Postprint: "New Infrastructure" Middle Platform Capabilities Supporting Smart Media Development

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Abstract

The national new infrastructure industry is accelerating, with mobility, datafication, and intelligence becoming the fundamental pillars driving industry advancement. How can new-generation information technology means be leveraged to optimize and upgrade the foundational capabilities of the media industry itself, thereby serving as a new engine and underpinning for smart media construction? This paper systematically elaborates, through research and practice on a big data and AI-driven technical middle platform, on how to concentrate efforts on the technical front to forge the "new infrastructure" middle platform capabilities for smart media, thereby further supporting the development of smart media.

Full Text

"New Infrastructure" Middleware Capabilities Supporting Smart Media Development

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Abstract: With China' s new infrastructure initiative accelerating, mobilization, datafication, and intelligence have become fundamental drivers of industry progress. How can the media industry leverage new-generation information technologies to optimize and upgrade its foundational capabilities, thereby becoming a new engine for smart media construction? This paper systematically explains how to build smart media "new infrastructure" middleware capabilities through research and practice of big data and AI-driven technical middleware, and further explores how these capabilities support smart media development.

Keywords: big data; artificial intelligence; technical middleware; smart media; new infrastructure; "Data + AI" dual middleware

1. Why Media Should Build Technical Middleware

The three core technologies underpinning information and convergence infrastructure in China' s new infrastructure context are: communication network infrastructure represented by 5G, computing infrastructure represented by data centers and intelligent computing centers, and new technology infrastructure represented by AI, cloud computing, and blockchain. Under this new technological support system, media forms will achieve full integration, while the capability construction supporting smart media faces new architectural evolution. The goal of technical middleware is not to solve single-point problems, but to provide an integrated platform of reusable "basic services and capabilities" [2]. Big data and AI technologies serve as foundational "resources, services, and capabilities," representing a new "system architecture approach" and "system construction model."

As smart media construction advances, there is an objective need to import massive volumes of internet content data and user data, as well as introduce various data forms such as third-party think tank reports and knowledge bases. Traditional architectures increasingly reveal their limitations in data integration, storage, and application. Data middleware abstracts and encapsulates data as services, providing them through APIs. The Data API is the core of data middleware, serving as the bridge between front-end and back-end systems. By introducing "data middleware" and adopting distributed, componentized technology systems, massive heterogeneous data can be intelligently collected, computed, stored, and processed to form a big data asset layer, thereby providing efficient data services for customers and business expansion.

Leveraging its years of deep cultivation in the media industry, Founder has accumulated unique advantages in business experience, technical expertise, and project implementation. Through multi-source data access management, data quality control, data organization and storage, and multi-dimensional external service output, Founder achieves the capability transformation from raw data to data services (Figure 2), empowering high-quality development in the digital economy era (Figure 1).

2.1 Data Middleware

Data middleware features a standardized, cross-system, cross-modal open service architecture [3] that adapts to various business system integrations, facilitates data exchange and sharing, accommodates requirement changes and extensions, and enables rapid data model construction based on business needs. As the foundation for aggregating and governing cross-domain data, data mid-

dleware is essential for the intelligent economy and represents an inevitable requirement for industrial digital transformation [3].

After decades of informatization development, China' s media industry has constructed numerous systems from different technology vendors. The objective need to import massive internet content data, user data, and various data forms such as third-party think tank reports and knowledge bases has made the drawbacks of traditional architectural approaches in data integration, storage, and application increasingly apparent. Data middleware abstracts and encapsulates data as services, providing them through APIs. The Data API is the core of data middleware, serving as the bridge between front-end and back-end systems. By introducing "data middleware" and employing distributed, componentized technology systems, massive heterogeneous data can be intelligently collected, computed, stored, and processed to form a big data asset layer, thereby providing efficient data services for customers and business expansion.

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2.1.1 Data Collection and Access Services

Through a rich set of collection tools, data middleware supports multi-source data access and enables real-time acquisition from various systems. Via plugin-based approaches, it implements cleaning, intelligent deduplication, conversion, standardization, and integrity/uniqueness verification of accessed data, ensuring completeness and consistency. The platform also supports thematic data service development.

2.1.2 Data Quality Management

The core of data quality management is establishing a unified data standard system that comprehensively tracks and inspects data capture, cleaning, and warehousing in real-time. The backend data monitoring platform checks warehoused data, supports generating data status reports, displays fault conditions when unexpected anomalies occur during processing, and sends early warning reports to multiple designated terminals through various alert methods.

2.1.3 Data Asset Management

Data asset management involves planning and organizing data management around media business characteristics and pain points to determine data asset planning and value confirmation. The distributed architecture enables flexible expansion with business growth, allowing persistent organization, storage, and

rights confirmation of owned and internet data resources to gradually form a big data asset center.

Data assets are divided into three major categories based on source and attribute characteristics: (1) owned content data assets comprising production data, audio/video data, and new media products; (2) internet data assets comprising internet manuscript materials, valuable information, and aggregated topic information; and (3) user data assets comprising integrated user resources, user behavior, and user profiles. Different categories adopt suitable organization methods to maximize retention of data characteristic information.

2.1.4 Data Mining and Analysis

Data mining and analysis enables large-scale data mining and model construction through deep integration with AI intelligent capabilities. Based on machine learning and deep learning algorithm models tailored for media application scenarios, it comprehensively integrates multiple algorithm analysis results and combines media domain business knowledge to form various application models such as hotspot models, dissemination models, event models, and influence models. This extracts knowledge from massive data and mines potentially valuable content information. Data application models adopt a plugin-based management mode that can be added or removed according to business needs, reserving space for future business development.

2.1.5 Data Service Output

The core objective of data middleware is to provide unified, open, and richly-typed data services for various applications. The data service layer provides standard data access interfaces for application systems, including unified data retrieval, data push, data viewing and selection, and external standard data interface APIs. The data service layer greatly reduces the binding and constraints of the business layer on data, thereby enabling lower-cost, higher-efficiency business innovation incubation. Data middleware practices a philosophy of complete data openness, striving to eliminate data barriers between systems and build an ecosystem with unobstructed data flow.

2.2 AI Intelligent Middleware

Smart media construction requires introducing numerous AI intelligent capabilities. The media industry' s informatization development has entered a rapid growth period for intelligent capability application, where intelligence can effectively improve media operational efficiency. However, one persistent obstacle is that for AI capabilities to play a more comprehensive role, they must integrate more closely and deeply with business systems, which also means that with diversified access services, the cost of replacing AI capabilities becomes high and the cycle long. AI middleware emerges precisely in this context (Figure 3).

2.2.1 Open AI Capability Platform

Built on a PaaS platform using deep learning and microservices architecture, the open AI capability platform constructs an AI component library. Based on intelligent processing technologies related to text, images, and audio/video, it integrates and manages multi-source AI service capabilities, outputting AI intelligent processing capabilities to application systems through standard interfaces.

Through natural language processing technology, the platform achieves automatic classification and production assistance for text data, including keyword extraction, entity extraction, entity relation extraction, sentiment analysis, text classification, automatic summarization, and entity linking and disambiguation. Through speech processing technology, it achieves speech recognition, synthesis, and transcription of audio/video files. Through image processing technology, it achieves OCR, similarity comparison, face recognition, image tagging, and image retrieval. Through video processing technology, it achieves shot segmentation, keyframe extraction, video tagging, and video retrieval. The comprehensive utilization of multimodal content analysis and recognition, semantic analysis, VR/AR, virtual anchors, machine creation, knowledge graphs, and blockchain copyright technology clusters continues to develop and permeate, opening imaginative space for media content production and presentation.

2.2.2 Scenario-Based Intelligent Applications and Services

Deeply integrated with application scenarios and centered on core business needs such as production diversification, review deepening, and dissemination interaction, the platform comprehensively analyzes multimodal data of text, speech, images, and video. It provides intelligent capability components for scenario-based applications, including intelligent planning, intelligent writing, intelligent production assistance, intelligent tagging, intelligent risk control, intelligent distribution and dissemination, and intelligent recommendation.

For content production, the platform uses natural language processing, speech recognition, and computer vision technologies to extract structured tags from content across multiple dimensions, including region, domain, sentiment, entity, keywords, and scene. These capabilities can be widely applied to content management, search, and recommendation for quickly obtaining needed multimodal data in business operations.

For content safety, the platform employs multiple deep learning technologies such as spell checking, grammar correction, pre-training, and target detection, assisted by media domain knowledge bases, to enable content review to quickly and effectively capture non-compliant information. This ensures the authenticity and legality of disseminated content by identifying typos, sensitive words, pornography, violence, terrorism, political sensitivity, and micro-business advertisements, significantly saving labor costs for content review while improving accuracy and efficiency, thereby safeguarding content publication.

For graphic, audio, and video production, the platform provides convenient intelligent tools such as image subject detection, style transfer, text-to-video conversion, video-to-gif animation, and video cover selection. For information dissemination, it comprehensively analyzes factors such as content emotion and news value to make predictions on information and manuscripts. By evaluating influencing factors on news reading volume, likes, comments, and forwards, it comprehensively assesses news dissemination power index and predicts manuscript influence, providing support and basis for media business correction or transformation.

3. Application Scenarios and Construction Value of Data & AI Dual Middleware

Based on our application and practice of middleware, we share insights on the scenarios that require middleware-related technologies.

3.1 Dual Middleware Provides Strong Support for Media Data Asset Construction

Traditional data systems integrate front-end and back-end, causing data structures to become highly fused with application business. When applications change, data structures must change, restricting data value mining. Middleware technology separates front-end and back-end, encapsulating data as data services and capabilities while encapsulating the AI computing pool as AI intelligent capabilities. Business applications no longer need to focus on underlying data structures but can directly call required data capabilities and AI intelligent capabilities through micro-components, achieving business goals through simple input and output.

The same philosophy applies to data analysis and mining, which also adopts a plugin-based construction approach. Through such model abstraction, internal production data, internet data, and user data are integrated, generating new data associations and forming new data values or knowledge nodes. For example, combining new media product data storage with dissemination and operational analysis value data not only preserves data historically in a comprehensive, multi-dimensional manner but also provides data analysis basis for how media organizations can more effectively conduct new media operations in the present and future. This guides decision-making for leaders at the macro level while optimizing daily work at the execution level.

3.2 Dual Middleware Enables Standardized Capability Output of Data and Intelligence

Dual middleware develops components according to business scenario needs to provide better data or intelligent capability output. For example, intelligent microservice components include component systems, standard interface specifications, and CI/CD specifications, characterized by vertical development, horizon-

tal expansion, and rapid reuse. Adopting an agile development mode, developers can freely choose appropriate technologies for rapid iterative deployment, select suitable virtual machines according to service requirements, match hardware to service resource requirements, and decompose applications into manageable modules and services where individual services can achieve rapid development.

3.3 Dual Middleware Is an Ecological Platform That Stimulates Business Innovation

Dual middleware application practice is elastically extensible according to specific projects. In simple media resource library projects, data access services can effectively solve heterogeneous data integration and comprehensive utilization, while AI intelligent analysis capabilities can improve resource tagging levels and precise retrieval probability, especially for images, audio, and video resources. For complete data asset construction projects, technical dual middleware is more conducive to overall system architecture building, fully supporting current business needs while enabling the introduction of more advanced intelligent capabilities as business develops and data services incubate, thereby driving business innovation.

Dual middleware makes data services and intelligent capabilities no longer tightly bound to business applications, providing sufficient openness. Its standardization allows more services to access or more applications to conveniently call services, enabling independent development of scenario satisfaction and service capability improvement without mutual constraints. This lowers the cost for businesses to replace service capabilities and enables service capabilities to flexibly combine and support more innovative businesses. Middleware is an ecological platform where various data services continuously grow, and data service needs can be recorded, tracked, and monitored. It continuously inputs mined data value and capabilities into the entire smart media business, practicing the philosophy from data to data service capability. As intelligent capabilities evolve, AI middleware can continuously access and output the latest quality intelligent capabilities for flexible selection by business systems. The combination of data and AI provides more new possibilities for smart media development.

4. Outlook

The media industry is about to welcome an intelligent media era characterized by "information arrives as desired, everything is accessible." Targeting new technologies and embracing the services of big data and artificial intelligence represents the optimal path for smart media construction in the new era. "Data + AI" dual middleware technology, guided by safe, reliable, robust, and mature pragmatism, provides strong support for smart media development as media "new infrastructure" and creates fertile ground for business innovation. This enables the transformation of media' s role from "information content provider" to "city information service provider."

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