

Exploration and Practice of Cloud Architecture Technology in Xinhua News Agency's Video Technology System (Postprint)

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Abstract

Xinhua News Agency's video technology architecture is a converged media production management system constructed based on cloud architecture technologies, oriented toward both campus networks and the Internet. It covers the entire workflow of program production management, encompassing video acquisition, program production, material storage, and multi-channel distribution. This paper provides a detailed exposition of its design philosophy, technical implementation, and application status.

Full Text

Preamble

Exploration and Practice of Cloud Architecture Technology in Xinhua News Agency's Video Technology System

Abstract: Xinhua News Agency's video technology system is a converged media production management system built on cloud architecture for both campus network and Internet environments, covering the entire program production workflow including video acquisition, production, asset storage, and multi-channel distribution. This paper elaborates on its design philosophy, technical practices, and application scenarios.

Keywords: cloud architecture; video technology system

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Traditional broadcast media have long employed parallel technical architectures for audio/video systems and IT information systems—two independent systems with clear divisions of labor that evolved separately. However, with the rapid advancement of Internet technologies represented by virtualization and cloud computing, and the increasingly evident trend of convergence between traditional and new media, this architectural model has begun to constrain technological development in broadcast media, failing to meet the flexible demands of video program production and management.

1.1 Reducing Signal Topology Complexity Through IP-Based Architecture

Broadcast media have traditionally relied on SDI baseband signals as the primary means of video transmission within facilities. As business operations have expanded, signal volume and bandwidth have become system bottlenecks. Consequently, transitioning traditional audio/video systems to IP-based architectures and leveraging IP switching networks to address signal topology complexity has emerged as an intuitive and viable improvement strategy.

1.2 Reducing Costs Through Generalized Equipment

With the proliferation of cloud computing and the exponential growth of processing power, the functions of traditional specialized equipment are increasingly being replaced by “generalized hardware + software” solutions, with deployment on virtualization platforms or public clouds becoming commonplace. This shift to generalized equipment has substantially reduced procurement and operational costs while improving overall system compatibility and scalability. [Figure 1: see original paper]

1.3 Integrating Legacy and New Business Through Cloud Architecture

Traditional broadcast media production and broadcasting systems demand extremely high levels of security, making isolation between production networks and the Internet a critical requirement. Xinhua News Agency’s core business is news agency feed provision, which has substantially extended toward the Internet. To integrate traditional and Internet-based media operations, the adoption of new technologies has become imperative, with cloud architecture serving as the bridge between legacy and new business models.

2. System Architecture

Xinhua News Agency’s video technology system employs a cloud architecture design, planned according to a resource modularization approach and composed of foundational network, computing resources, storage resources, application resources, basic service resources, and video stream resources (Figure 1).

2.1 Foundational Network

All systems are built upon Xinhua News Agency's overall network planning, utilizing a full Ethernet architecture design with 10 Gigabit interconnections between switches and Gigabit-to-desktop connectivity at the front end. Selected network equipment supports SDN, enabling smooth transition to SDN networks in later phases as requirements evolve.

2.2 Computing Resources

Computing resources include CPU virtualization blade servers, GPU virtualization blade servers, and high-density servers. Blade servers are equipped with SSD fiber channel storage and deployed with general virtualization software. CPU blade servers provide computing resources for generalized application services, while GPU blade servers and high-density servers support lightweight non-linear editing, VDI, and other video applications. The pooling of cloud architecture computing resources has significantly enhanced system flexibility, scalability, and reliability while enabling exploration and practice of public cloud deployment.

2.3 Storage Resources

The storage resource pool consolidates all unstructured data throughout the video production process, with storage devices providing services exclusively over Ethernet and achieving unified management of users and resources under domain controller support. Distributed NAS storage employs a fully symmetric, scale-out architecture designed for bandwidth-intensive applications such as high-bitrate data sharing in non-linear editing networks. High-performance NAS storage supports I/O-intensive applications, hosting files requiring rapid browsing such as hot videos, keyframe images, and low-bitrate videos, while also serving as backup storage for virtualization platforms. Archive storage, composed of tape libraries and object storage, forms the core of Xinhua News Agency's video asset management system, digitizing high-bitrate media data to enable efficient and convenient online sharing of massive historical archives.

2.4 Application Resources

Application resources are deployed across both the audio/video domain network and the Internet domain network, primarily integrated on general rack-mounted servers. The audio/video domain runs specialized applications unsuitable for virtualization, such as IP stream recording and monitoring, video packaging and transcoding, and media asset archiving and migration. For security considerations, audio/video domain applications cannot directly provide services to the Internet, necessitating separate deployment of certain applications in Xinhua News Agency's Internet domain network, such as the video return system supporting global correspondents.

2.5 Basic Resources

The basic resource pool contains various database servers, consolidating all structured data throughout the video production process and providing multiple database services including Oracle, SQL Server, and MySQL for applications. As the foundation supporting critical business operations, the server selection employs a heterogeneous parallel approach using both minicomputers and X86 servers, with all related network and database services achieving high availability. This design enables the basic resource pool to efficiently, reliably, and securely meet the performance requirements of the application resource pool.

The video stream resource pool adopts a UDP multicast-based TS over IP Gigabit network architecture, managing all signal sources through IP addresses to enable unified monitoring, recording, and scheduling, thereby simplifying signal topology complexity across the entire video technology system. Signal sources include 4G backpacks, mobile phones, Internet video live streams, Xinhua's internal business television systems, satellite live signals, terrestrial dedicated line signals, and SDI signals within Xinhua's audio/video systems. These signals are converted into unified TS over IP streams by respective receiving devices at system boundaries and connected to IP stream multicast network switches. Recording and monitoring servers connect to both the audio/video domain network and the IP stream multicast network via dual network cards, enabling signal monitoring, recording, and scheduling. This "dual-network architecture" ensures multicast data does not impact core network operations while achieving video signal data sharing.

3.2 IP-Based Acquisition and Distribution

Lightweight non-linear editing leads the generalization of video equipment in the video technology system, but the absence of professional audio/video cards also necessitates corresponding adjustments to signal acquisition, distribution, and related workflows. Xinhua News Agency has adopted a parallel approach of "IP signals + baseband signals" to complete system-wide IP transition in phases, with the current phase achieving IP-based acquisition and distribution processes.

As a news agency, video feed provision and distribution constitute primary business operations. Xinhua News Agency's video Internet feed system has operated stably for years, gradually replacing traditional satellite feed methods. For video signal live distribution, the system is equipped with IP-based Internet video stream gateway devices that connect the Internet and IP stream multicast network, enabling transmission and distribution of all signals from the video stream resource pool over the Internet for video signal distribution to new media users. During the 2017 Two Sessions and 19th Party Congress coverage, Xinhua's live reporting of events such as the "Ministerial Corridor," "Two Sessions Press Conferences," and "Party Representative Corridor" provided high-definition live signals to major Internet media platforms including

Xinhua's client, Tencent, and Toutiao.

In traditional broadcast media, SDI signals serve as the primary video exchange method, with mainstream non-linear editing workstations adopting an “industrial host + broadcast-grade audio/video cards” design operating on dual-network architectures of “Ethernet + SAN.” Non-generalized hardware and complex network structures result in high procurement and operational costs while severely constraining system flexibility in converged media production contexts. With the proliferation of 10 Gigabit networks, improved NAS storage performance, and virtualization technology development, the path to “lightweight” non-linear editing has become viable.

Xinhua News Agency's video production network system deploys thin clients at the front end, with back-end computing resources provided in parallel by high-density servers and GPU virtualization solutions, enabling operation and display interaction through remote image transmission software between front and back ends. High-bitrate data is stored on distributed NAS, with all packaging and rendering tasks completed in the background by the application resource pool. Editing and review processes are conducted through thin clients, while ingest, download, fine editing, and packaging tasks are performed on non-linear editing workstations with cards within the system.

Xinhua News Agency's video technology system, based on cloud architecture, has established a technical route suitable for its news agency video operations through exploration and practical validation of emerging technologies. Through unified planning of overall architecture and business development, Xinhua has selectively implemented practices such as “lightweight non-linear editing” and “IP-based acquisition and distribution,” making significant explorations toward the development direction of video technology system architecture with important reference value.

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Note: Figure translations are in progress. See original paper for figures.

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