Progress and Prospect of Network Design in the Face of Group Management

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Abstract. The optimization design of the group management website is of great value in ensuring operational efficiency and management level. This paper focuses on the design and analysis of several types of group management websites and discusses the difference between centralized network architecture and distributed network architecture in the application of group management websites. Traditional centralized network designs have limitations in terms of scalability and fault tolerance, so alternative solutions are needed. This study uses a comparative analysis approach to evaluate the advantages and disadvantages of centralized and distributed network architectures in the context of group management websites, to identify designs suitable for various scenarios. This study provides a comprehensive analysis of the functions, workflows, and performance metrics of centralized and distributed network design for group management websites and provides researchers' insights into their application and impact. The findings contribute to a better understanding of network design considerations for group management websites and provide practical guidance for developers and network administrators to optimize website performance and user experience.

Keywords: Group management, Network design, Network performance optimization, Data security, Privacy protection.

1 Introduction

The rapid development of digital technology has changed the way individuals and organizations interact and collaborate online. An important aspect of this digital revolution is the emergence of group management websites, which play a vital role in facilitating communication, coordination, and cooperation between members of different groups, communities, or organizations. These platforms enable users to create, join, and manage groups, share resources, and participate in collaborative activities, making them invaluable tools for modern teamwork and community building.

However, for a business, integration of the website with social media provides ample challenges in formulating an operational strategy [1]. To address these challenges and with the growing use of group management sites in diverse fields such

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as education, business, social networking, and project management, there is an urgent need for web designers to understand and optimize the underlying network architecture that supports these platforms. The network architecture of a group management website plays a crucial role in its performance, scalability, security, and overall user experience. In this context, the debate between centralized and distributed network architectures has attracted considerable attention from researchers, practitioners, and industry experts.

Through the review and analysis of the existing literature, the traditional centralized network design has been widely adopted because of its simplicity, economy, and easy management. The concept of centralized management is not only used in network architecture but also other places. Regarding this notion, data silo is used as a major concern in local government, where data is stored across the institutions. All institutions in a local government are aggregated in a single architecture to manage data and information traffic flow [2]. However, they face inherent limitations in terms of scalability, fault tolerance, and potential single points of failure [3]. This has led researchers and practitioners to explore alternative solutions, such as a distributed network architecture that distributes computing resources and workloads across multiple nodes or servers.

Recent research in this area has focused on conducting comparative analyses between centralized and distributed network architectures to assess the advantages and disadvantages of each. Factors such as system performance, resource utilization, fault tolerance, data consistency, and scalability were evaluated in different operation scenarios. These surveys provide valuable insights into the potential benefits of a distributed architecture in enhancing system resilience, scalability, and the overall user experience, especially in large-scale organization management applications.

The motivation of this study is to explore the reasons why the architecture of group management websites has gradually changed to distributed network architecture in recent years, replacing the traditional centralized network architecture.

Therefore, this study aims to explain the reasons for the replacement of centralized network architecture by conducting a detailed comparative analysis of centralized and distributed network architectures in the context of group management websites. The study focuses on evaluating key performance indicators for different use scenarios, such as system scalability, fault tolerance, data consistency, resource utilization, and user experience. The research framework includes analyzing the literature, collecting diagrams, reviewing examples for performance evaluation, and drawing conclusions to look ahead to future network design and optimization efforts in the field.

2 Design Requirements of Group Management Website

2.1 Functional Requirements for Group Management Website

Group management sites have many features that developers need to consider. These functional requirements are designed to meet the needs of users when managing groups, interacting with members, and accessing relevant information. First, group management sites need to provide user registration and login capabilities so that users

can create their groups or join existing groups. Second, the website should have a member management function, including the ability to add and remove members, set permissions, and manage member information. In addition, the group management site needs to support content management within the group, including publishing, editing, and deleting content, as well as file sharing and discussion activities. In addition, notification and reminder functions are also essential, such as new message alerts, activity notifications, etc., to ensure that users keep abreast of the dynamics within the group. Finally, data statistics and analysis can help administrators understand user activity, content popularity, and other information to optimize group management strategies. In summary, the functional requirements of group management websites cover user management, content management, notification reminders, data analysis, and other aspects, and the realization of these functions directly affects the user experience and management efficiency of the website.

2.2 Key Performance Indicators for Group Management Websites

Group management website key performance indicators are important criteria for evaluating website operation and user experience. Among them, the primary indicator is user activity, including registered users, active users, daily active rate, etc., reflecting the attraction of the website and user engagement. Secondly, the response speed and stability of the website are also key indicators, measuring the average response time of the website, the page loading speed, and the stability of the system to evaluate the user access experience. Security is another important Key Performance Indicator, covering data encryption, user rights management, prevention of malicious attacks, etc., to ensure the security of user information and website operation. In addition, scalability is also one of the indicators to consider, that is, whether the website can support the growth of large-scale users and groups, and the flexibility to expand functions to meet different needs. Finally, user satisfaction and loyalty are the key indicators to evaluate the success of the website, through user surveys, feedback, and evaluation to understand the user's satisfaction and loyalty to the website, to optimize the design and function of the website, improve the user experience and user stickiness. In summary, the key performance indicators of group management websites cover many aspects such as user activity, response speed, security, scalability, and user satisfaction. Whether these indicators reach the standard or not is directly related to the operation effect and user experience of the website

3 Introduction to centralized network design

3.1 Concept of Centralized Networks

As shown in Fig 1, centralized network design revolves around a central server that handles most of the workload. Workstations connect to this server and send their requests for processing, instead of handling tasks directly. This processing can involve running programs, storing data, and providing utilities [4].

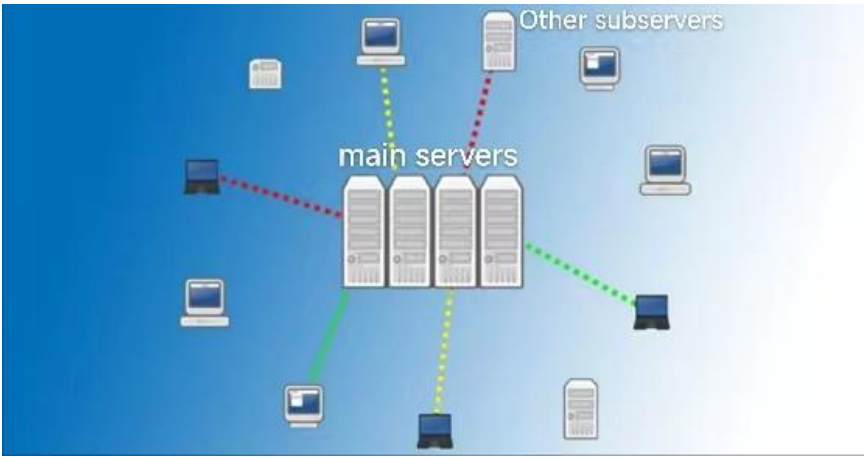

Fig. 1. Centralized network diagram [4].

3.2 Application of Centralized Web Design in Group Management Websites

A web-based self-management site for patients with type 2 diabetes - systematic website is a classic example of the use of centralized networks by Yu, C.H., Parsons, J., Mamdani et al. [5] In this patient self-management website, other physical assessment pages are developed around the center of the patient's main health. Another example is WordPress Multisite. “WordPress Multisite is a robust feature of WordPress that enables website owners to run multiple websites from a single WordPress installation. This WordPress support has a centralized dashboard that can manage several websites with unique content and customization [6].” Both Facebook and WordPress have built their websites using a centralized web design. These sites all have the same advantages, but also the same disadvantages. In terms of advantages, they centralizing all patches on the central server, many potential issues can be avoided. Another advantage lies in the centralized management of information. This streamlines data tracking and collection across the entire network, rather than managing each computer individually, leading to improved efficiency and easier management.

However, there are some drawbacks to consider as well. While centralized networks may offer benefits in terms of security, if an attacker manages to breach the central team's defenses, they could potentially gain access to all other nodes, exposing the entire network. Another concern is the potential for saturation. When a large number of nodes simultaneously request access to the central server, it may lead to a response time delay; A sharp increase in the load on the central server may lead to a decline in server performance; When a large number of nodes request at the same time, the bandwidth of the server may not be able to meet the demand, resulting in network congestion and reduced transmission speed.

4 Introduction to Distributed Network Design

4.1 Concept of Distributed Network Design

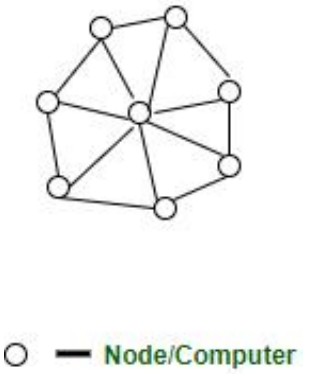

Fig. 2. Distributed Network diagram [7].

As shown in Fig 2, a distributed network comprises numerous autonomously operated networks managed collectively. Typically, these networks are geographically dispersed to enhance reliability and incorporate multiple entry points, termed points of presence, to enhance performance for users across various locations. Within a distributed network architecture, each network can interact with others to achieve service resiliency, performance enhancements, and automated resource sharing.

4.2 Application of Distributed Web Design in Group Management Websites

For a large shopping site, a distributed web design may be a good choice, such as Amazon. During peak shopping seasons, server demand could skyrocket. A distributed network maintains balanced server loads, preventing potential crashes. In case a server in the US experiences issues, the system can reroute user requests to other servers, possibly in Europe, ensuring uninterrupted service. This worldwide distribution not only provides resilience but also delivers optimal performance for users globally.

Also, for distributed network design, there are disadvantages. Firstly, they are often more complex than centralized networks due to the multiple layers of software abstraction involved, making deployment and management more intricate. Secondly, there's a skills gap as NetOps staff need to acquire new skills and knowledge to effectively operate distributed networks, which are in high demand and may be challenging to find and retain within an organization. Lastly, the cost to migrate and manage a distributed architecture from traditional centralized networks is substantial, requiring significant investment in designing and implementing new infrastructure.

5 Comparison and Analysis of the Two Network Designs

Table 1. Centralized and Distributed network design comparison on management types

ManagementType	Central Server	Resilience	Scalability
Centralized	Yes	Low	Moderate
Distributed	No	High	High

As can be seen from Table 1 [8], distributed network design has greater advantages in terms of elasticity and scalability compared to centralized network design and distributed network design. This means that in the event of a server failure or a temporary problem that cannot be solved, the distributed network design can continue to run the website through other nodes, while the centralized network design faces a complete shutdown.

Table 2. Centralized and Distributed network design comparison

Aspect	Centralized network architecture	Distributed network architecture
Redundancy	May cause interruption in case of server failure.	Allows resources to be shared and redirected to different clusters
Remote workforce accessibility	Suitable for legacy remote access virtual private network (VPN) architectures.	Less suitable for legacy remote access VPNs
Resource sharing	Limited resource sharing as all endpoints connect to a single server/application in a client-server manner.	Improved resource sharing and performance optimization due to constant communication and resource redirection among server clusters.
Application performance	Potential performance bottlenecks and downtime in case of central server/network failures.	Enhanced application performance through load balancing, resource redirection, and cluster communication.

Table 2 shows a comparison of two network designs in terms of redundancy, remote worker accessibility, resource sharing, and application performance.

First, a centralized network architecture has some applicability in traditional remote access to VPNs and application-specific services, but there is a single point of failure risk that can lead to system downtime and performance bottlenecks. The distributed network architecture provides better redundancy and resource sharing through clustering, thus improving system reliability and performance.

Secondly, for the accessibility of remote workers, the centralized network architecture is suitable for the traditional VPN architecture, but it may have the risk of a single point of failure, while the distributed network architecture can provide better reliability through clustering, but it also needs to pay attention to the problems that may be caused by a single point of failure.

In addition, in terms of resource sharing, the distributed network architecture is superior to the centralized network architecture, and better resource sharing and

performance optimization are achieved through the cluster mode, which can better meet the needs of large-scale networks and applications.

Finally, in terms of application performance, distributed network architectures improve application performance through load balancing, resource redirection, and cluster communication, while centralized network architectures may have performance bottlenecks and downtime issues.

To sum up, the selection of the appropriate network architecture should be considered according to the specific requirements, system scale, and performance requirements. Distributed network architectures offer clear advantages in terms of redundancy, resource sharing, and application performance, but may require more attention and management in terms of remote worker accessibility and management complexity.

Table 3. Advantages and Disadvantages of Centralized Network Management

Advantages	Disadvantages
Centralized Network Management is quick and easy to deploy	Centralized network management presents a single point of failure on the network
Centralized Network Management can easily add and remove client systems, users, and other servers without waiting	All data is stored and accessible from one server in a centralized network, presenting a security risk.
Centralized network Management is relatively inexpensive	Centralized network management is challenging to scale

Table 4. Advantages and Disadvantages of Distributed Network Management

Advantages	Disadvantages
Distributed networks are extremely fault-tolerant.	Distributed networks are more expensive
Distributed networks are highly scalable	Distributed networks are more complicated to architect and implement
Distributed networks experience lower latency than other architectures	
Distributed networks are safer because of their construction.	

Tables 3 and 4 are presented by ZPE Systems [9] in his article Centralized vs. Distributed Network Management: Which One to Choose? Proposed in the advantages and disadvantages of the two network designs are listed respectively.

By listing the advantages and disadvantages of the two types of network design, the application scope of the two types of network design is summarized as follows: distributed network design has great advantages over centralized network design in fault tolerance, scalability, delay, etc., but it also has great limitations. Distributed architecture has the advantages of high reliability, flexibility, and scalability, but the management and maintenance complexity is high [10]. For small and medium-sized businesses, choosing a centralized network design may be a better option because it requires less cost and fewer technical personnel. In general, centralized network

management has advantages in simplicity and cost, but it is inferior to distributed network management in fault tolerance and scalability. Distributed network management, on the other hand, performs better in large-scale and complex network environments and has a broader development prospect in the future.

For today's environment and prospects, centralized network design has become much less competitive. This only works when testing environments or isolating Lans. In the future, distributed network design will become more extensive with the continuous investment of website owners. Relevant technical knowledge will be continuously learned by website developers and designers, and then replace centralized network design. The complexity of orchestration and management of distributed networks is still a hurdle for developers, and how to optimize it is still a problem to consider.

6 Conclusion

This study compares distributed network architecture and centralized network architecture in many aspects, and then analyzes the application of these two network architectures in group management website design and looks forward to the future. According to the results of the research, the distributed network architecture is stronger than the centralized network architecture in terms of performance and practicality and is the choice of most website platforms at present. But at the same time, there are also high costs, difficulty, management, and maintenance complexity. The results of this study are to analyze the reasons for the elimination of centralized network architecture and the advantages and disadvantages of distributed network architecture, which can make website designers better choose different network structures to assume websites. In the future, research can be conducted on more specialized network structures, such as star-shaped and decentralized network structures. The role and shortcomings of these network structures in the construction of group management websites can be further analyzed.

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