System design object-based multi-agent network storage (OBMA-MNSS)

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Abstract. Information superiority is the key to ensure the success of information construction, and information storage system is the basis to obtain information superiority. Based on the analysis of the statistical methods of network value evaluation and the influence of storage system networking on information construction, according to the demand of information construction for data storage application, combined with the latest development of storage technology, an object-based multi-agent military network storage system is proposed. The design goal, design idea and prototype design of the system are given.

Keywords: Information Construction, Storage System, Network Storage

1. Introduction
Early information storage system was realized by attaching storage disk or array to server, that is DAS (Direct Attached Storage). With the increasing demand for information resources in the information society, the storage system based on Das obviously can not meet the needs of the information society. Therefore, with the development of information technology, we should consider the construction of network storage system and build network storage system or data center. According to the requirements of information society and the latest development of storage technology, we propose an object-based multi-agent hybrid network storage system(obma-mnss). On this basis, the corresponding prototype system structure is designed and its basic technical composition is analyzed. The prototype system uses high-speed Ethernet transmission technology as the bottom communication backbone of the entire storage network, divides and integrates the storage devices (or systems) according to the object storage principle, uses intelligent agents to weaken or eliminate the differences between the storage objects, and provides shared data access services for users. Using object technology, we can encapsulate various heterogeneous storage devices (or systems), and use intelligent agent technology to improve the intelligent degree of storage services and resource management, facilitate the expansion of system resources, enhance the overall reliability and security, and provide a "middle agent layer" that can blur the boundary for various heterogeneous storage devices (or systems), Realize the compatibility of all kinds of storage devices (or systems) in different periods, and reduce the total cost of building network storage system.
2. Analysis of object-based multi-agent military network storage system obma-mnss) architecture

According to the requirements of information construction and the latest development of storage technology, we propose an object-based multi-agent hybrid network storage system (obma-mnss). On this basis, the corresponding prototype system structure is designed and its basic technical composition is analyzed.

2.1. The objectives of system designed

In order to ensure the effective use of information resources, will not be destroyed, we must establish a safe and reliable information storage system. The main purpose of our research and design of obma-mnss test prototype system is to provide data resource support and shared access environment for military information command system. Therefore, the network storage system must be able to meet the following requirements:

- Support distributed heterogeneous environment, each node has self-organization management ability, and can be adjusted adaptively. Reduce the dependence on the storage system management center, so that the whole system has a high degree of autonomy and self-management characteristics;
- It has the ability of dynamic allocation of storage resources and I / O load balancing;
- It must be able to adapt to dynamic expansion, combine object storage technology, allocate storage space with object granularity, and eliminate the sensitivity of the system to heterogeneous devices;
- To be compatible with the early built storage system;
- It need has high reliability and security, strong fault tolerance and disaster tolerance mechanism, and can achieve high-level security protection ability. The redundant management information is saved by the proxy node, so that the system can still work normally in the case of a small amount of storage device failure, and the information reconstruction of the failed node is realized by the self-healing mechanism, so as to realize the no downtime capability of 24 * 7 * 356.

2.2. The ideas of system designed

In the information society, the requirements for high-performance computing, storage and communication are more and more high. The information environment based on network is gradually improved, which puts forward new requirements for information storage system, namely, infinite capacity, infinite bandwidth and infinite processing power. According to these requirements, from the perspective of application top-level design, we propose an advanced network storage prototype system that can be applied to the future complex environment, providing research direction and object for further research on the composition technology of storage system. By using the technology of intelligent agent and autonomous domain management in Wan, a kind of information storage "middle layer" can be built in a certain range (according to the specific application requirements, the system scale can be dynamically adjusted), which can completely shield the differences of various storage systems, realize the transparent access of users without paying attention to the storage details, and achieve the seamless information and data between industries and institutions share.

Obma-mnss is a highly reliable, self-organized and self managed test prototype system of distributed data sharing network storage system. We combine distributed storage and centralized storage, and put forward a storage system framework of distributed deployment of equipment, centralized planning and design of the system, and decentralized adaptive management within the system. The system uses the method of separating the I / O command stream and the data transmission stream to realize the direct data transmission between the storage device and the user, reduce the workload of each server, and maintain the high storage performance of the system. Therefore, the prototype system from the perspective of improving the storage architecture to improve the overall performance of the storage system for the purpose of solving the storage device compatibility, system scalability and storage performance bottlenecks and other issues opened up new methods and ways.

Obma-mnss can integrate complex and diverse physical storage media and storage subsystems at different levels, and use virtualization technology to provide users with a single view of storage systems.
resources, shield the underlying characteristics of storage devices, and achieve effective utilization and management of various heterogeneous storage resources. Specifically, it is an intelligent "intermediate system" that spans the underlying physical storage media and management software, and realizes the transparent storage and access of data on different storage media. In the obma-mnss storage environment, storage will no longer depend on the geographical location, or limited to the architecture, which improves the visualization, scalability, and adjustability of storage resources. Managers do not need to care about the physical storage devices in the background, just focus on the allocation and management of logical storage space, which simplifies the storage management operation.

In the system design, the principle of storage virtualization is fully used for reference and extended to the device and system level. Through the unified management of various storage devices and systems, the differences in system, structure and distance are shielded, and the unified access of users to storage resources is realized.

3. Design of obma-mnss prototype system

The core of obma-mnss is an adaptive network storage system which can realize distributed centralized management and decentralized data placement. The system is divided into autonomous regions in general, and combined with intelligent agents to achieve effective management of storage objects. The overall structure of obma-mnss is shown in Figure 1, which is composed of storage service domain, metadata management domain, security protection domain, storage agent control domain, etc.

![OBMA-MNSS Architecture sketch](image)

**Figure 1. OBMA-MNSS Architecture sketch**

In the picture, line a represents the workflow in obma-mnss metadata management domain, which is responsible for hierarchical adjustment and configuration of storage resources, analysis, migration and backup of data resources, management and coordination of metadata and global unified naming, etc; line B is the workflow of storage security protection, such as setting the security level of each system, user's identity authentication and authorization, monitoring the security risks and threats in the storage network, recording logs and providing policies and mechanisms of security and anti-destruction.

The basic workflow of obma-mnss is as follows:

(1) User sends I/O access request to storage service domain;
(2) After receiving the I/O access request, the storage service domain first confirms the user identity and authorization to the security protection service domain, and determines whether to accept or reject the access according to the query results;

(3) After the security authentication is passed, the storage service domain contacts the metadata management domain to obtain the metadata information such as the logical view, name and location of the storage and data resources related to the user's I/O request;

(4) According to the resource management strategy, the storage service domain distributes the corresponding I/O load to the storage agent (SA) which can satisfy the user's request, and feeds back the relevant service information to the user;

(5) The user establishes a connection with SA for direct data access.

As can be seen from the figure, the storage service domain is the entrance of the whole obma-mnss, providing users with the storage service interface and resource logical view. The amount of users it can accommodate will directly affect the performance of obma-mnss applications. Therefore, the distributed parallel cluster technology is considered to realize the concurrent operation of services in the service domain. Metadata service management domain includes various basic operations, fault tolerance and search of metadata. Among them, the global naming service part provides the necessary location information and data resource distribution information for distributed storage resources, while the resource hierarchical management service part is mainly responsible for the allocation, scheduling and application processing of storage resources. Security protection service domain is mainly responsible for the security and reliability of the whole storage system. It implements access control mechanism and log audit for data and storage resources, and combines with SA to realize remote backup, disaster recovery and other anti damage mechanisms. Storage agent domain shields the diversity of storage resources, provides a unified storage access interface for the system, and also provides a variety of access operation modes for the system and users by combining with storage objects. SA realizes the virtualization of storage resources from the bottom, provides the possibility for unified management of different storage devices and systems, and implements a variety of intelligent storage management operations, such as self adaptation, self coordination, self recovery, etc.

The whole prototype system uses the hierarchical management of storage resources to abstract the distributed storage resources and form a unified logical view. According to the different application environment, it analyzes the performance and application differences between the current storage devices (or systems), and divides them into different storage levels. Using agents to shield the physical characteristics of storage devices (or systems) to ensure that they can adapt to a variety of heterogeneous storage environments. At the same time, according to the different utilization of information resources, agent realizes the data distributed deployment mode in the hierarchical storage space. The agent domain adopts a hierarchical structure, each layer is composed of several agent controllers and storage devices (or systems), which are interconnected by high-speed channels. It is very convenient to realize the dynamic expansion of storage devices (or systems) by adopting the hierarchical nested management structure. But this kind of hierarchical structure, because the more down channels, the more equipment systems are connected, will gradually form a "inverted tree" topology structure, which is easy to cause the problem of transmission bottleneck in bandwidth allocation.

It should be noted that the attached storage device in the agent can be a separate network storage device or a relatively independent network storage system. It makes full use of agent technology to realize the "storage service middle layer", and transparently handles the physical details of the underlying equipment, on the one hand, it realizes the dynamic expansion ability of the system; on the other hand, it realizes the compatibility of the early built storage equipment and the system, and reduces the unnecessary cost of repeated investment.

4. Characteristic analysis of obma-mnss

Obma-mnss is a new type of network storage system that can be compatible with the early storage system, and can be continuously expanded and upgraded. By gradually integrating the existing
information storage system into a new network storage system with perfect storage mechanism and protection strategy. In the design of obma-mnss, many new technologies and algorithms in data storage are added, which make the system have some advantages that the traditional storage system does not have:

(1) Object based scalable storage. The unified access of file and block I / O interface is realized; the detailed control of data is realized by using the attribute and method mechanism of object; some functions of file system are moved down to storage device, which improves the intelligience of storage device, simplifies the complexity of metadata management and eliminates the performance bottleneck of I / O service.

(2) Three party transmission mode is adopted. The user first obtains the metadata of the object from the related servers in the metadata management domain, and then directly establishes a connection with the storage device for data access. On the one hand, tripartite transmission reduces the load of metadata server, on the other hand, it increases the feasibility of parallel storage between users and devices.

(3) Hierarchical resource management. It realizes the mapping of different data levels, different utilization rates and different levels of storage devices, so that the data can be stored in storage devices according to the application environment and conditions. The independent storage resource management is used to realize the dynamic allocation and scheduling of storage space in the system, which improves the performance of data distribution and enhances the robustness and security of the storage system.

(4) Multi agent adaptive intelligent technology. By using agents to attach storage devices, the intelligent degree of the whole storage system is improved, and the possibility of intelligent analysis and decision-making of military information resources is provided. In addition, using agents to "transparencyly" process heterogeneous storage devices or systems, users can use a variety of storage devices or systems seamlessly. Secondly, the "middleware" feature of agent is used to realize the compatibility of early storage system. By using the agent, the user's I / O requests can be scheduled in parallel, and the real parallel distributed storage access mechanism can be realized.

(5) Replica redundancy and load balancing technology. Because of the large amount of military information data, the wide distribution of user access, and data access also has timeliness and regional. The redundancy technology of multiple copies can be used to distribute the data with high access frequency in multiple access points to improve the direct hit rate of user requests, reduce the delay of user access, and improve the performance of the system. In addition, reasonable data deployment strategy is adopted to evenly distribute data resources in each storage space, so as to improve the parallelism of user access and system operation as much as possible, and achieve the purpose of load balancing.

(6) High level of security and survivability. Because of the distributed deployment strategy, the service nodes and storage nodes are distributed, and the current mature cluster technology is used to enhance the stability and robustness of system services. Intelligent agent can understand the usage of data and storage resources in real time, and implement remote data backup and recovery mechanism based on WAN in time. In addition, the access authentication mechanism is added to the whole storage system. Based on the security protection of the storage network itself, encryption and authentication are used to improve the path and data security between users and devices, and reduce the risk and threat of the system.

5. Conclusion
The prototype system uses high-speed Ethernet transmission technology as the bottom communication backbone of the whole storage network, divides and integrates the storage devices (or systems) according to the object storage principle, uses intelligent agents to weaken or eliminate the differences between the storage objects, and provides shared data access services for users. Using object technology, we can encapsulate various heterogeneous storage devices (or systems), and use intelligent agent technology to improve the intelligent degree of storage services and resource
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