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On the Applications and Advantages of Private Cloud Storage in High-Definition Production Networks (Postprint)

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Abstract

Employing private cloud storage methodologies to construct non-linear high-definition production networks can effectively enhance both the caliber and quality of program production while concurrently improving network security. Based on this premise, this paper analyzes the application of private cloud storage within high-definition production networks and investigates the associated advantages.

Full Text

The Application and Advantages of Private Cloud Storage in HD Production Networks

Abstract: This paper analyzes the application of private cloud storage in non-linear HD production networks. This approach not only effectively improves the quality and efficiency of program production but also enhances the security of production networks. Based on this analysis, the paper examines the associated advantages of private cloud storage in HD production environments.

Keywords: private cloud storage; HD production network; application; advantages
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The rapid development of the television industry has imposed higher demands on program production, data processing, and data management. To meet public demand, technical personnel have adopted advanced cloud storage solutions to

improve television program quality and efficiency while managing and storing digital television content. Production networks are responsible for critical tasks such as program editing and post-production, and massive amounts of program data are inseparable from these networks. Consequently, the use of cloud storage in HD production networks is particularly important.

1. Virtual Storage Technology and Its Application

With the rapid advancement of technology, network and computer technologies have developed significantly, enabling the gradual integration of video networks and entire broadcast channels. This is especially true for HD production networks, which have extremely high storage requirements and necessitate the introduction of advanced products and storage technologies into the video domain.

Since its inception, SAN technology has generated many new concepts, with virtual storage emerging as a particularly representative development. Unlike traditional switches and RAID arrays where the SAN structure can be directly accessed by hosts at the hardware layer, virtual storage abstracts data storage capabilities from physical, tangible data storage. For most editing users, they need not understand the underlying storage implementation—only the storage interfaces. This creates an intermediate layer between users and private cloud storage. When modifications are made to the backend cloud storage, frontend data remains unaffected and editing workflows continue uninterrupted. Consequently, private cloud storage enables flexible maintenance, expansion, and upgrades with minimal impact on backend operations.

The system employs a 10GE switching mode for upstream connections with fully redundant connectivity to ensure bandwidth guarantees and disaster recovery capabilities. In terms of storage capacity and tiered storage, and considering reasonable investment costs and platform scalability, the initial deployment includes 60TB of disk capacity comprising three different types—SSD, SAS, and SATA—with varying capacities to meet diverse application requirements. Capacity can be gradually expanded as business systems migrate to the cloud storage platform. A SCALE-out architecture ensures simultaneous linear performance improvement and dynamic capacity extension, providing fast and efficient storage services that address large data capacity demands while delivering ultra-high frontend bandwidth through stacked multi-node bandwidth aggregation.

Based on disk performance and business application requirements, detailed planning has been implemented for disk types and configurations. High-performance SSDs are deployed on the bus closest to the controller, while lower-performance SATA disks are placed on the bus farthest from the controller to optimize overall storage device performance. Additionally, data tiering technology is employed: data with the highest read/write frequency resides on high-performance SSDs (smaller capacity), moderately frequently accessed data is stored on SAS disks (balanced capacity and performance), and infrequently accessed data is placed on SATA disks (largest capacity but lowest performance), thereby achieving

optimal data read/write efficiency.

2. Key Features of Private Cloud Storage in Production Networks

2.1 Ultra-Low Latency and Ultra-High Bandwidth

Currently, most cloud storage systems utilize 8GB FC-SAN architecture to meet user storage requirements. The high performance of SAN provides massive storage space while satisfying stringent demands for ultra-low latency in certain critical applications.

2.2 Centralized Disaster Recovery and Backup

No equipment is completely reliable, and storage devices cannot guarantee 100% uptime. While users can replace failed hard drives, damaged data is often irrecoverable—especially when data loss occurs, resulting in irreparable damage. Therefore, implementing data backup and disaster recovery within acceptable timeframes and costs is essential to ensure business and application availability. Centralized data backup and disaster recovery are easier to manage and implement than decentralized storage solutions and are more rapid and effective. Multiple RAID level combinations, fully redundant hardware designs, plus data services such as replication and snapshot technology ensure data security.

The cloud storage platform' s storage gateway must provide high-performance IOPS (input/output operations per second) and storage bandwidth, deployed with dual-engine units where each engine contains two management modules for storage device management and external interfaces. The dual engines implement active-standby failover, while management modules within each engine also provide mutual hot backup. For transmission links, each management module provides multiple interfaces to achieve link balancing and load balancing with various switches and storage devices, thereby ensuring high security and performance of the storage platform.

2.3 Centralized Management and Ease of Maintenance

Centralized management enables control and maintenance of all data through a single unified interface. Users simply store data in the cloud space, after which data processing, management, and backup are handled automatically by the cloud. This not only enhances data security but also reduces the workload of data storage management.

2.4 Excellent Scalability and Flexibility

To accommodate diverse business system applications, the cloud storage platform' s storage network must support all required storage methods and provide multiple modular storage interfaces while supporting online expansion of interface modules. For example, in Wuxi Broadcasting' s archive media asset system,

various materials use NAS storage with data transmission over 10 Gigabit Ethernet, while virtualized server infrastructure employs SAN storage interconnected via FC interfaces.

As society progresses, private cloud storage is increasingly applied in production networks. Its application not only improves the efficiency of HD television program production but also enhances program special effects quality. Research on cloud storage applications in production networks demonstrates that cloud storage-based production network innovation fully meets the requirements of HD program production. Private cloud storage application in HD production networks strengthens television stations' ability to process massive media data and video/audio materials, eliminates bottlenecks in late-stage audio file processing during media editing, and enables simultaneous operation of over one hundred workstations.

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