the network, including device types, network topology, and data transmission media; the logical architecture focuses on the software components of the network, including network protocols, network services, access control, and security mechanisms.

1.2 Key Technologies for network architecture design and Implementation

Network topology defines how network devices are physically and logically connected, such as stars, 3

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'=;kbuses, rings, and mesh (Shi, 2021.) Network protocols are the rules that control and manage the transmission of data through the network, such as TCP/IP, HTTP, FTP, etc. Network devices such as routers, switches, servers, etc. are hardware devices that implement network functions. Data transmission media such as fiber optic, twisted pair, radio waves, etc., affect the speed and quality of data transmission. Security technologies such as firewalls, intrusion detection systems, encryption technologies, etc., are used to protect the network and data security. Network management technologies such as network monitoring, performance optimization, and fault recovery are used to maintain the normal operation of the network.

1.3 The current mainstream network architecture and its advantages and disadvantages

In client-server architecture, the server is responsible for providing services and the client is responsible for requesting services. The server generally has powerful processing power and large storage space and can handle requests from multiple clients at the same time, which is easy to manage and maintain and can centrally control and protect data, however, the server may become a bottleneck, and when there are too many concurrent requests, the server may not be able to handle them effectively. In Peer-to-Peer (P2P) architecture, all nodes are both clients and servers, and nodes communicate and share resources directly with each other without relying on a central server, which can effectively use the bandwidth and storage resources of the network (Zheng & Zheng , 2020) and improve the availability of data, but it is difficult to manage and control, and there may be data security and copyright problems. Cloud computing architecture provides computing resources and services such as storage, processing power, and software applications through the Internet, which can provide services on demand, save hardware investment, improve resource utilization, and are easy to scale and maintain (Guan, 2021), but requires dependence on the Internet and may have data privacy and security issues. Software Defined Networking (SDN) architecture separates the control plane and data plane of the network, making network configuration and management more flexible and efficient, allowing dynamic adjustment of network resources to meet different service demands and improving network performance and flexibility, but it is more difficult to implement and requires network redesign and reconfiguration.

2. Research on the design and implementation of computer network architecture in education and teaching

2.1 Network design concept considering educational needs

In the university education environment, network users contain teachers and students of different age groups and different technical backgrounds. Therefore, the network should be designed to be easy to use so that everyone can easily access and use network resources, which involves the design of network interfaces, such as web pages and applications, as well as the accessibility of the network, such as network coverage and stability of network connections. Teaching activities in higher education include classroom teaching, distance learning, collaborative learning, independent learning, etc. Each teaching activity has different network requirements (Zhang, 2022), for example, classroom teaching needs high-speed LAN, distance learning needs a stable Internet connection, collaborative learning needs real-time communication tools, and independent learning needs rich online resources, so the network design should focus on adapting to various teaching activities to provide necessary network services. In education and teaching, it is very important to protect students' privacy, which involves the security design of the network, such as data encryption, user authentication, and permission control, as well as the management of data, such as data collection, storage, use, and sharing. Education is a field of continuous development and innovation, and the network design should be able to support innovative teaching methods and tools, for example, the network should support innovative projects of teachers and students, such as programming, making

websites, developing applications, etc. This involves the flexibility and scalability of the network, as well as the openness of the network, such as the compatibility and interoperability of the network, etc.

2.2 Key Steps in the Design and Implementation of computer network architecture in Education and Teaching

According to the requirement analysis, the topology of the network is designed, suitable network devices are selected, network protocols and services are determined, and the security policy and management policy of the network are formulated. This stage requires consideration of various factors, such as cost, performance, security, scalability, and manageability, to ensure the effectiveness and feasibility of the network design plan. According to the design plan, the procurement and deployment of network equipment, including routers, switches, servers, terminal equipment, etc. In the deployment process, the physical location of the equipment, power and heat dissipation conditions, wiring, and configuration need to be considered to ensure the normal operation of the equipment and the stability of the network. Install and configure network operating systems, network service software, security protection software, etc., set up network addresses and routes, device permissions and passwords, service parameters and options, etc., to ensure the functionality and security of the network. Perform system testing and optimization, including functional testing, performance testing, security testing, etc., to ensure that the network meets the designed requirements and standards. Based on the test results, perform system adjustment and optimization, such as modifying configuration, updating drivers, increasing bandwidth, etc., to improve the performance and availability of the network. Finally, system operation and maintenance management are performed, including system monitoring, maintenance, updating, and backup, as well as problem identification and resolution, and effective operation and management strategies need to be developed in this phase to ensure the continued stability and efficiency of operation of the network (Cai, 2019) .

3. Case study of computer network architecture design and implementation in education and teaching

3.1 Online learning platform network architecture

A typical online learning platform network architecture generally includes a user access layer, application service layer, data processing layer, and data storage layer. The user access layer is the front-end network interface, facing users directly. Its main task is to handle user access requests, including student and teacher login, registration, information query, course access, etc. This layer usually adopts load-balancing technology to ensure stable and smooth access for a large number of concurrent users. The application service layer covers various teaching application services, such as course resource services, homework submission services, online test services, communication and discussion service, etc. The network architecture design of this layer should take into account the independence and scalability of services so that services can be added or modified flexibly according to different teaching needs. The data processing layer is mainly responsible for data processing and analysis, such as statistical analysis of learning data, evaluation, and analysis of learning results, search and indexing of learning resources, etc. The network architecture design of the data processing layer should focus on the efficiency and accuracy of data processing to support teaching decisions and personalized learning. The data storage layer is responsible for the storage and management of all data, including user information, course resources, learning records, etc. In the design, full consideration should be given to data security, integrity, and persistence, and also support efficient data reading and writing and backup recovery (Cheng & Liu &Sun & Ni, 2019). In terms of network security, the network architecture design should also include access control, data encryption, a firewall, and other security measures to protect user privacy and teach data from illegal access and tampering. The network architecture design and implementation of an online learning platform needs to consider multiple aspects such as user experience,

service functions, data processing, and security protection to realize online, intelligent, and personalized teaching activities.

3.2 Design and implementation of the university campus network

The campus network of colleges and universities generally adopts a layered design mode, mainly divided into a core layer, a convergence layer, and an access layer. The core layer, as the core of the network, is mainly responsible for high-speed data transmission and routing decisions, and is usually composed of high-performance routers or switches; the convergence layer is responsible for aggregating data from the access layer to the core layer, and is generally composed of convergence switches; the access layer is responsible for connecting user terminals, including computers, cell phones, and other devices, and is mainly composed of access switches and wireless APs and other devices. In terms of network topology design, campus networks usually adopt a star or tree network topology to achieve the best network coverage and performance, in addition, redundant lines and devices are also used (Zhang, 2023) to increase the reliability and availability of the network. In the selection of network devices, the performance, compatibility, and cost of the devices should be considered, and devices with stable performance, good compatibility, and high-cost performance are usually chosen, such as devices from Cisco, H3C, Huawei, and other brands. In terms of network protocol configuration, suitable network protocols should be selected, such as TCP/IP, HTTP, FTP, etc. In addition, various network services, such as DHCP, DNS, VPN, etc., also need to be configured to meet the needs of teaching and management. In terms of network security, firewalls need to be configured to prevent external attacks and internal malicious behaviors, and access control also needs to be configured to restrict users' access to sensitive resources. The design and implementation of the campus network in colleges and universities need to consider multiple factors such as network coverage, performance, security, and cost to achieve an efficient, stable, and secure teaching network environment.

3.3 Mobile learning environment network construction

In the mobile learning environment, network access is the most basic requirement, including the provision of a Wi-Fi network with wide coverage and stable signal on campus and network access services based on 4G, 5G, or other mobile networks outside the campus. At the same time, network load balancing is required to guarantee the quality of network services to prevent network congestion and ensure the network experience of each user. The mobile learning environment network architecture should consider using cloud service technologies, such as IaaS, PaaS, and SaaS, which can reduce the complexity of the network architecture, improve the flexibility and scalability of network services, and also provide more diverse learning resources and applications. The mobile learning environment should support real-time synchronization and sharing of data so that students can learn anytime and anywhere, and it can also facilitate teachers' teaching management, which requires the design and implementation of efficient data synchronization and sharing mechanism, such as the use of cloud storage services, or the use of technologies such as P2P (Ding & Wang, 2018). The mobile learning environment network architecture needs to have strict security measures, including access control, data encryption, firewall, and anti-virus, to protect the learning data from illegal access and attacks. Finally, the mobile learning environment network architecture should focus on optimizing user experiences, such as providing fast network access speed, stable network connections, and convenient web service interfaces. In conclusion, building an efficient, stable, and secure network architecture for a mobile learning environment requires comprehensive consideration of multiple aspects, such as network access, cloud services, data synchronization and sharing, security assurance, and optimized experience, to meet the special needs of mobile learning.

Conclusion

This paper provides a detailed study of the design and implementation plan of computer network architecture in education and teaching. First, the basic theory of computer network architecture is reviewed, the key technologies of network architecture design and implementation are discussed, and the current mainstream network architectures and their advantages and disadvantages are described. Then, how to design and implement computer network architectures according to the needs of education and teaching is discussed, and some practical implementation cases are given. During the study, in addition to the technical aspects involved, more consideration is given to the characteristics and needs of the educational teaching environment and the impact of computer network architectures on the effectiveness of educational teaching. Through such research and discussion, it is expected to provide some theoretical basis and practical guidance for the design and implementation of educational teaching network architecture, promote the development of modern educational technology, and improve the effectiveness and quality of educational teaching.

Conflict of Interest

The authors declare that they have no conflicts of interest to this work.

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