Thoughts on the Development of China' s Broadcasting Cable Network (Postprint)

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Date: 2023-10-08T00:00:00+00:00

Abstract

In 2018, China' s broadcasting cable network industry actively promoted the "Smart Broadcasting" strategy, striving to expand the space for transformation and development. However, in an environment of rapid evolution of the industrial ecosystem pattern and unprecedentedly fierce market competition, the fundamental industry conditions and operational development environment of the broadcasting cable network have not yet seen fundamental improvement. This paper reviews and summarizes the latest developments in the broadcasting cable network industry and technological applications, analyzes the current competitive landscape and potential development opportunities, and proposes development ideas and countermeasures including accelerating the advancement of "National One Network" and resource sharing, expediting the layout of the 4K industry, making strategic choices for 5G technology application, researching and solving business and technical issues that have significant impact on industry development, promoting digital transformation oriented towards Smart Broadcasting, and cultivating cybersecurity talent specialized for the broadcasting system.

Full Text

Preamble

Reflections on the Development of China' s Broadcasting Cable Networks

Abstract: In 2018, China' s broadcasting cable network industry actively promoted the "Smart Broadcasting" strategy in an effort to expand its transformation and development space. However, against the backdrop of rapidly evolving industrial ecosystems and unprecedented market competition, the industry' s fundamentals and operational environment have not fundamentally improved.

This paper reviews and summarizes the latest developments in the broadcasting cable network industry and its technological applications, analyzes current competitive dynamics and potential development opportunities, and proposes development strategies and countermeasures. These include accelerating the "National One Network" initiative and resource sharing, expediting 4K industry layout, making strategic choices for 5G technology applications, researching and resolving business and technical issues with significant industry impact, promoting digital transformation toward Smart Broadcasting, and cultivating specialized cybersecurity talent for the broadcasting system.

Keywords: Smart Broadcasting; Converged Media; 5G Technology; 4K Industry

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1.1 Overview of Broadcasting Cable Network Industry Development

Broadband services continued to develop in 2018, but user growth slowed significantly, marking an inflection point. By the end of 2018, China' s cable broadband subscribers reached 38.563 million, an increase of 3.578 million (approximately 10% growth) from 2017, raising the proportion of cable digital TV subscribers to about 19.7%. Quarterly net additions of cable broadband users from late 2017 to late 2018 were 1.347 million, 1.926 million, 75,000, and 230,000 respectively—a noticeable slowdown compared to the rapid growth in 2017.

Smart terminal user scale grew rapidly. By the end of 2018, broadcasting cable network smart terminal users reached 19.143 million, a net increase of 6.613 million (52.8% year-over-year growth). The development of the broadcasting cable network industry in 2018 exhibited several key characteristics.

First, cable network subscribers continued to decline, with both total operating revenue and profit margins dropping significantly. National cable TV subscribers fell to approximately 223 million, a decrease of 21.396 million (8.7% churn rate) from 2017. China's digital cable TV subscribers decreased to approximately 196 million, down 13.19 million (6.3% churn rate), with a digitalization rate of 87.7%. Paying digital cable TV subscribers totaled about 146 million, a reduction of 7.027 million from 2017, representing a payment rate of 74.5%. By the end of September 2018, the market capitalization of 10 domestically listed cable TV companies had shrunk by nearly half year-over-year, with operating revenue nearly "cut in half" and average profit margins declining by nearly 5 percentage points. Digital TV, as the main business of the broadcasting cable network industry, is closely related to total industry subscribers. Considering various factors, actual subscriber loss may be more severe than the data suggests.

Second, interactive video services and high-quality video services became the primary business growth drivers. By the end of 2018, cable video-on-demand subscribers reached 65.931 million, an increase of 5.997 million (approximately 10% growth) from 2017. Among them, high-definition cable subscribers reached 63.81 million, up 6.427 million (approximately 11.2% growth). 4K video-on-demand users grew rapidly to 12.972 million, a year-over-year increase of 7.854 million (153.6% growth). Indicators such as interactive video services, high-quality video services, and smart terminal scale showed positive growth, which is directly related to the two-way network construction and transformation as well as broadband business development. The payment rate for digital cable TV stabilized and improved overall in 2018, primarily due to the large number of subscriber losses rather than improved conversion and activity rates.

Third, two-way network construction and transformation continued, with steady growth in two-way service penetration. By the end of 2018, two-way network coverage reached approximately 171 million users, an increase of 6.011 million (3.6% growth) from 2017. Two-way network penetration users reached 97.166 million, an increase of 14.652 million (17.8% growth) from 2017.

Fourth, broadband business continued to develop but with significantly slower growth. As mentioned earlier, the broadband user growth rate has slowed markedly, indicating an inflection point.

Fifth, smart terminal user scale expanded rapidly, as previously noted.

Faced with difficulties in the public customer market, the broadcasting cable network industry in 2018 continued to focus on government and enterprise group customer markets for breakthroughs, actively exploring areas such as the "Xueliang Project" (Bright Snow Project), smart party building, smart communities, and video conferencing. The industry accelerated promotion of new business forms such as IoT, industrial internet, and new retail applications, expanding business space and increasing revenue share. Some provincial networks' group customer business revenue accounted for over 40% of total revenue, even approaching 50%.

1.2 Competitive Landscape of Broadcasting Cable Network Market

In 2018, the broadcasting cable network industry made gradual progress against headwinds in market expansion, but still lagged significantly behind major competitors.

1.2.1 Large-Screen Viewing Patterns Shift from Cable Dominance to Tripartite Competition

The viewing landscape has transformed from cable networks' "monopoly" to a "three-way standoff" among cable TV, IPTV, and OTT TV. OTT TV has developed the fastest and is most competitive. IPTV continues to grow through integrated layout and bundled marketing by telecom operators, while cable TV remains passive with limited competitive strategies. Currently, mass communication models have shifted from linear to interactive, with internet video gaining advantage and beginning to compete for content dominance. The three major telecom operators have reinvigorated IPTV through "4G + Broadband + IPTV" bundled marketing, capturing significant market share and changing IPTV' s lukewarm situation since 2015.

1.2.2 Broadband Market Faces "Asymmetric" Competition from Telecom Operators

With the booming mobile internet, demand for mobile broadband has become essential, with mobile data operations generating the highest ARPU values. Leveraging mobile internet operational advantages, the three major telecom operators have developed comprehensive product portfolios for households, making home fixed broadband a bundled service within their communication and video product suites. This creates "asymmetric" competition for broadcasting cable network companies. In 2018, China Mobile, with massive capital and user scale, invested heavily in fixed network resources while adopting aggressive broadband pricing strategies, surpassing China Telecom to become the market leader. China Telecom, leveraging its long-accumulated fixed network advantages, vigorously promoted the "Broadband + Mobile + TV" trinity model. China Unicom implemented mixed-ownership reforms with internet giants like BAT, conducting fundamental reforms internally and externally through equity restructuring, strategic cooperation, new company establishment, and market-oriented initiatives to "slim down and strengthen" itself while actively seeking breakthroughs.

1.2.3 Social Informatization Faces "Ecosystem Chain" Competition

In building Smart Broadcasting, local broadcasting cable network companies have explored social informatization through various models, with new businesses "blooming everywhere." However, compared to competitors, they face several disadvantages. First, insufficient technical capabilities place them in the primary stage of the social informatization industry. Limited by resources and capabilities, most provincial networks primarily provide basic services like network transmission in the government-enterprise market and need to deepen vertical industry cultivation to enhance competitiveness and customer stickiness. Second, lack of scale advantages makes cost reduction difficult and resource integration challenging. In competition with internet enterprises and the three major telecom operators' nationwide scaled operations, fragmented provincial networks

appear weak in "breaking through" the social informatization domain. Third, lack of ecosystem layout makes it difficult to seize the commanding heights of technical standards. Broadcasting cable network participation in social informatization construction often adopts a "point-by-point breakthrough"approach on a case-by-case basis, making it difficult to replicate cases into business models, let alone integrate industrial chain resources through successful business models to seize technical standard 制高点 and build solid competitive barriers. Fourth, lack of continuous operational support makes it difficult to cultivate vertical fields meticulously. Compared to the three major telecom operators, broadcasting cable network companies have not yet fully established institutional mechanisms, organizational structures, and operational support systems for group customer markets, lacking long-term, continuous, and systematic operational support capabilities for government-enterprise clients. Compared to internet giants facing similar issues, broadcasting cable network companies' reforms are insufficient in depth, breadth, and speed.

1.3 Potential Development Opportunities for Broadcasting Cable Networks

Despite unfavorable conditions, broadcasting cable networks have three potential development opportunities. First is the opportunity from national information and cultural consumption market upgrades. The national push to expand and upgrade information consumption and cultural consumption has promoted the deepening of supply-side structural reform in broadcasting and television, bringing development opportunities to broadcasting cable networks. The national rural revitalization strategy will also bring broad market space and new urban-rural integration demands to the cable TV industry.

Second is the opportunity from industry-wide transformation to Smart Broadcasting. By building Smart Broadcasting and deepening the application of new technologies, the broadcasting cable network industry can further promote the "intelligent" upgrading of business, services, and operations, which contains new opportunities for transformation and development.

Third is the opportunity from expanding new technology applications and laying out new business development. IoT, 5G, and IPv6 were technology hotspots in 2018, with related applications moving from exploration to maturity, which will inevitably 催生 new business services and business models. In this process, if broadcasting cable networks accelerate exploration, they may occupy favorable positions in emerging industrial chains, forming a favorable situation with multiple business forms and collaborative development across multiple fields.

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2. Technology Application Progress

In 2018, fierce market competition and business development dilemmas forced broadcasting cable networks to accelerate technology application upgrades. On the other hand, facing new opportunities in the new era, broadcasting cable networks also actively laid out new business development and explored new technology application fields.

2.1 Market Competition Forces Technology Application Upgrades

2.1.1 Seeking Differentiated Competitive Advantages Through 4K Video Business Layout The launch of ultra-high-definition channels will accelerate the transformation and upgrading of broadcasting cable networks to full 4K ultra-high-definition digital video services, promoting the development of China' s ultra-high-definition video industry. Meanwhile, the combination of ultra-high-definition video with cultural entertainment, security monitoring, and medical imaging will facilitate cross-domain innovative applications, continuously injecting new vitality into digital life. Broadcasting cable network companies laid out 4K video businesses in 2018. In June 2018, multiple broadcasting cable network companies broadcast FIFA World Cup programs in ultra-high-definition 4K through the "CCTV 4K Zone." At the transmission level, provincial broadcasting cable networks have initially established 4K program delivery capabilities, with Beijing, Shanghai, Chongqing, Jiangsu, Zhejiang, Hunan, Sichuan, Shenzhen, and other regions carrying out 4K ultra-high-definition program production and broadcasting practices to varying degrees. In September 2018, the National Radio and Television Administration issued the "4K Ultra-high-definition Television Technology Application Implementation Guide (2018 Edition)," making the second-generation AVS standard (AVS2) the sole video coding standard adopted in the Guide, with domestic mainstream chip manufacturers launching corresponding chip solutions.

2.1.2 Developing Diversified Smart Terminals to Capture New Traffic Entry Points Currently, competition across different business domains on a single display screen is intensifying, making large-screen terminals a new hotspot for traffic entry competition. In 2018, the broadcasting cable network industry segmented market demands, adopting smart terminals as the main approach, broadband-enabled pure IP smart terminals and smart TVs as supplements, and various software-based large-screen and small-screen Apps as complements. Various terminal types were adapted to multiple application scenarios, with progress in several areas.

First, diversified large-screen terminals promoted comprehensive scenario coverage. Cable smart set-top boxes, pure IP smart terminals, smart TVs, software-based large-screen Apps, and small-screen Apps supporting multi-screen interaction covered different application scenarios with varying value propositions.

Second, large-screen smart terminal operating systems continued to evolve. In

2018, the National Radio and Television Administration significantly accelerated the promotion of the TVOS smart operating system, releasing three TVOS-related industry standards. With the emergence of innovation mechanisms like "laboratories," continuous progress was made in platform, technology, application, hardware, and talent integration innovation based on converged terminals.

Third, based on large-screen smart terminals, companies optimized experiences, enhanced stickiness, and explored internet-based operational models. Explorations and practices in regions such as Gohua' s "Gohua Xiaoguo" and Sichuan Broadcasting Network's "Shu Xiaoguo" demonstrated that: (1) voice intelligence can improve interaction convenience and enhance experiences for middle-aged and elderly users; (2) cooperation with internet companies has led young users to begin using internet membership services through large screens; and (3) novel advertising forms combining smart TV usage scenarios and viewer attributes can enrich the large-screen business ecosystem.

Fourth, smart TV terminal scale continued to expand. By the end of September 2018, according to incomplete statistics, over 3 million, 1.4 million, 1 million, 800,000, and 775,000 TVOS smart set-top boxes had been deployed in Hubei, Shanghai, Guizhou, Jiangsu, and Inner Mongolia respectively.

2.1.3 Intensified Broadband Competition Drives Bandwidth Upgrades and Network Construction Facing the fiercely competitive broadband market, local broadcasting network companies increased construction efforts in internet exits, access networks, backbone networks, and SDN to strengthen network foundations based on actual conditions.

First, they expanded internet exits and promoted network interconnection and intercommunication. In June 2018, the Ministry of Industry and Information Technology issued a notice to promote interconnection between the National Cable Network Company and communication networks/education networks at five direct connection points in Beijing, Shanghai, Guangzhou, Zhengzhou, and Chengdu. Meanwhile, led by the National Cable Network Company, China Cable Network and four provincial network companies (Chongqing, Shanghai, Shandong, and Hubei) established China Broadcasting Broadband Network Co., Ltd. to plan top-level design and resource integration for broadcasting broadband services. Local broadcasting cable network companies adopted various approaches to continuously improve intra-network traffic localization rates. Among them, provincial network companies like Chongqing, which started construction earlier and had more abundant resources, began exporting resources to other provinces and cities.

Second, they continued to upgrade access networks and comprehensively launched bandwidth acceleration. Local broadcasting network companies continued to increase network transformation efforts, consolidating network foundations while seizing opportunities such as "telecom universal service" and "beautiful countryside" initiatives to vigorously expand rural markets with

weak network infrastructure and low penetration by the three major telecom operators. FTTH technology has become the main direction for access network construction and transformation, with rapidly expanding application scale. EPON technology is gradually transitioning to GPON and evolving toward 10G GPON.

Third, they continued to expand backbone networks to enhance business support capabilities. As broadcasting cable network business operations continue to diversify, particularly with the application of 4K video, IP live broadcasting, and VR technologies placing higher demands on backbone transmission networks, 100G OTN has begun to be widely applied. The application of multiple service transmission disaster recovery protection technologies such as dual-plane networks has effectively improved network stability and reliability.

Fourth, they explored future-oriented technologies like SDN. Facing the wave of future network technology transformation, broadcasting networks began considering SDN/NFV-based construction of new networks centered on DCs (data centers), building cloud-pipe converged network architectures to address issues in cloud networking, cloud access, and cloud connectivity. Provincial network companies in Chongqing, Zhejiang, and Hubei explored different directions and degrees.

2.1.4 Deep Integration of Broadcasting Networks and Internet Technologies Driven by competitive pressure in 2018, broadcasting cable network companies began widely applying cloud computing, big data, and intelligent voice technologies to promote deep integration between broadcasting network services and internet services.

First, they applied big data technology to promote refined operations. Broadcasting cable network companies gradually transformed from extensive operational models to refined operations targeting households and even individuals. Under deep integration between broadcasting networks and the internet, local broadcasting cable network companies applied big data primarily across four progressive levels: data foundation, correlation analysis, business support, and business intelligence.

Second, they applied artificial intelligence technology to enhance video service experiences. Based on broadcasting network live streaming data and two-way network interaction capabilities, combined with voice recognition and voice interaction operations, they strengthened long-tail content production and operations, activating non-head content, live-to-VOD association, and scenario-based extended live broadcasting business forms.

Third, they applied cloud computing technology to carry out open converged operations for smart home services. Through personalized family education, elderly care, security, and smart home services, broadcasting cable networks formed industry-specific online-offline service systems. Taking operators as the

main body, they integrated industrial chain resources to provide various converged service supports based on platform + ecosystem.

Provincial network companies in Guizhou, Jiangsu, and Hubei achieved remarkable results in deep integration and application of internet technologies.

2.1.5 Leveraging Big Data Application Value to Promote Enterprise Digital Transformation Through the gradual implementation of big data application projects, broadcasting cable networks achieved a transformation from "viewing data" to "using data," enabling big data applications to gradually penetrate all aspects of enterprises from marketing support. Guangxi Broadcasting Network Company, in collaboration with Huaqi Cloud, built Guangxi Broadcasting Converged Media Cloud Platform and Big Data Platform, constructing capabilities for aggregation, production, distribution, and big data analysis. Shandong Broadcasting Network Company built Shandong Data Lake Industrial Park, creating a big data industry chain. Jiangsu Broadcasting Cable Network promoted the construction of a cable TV big data fusion analysis platform in Wuxi, effectively enhancing support capabilities and strengthening public service capabilities of cable TV networks. Zhejiang Hua Shu Group gradually implemented a large number of intelligent application projects based on big data and broadcasting smart terminals, promoting the evolution of broadcasting networks toward intelligence. Hubei Broadcasting Network Company established a big data service framework based on open-source software technology, opening big data resources and processing capabilities, and achieving multiple thematic application analyses from various dimensions such as business analysis, user behavior analysis, and media content analysis, providing data support for precision marketing, content recommendation, customer service, advertising, and business decision-making. Heilongjiang Broadcasting Network Company applied big data technology to fully integrate online malls, offline business halls' ERP systems, and set-top box systems, deeply integrating resources to support business operations and intelligent decision-making.

2.1.6 Adapting to Transformation and Development by Strengthening Social Informatization Services Seeking breakthroughs in social informatization services has become an inevitable measure for the broadcasting cable network industry to pursue transformation and development. Local broadcasting cable network companies have already regarded government-enterprise group customer services as equally important main businesses alongside video services and broadband access.

First, they provided technical support to increase the supply of public cultural service products. Following the 2017 "Digital TV Network Library," similar projects were launched in 10 provinces (municipalities/autonomous regions) including Chongqing, Jiangsu, Guizhou, Ningxia, Qinghai, Xinjiang, and Jilin in 2018. Inner Mongolia Broadcasting Network launched projects such as "Charming Chifeng" and "Science Popularization Inner Mongolia Public Service

Platform," creating public cultural service platforms on TV through 4K smart network set-top boxes. Sichuan Broadcasting Network Company launched the "Tianfu Culture—Chengdu Public Cultural Service Cloud Platform," comprehensively presenting public cultural service products favored by the people through converged media methods.

Second, they addressed people' s livelihood needs to support comprehensive public information services. Guizhou promoted the "Colorful Treasure Internet + Beneficial Services," helping to realize smart living where "data travels more, people travel less." Fujian Broadcasting Network Company launched the "Green Education Platform," creating an educational platform where "parents can buy with confidence, students can use with satisfaction." Hua Shu Group carried out smart elderly care services in Wenzhou and Jiaxing, while Shaanxi Broadcasting Network Company promoted smart home construction in Yulin.

Third, they leveraged network coverage advantages to serve social comprehensive governance. Guizhou Broadcasting Network Company actively conducted IoT research and applications, achieving remarkable results in electric vehicle management, wireless gas meter reading, smart tourism management, Xueliang Project public security video monitoring, and automated monitoring of geological disaster hazards. Jiangsu Broadcasting Network Company, Hubei Broadcasting Network Company, Jilin Broadcasting Network Company, Shandong Broadcasting Network Company, and China Cable Network Hainan Branch also carried out substantial and effective work in promoting social comprehensive informatization governance.

Fourth, they leveraged the "Party Network" advantage to support party building and poverty alleviation. Guizhou Broadcasting Network Company built the "New Era Learning Lecture Hall" platform, Guangxi Broadcasting Network Company launched the "Bagui Pioneer" platform, Hebei Broadcasting Network Company supported agricultural services and the "Four Ones Project," Guangdong Cable Network Company launched the targeted poverty alleviation demonstration section "U Public Welfare," Shaanxi Broadcasting Cable Network Company deeply implemented the "Broadcasting Poverty Alleviation · Broadband Countryside" project, and Hubei Broadcasting Network Company supported party building and poverty alleviation through the "Smart Broadcasting Informatization Cloud Platform."

2.2 New Business Development and New Technology Exploration

2.2.1 Preparing for 5G Development and Exploring 5G Technology Applications 5G technology offers advantages of higher speed, lower latency, and more supported connections, enabling three major application scenarios: high-bandwidth high-speed applications (4K, 3D, VR, AR, etc.), low-latency high-reliability applications (intelligent manufacturing, autonomous driving, etc.), and massive-connection applications (smart home, IoT sensing, etc.).

Based on current technology maturity, commercialization will gradually proceed in the order of eMBB → uRLLC → mMTC.

Broadcasting networks began exploring ways to integrate broadcasting, multicast, and unicast during the 3G era. In the 4G era, this approach received increasingly multi-faceted support. As 5G technology continues to evolve, trends of broadcasting network and 5G network convergence have emerged in Europe and other regions. China' s broadcasting cable network industry is also actively participating in 5G technology standard formulation and exploring broadcasting industry wired-wireless converged network and 5G technology application models.

2.2.2 Orderly Promotion of IPv6 Upgrade, Transformation, and Application In late 2017, the General Office of the CPC Central Committee and the General Office of the State Council issued the "Action Plan for Promoting Large-scale Deployment of Internet Protocol Version 6 (IPv6)."In early 2018, the National Cable Network Company began IPv6 pilots at the national backbone network level and some local network levels. Currently, dual-stack deployment 打通 and bearing at some business process ends are basically ready, and a four-step IPv6 large-scale deployment plan through 2020 has been formulated. At the local network level, Jiangsu, Zhejiang, Beijing, Hunan, Guangdong, Hubei, and other regions have also carried out IPv6 transformation pilots.

Currently, the broadcasting cable network industry still faces many difficulties in IPv6 transformation: (1) solving smooth transition issues during network cutover transformation; (2) addressing security issues brought by IPv6 direct connection; (3) resolving the lack of operational experience caused by significantly increased operational complexity during the transition phase; (4) balancing IPv6 large-scale transformation investment returns; and (5) deepening the application of IPv6 new features to realize their value.

2.2.3 Facing New Security Situations and Gradually Establishing New Security Systems As broadcasting cable network technology rapidly develops toward intelligence, IP-based, and cloud-based directions, traditional system and platform boundaries are broken, bringing new security risks. Meanwhile, with the rapid development of broadcasting network services, multi-level cybersecurity threats and risks are also increasing. In 2018, while responding to new security situations, the broadcasting cable network industry made certain progress in establishing new security systems.

First, they built comprehensive network and information security protection systems. In 2018, the industry focused on the reliability of business systems against external security threats and strengthened security protection capabilities. According to the National Radio and Television Administration' s "Notice on Carrying out Security Level Protection Classification Work for Broadcasting and Television Related Information Systems," local broadcasting cable network companies reasonably classified security levels for various broadcasting-related

information systems and planned, designed, constructed, evaluated, and rectified them according to corresponding level requirements.

Second, they applied new security technologies to upgrade security perception systems. The broadcasting cable network industry began establishing complete network and information security situation awareness and threat intelligence systems to dynamically understand network security conditions and predict and warn about network security development trends. Hua Shu Group, Guangdong Broadcasting Network Company, and Hubei Broadcasting Network Company began related work in different ways.

Third, they built cybersecurity protection systems through multi-party cooperation. In 2018, the State Administration of Radio and Television Planning Institute, Hubei Broadcasting Network Company, and 360 Enterprise Security Group launched in-depth cooperation in information security assurance and other fields, jointly building the "Broadcasting and Television Industry Cybersecurity Technology Research Laboratory" to carry out product design, R&D, ecosystem construction, marketing and expansion, and content innovation in the security field. This collaboration helps enhance the broadcasting system' s security assurance capabilities, build comprehensive broadcasting business security protection systems, and escort the development of Smart Broadcasting. Sichuan Broadcasting Network Company cooperated with 360 Enterprise Security Group to create the "Sichuan Broadcasting 360 Security Cloud," launching high-security-level government-enterprise information service solutions and promoting the wide application of Smart Broadcasting services.

3.1 Accelerating "National One Network" and Resource Sharing

Under current circumstances, the "time window" for large-scale development and transformation of broadcasting cable networks is narrowing, making the advancement of National One Network extremely urgent.

First, a new positioning should be clarified to obtain sufficient government impetus for the National One Network. In terms of positioning: (1) the National One Network should be a secure, reliable, manageable, controllable, and green interconnected national strategic resource network; (2) it should be a new media convergence transmission network that emphasizes politics and orientation; (3) it should be a new digital cultural dissemination network for deep development, integration, and reuse of massive programs and propaganda cultural resources, as well as a digital economy foundation network providing private network and internet services.

Second, sufficient internal industry driving force should be created for the National One Network. The broadcasting cable network industry's traditional business chains, value chains, and industrial chains are declining and deconstructing

under dual impacts of technology and market. In promoting the National One Network, recomposing market resources, promoting industrial synergy, establishing new business and value connections, and building a new broadcasting cable network industrial chain with market competitiveness have become urgent tasks. Advancing the National One Network should combine institutional mechanism reforms and functional transformations, being both innovative and reasonable, fully considering provinces' historical investments, current rights and interests, and autonomous operations, while promoting Smart Broadcasting development during the National One Network process.

In network integration, it is recommended to: (1) promptly determine the legal entity for the National One Network; (2) align the strategic goals of Smart Broadcasting development with cultural power and cyber power strategies, adapting to the requirement of providing gigabit-level broadband access in urban areas and hundred-megabit-level access in conditional rural areas by 2020; (3) accelerate the business strategic layout of the National One Network, including establishing direct interconnection points with the three major telecom operators in multiple locations to introduce broadband exit resources to provincial networks, adopting the strategy of "national business with national unified planning and operation, base business with national unified planning and base-coordinated operation, and local business with national unified planning and provincial autonomous operation," establishing one or several national businesses with unified planning and operation to inject substantive content into the National One Network, and integrating content resources to avoid obvious shortcomings in overall business competition; (4) accelerate the construction of a national broadcasting cable network standardization system and innovatively resolve standardization dilemmas by implementing relevant international, national, or industry standards for internet and IT technologies, and for urgently needed but not yet standardized technological innovations and business applications, considering the formulation of practical planning standards by the National Cable Network Company or multiple network companies jointly with research institutions and industry associations for reference by local broadcasting cable network companies; (5) accelerate the technical construction of the National One Network, including national interconnection network engineering, a national converged media business platform, national big data standard systems and data series standards, and unified national network terminal and smart terminal standards; (6) innovate supervision and management models, continuing traditional management methods for conventional broadcasting transmission services while adopting new approaches for Smart Broadcasting innovative businesses.

3.2 Accelerating 4K Industry Layout to Seize Future Commanding Heights

The rapid development of 4K technology and industry represents another historical opportunity for broadcasting cable network upgrading and transformation.

First, accelerate the enhancement of broadcasting cable network transmission capabilities. The industry should further accelerate network speed upgrades, gradually raising user access bandwidth to over 100Mbps universally, and to 1Gbps in areas with favorable conditions.

Second, 打通 all aspects of the 4K industry ecosystem. Broadcasting cable network companies should strengthen 4K content supply, enhance 4K channel program broadcasting transmission and on-demand service platforms, and connect content production and consumption links. They should actively intervene in and support ultra-high-definition 4K content production through multiple methods, strengthen the construction of national ultra-high-definition media asset libraries and business transaction zones, promote efficient circulation of high-quality 4K film and television works through broadcasting cable networks, and improve the content supply ecosystem.

Third, develop 4K TV users through multiple measures. The industry should steadily reduce 4K TV package fees, replace ultra-high-definition smart set-top boxes and smart gateways, and adopt various measures to increase 4K TV user numbers, thereby further consolidating the user foundation of broadcasting cable networks through the strategic layout of 4K Smart Broadcasting.

3.3 Strategic Choices for Broadcasting Cable Network 5G Technology Applications

Currently, the mobile communication personal consumption market is basically saturated, making it difficult for the broadcasting cable network industry to compete with the three major telecom operators in terms of capital and 5G network deployment. Therefore, the industry should make strategic choices in applying 5G technology and expanding 5G businesses, adhering to the principle of doing some things while refraining from others, and investing limited resources where they may generate benefits.

First, if policies clearly allow the broadcasting cable network industry to conduct mobile business on a large scale in the 700MHz band, the industry should leverage the advantages of 700MHz wide coverage to build networks at low cost.

Second, the industry should leverage its Party Network advantage to play the policy card, seek government support, and build wireless private networks serving government, public security, and related departments.

Third, the industry should seize IoT development opportunities. IoT involves

numerous industries and application scenarios with vastly different network connectivity and application requirements, representing a typical fragmented market. In this market, even the three major telecom operators need to expand customers one by one, allowing broadcasting cable networks to engage in "positional warfare" with them.

Fourth, the industry should cultivate 5G technology professionals and accumulate 5G application resource reserves. Facing potential future 5G market opportunities, broadcasting cable networks need to establish specialized teams early to track technologies and accumulate capabilities, preparing for future market competition.

3.4 Thematic Research on Business and Technical Issues with Major Industry Impact

Currently, application methods, business models, and operational models for new technologies and businesses are still being explored. Thematic research and early layout on these issues will have a profound impact on promoting Smart Broadcasting construction and broadcasting cable network industry development. The following topics are recommended for priority research:

First, research on security assurance for broadcasting cable networks under new security situations, including: enhancing security management and monitoring levels through new technology applications; security risk analysis, security architecture, and security measures under new technologies like cloud computing; and national security management hierarchical control systems.

Second, research on collaborative mechanisms between converged media platforms and traditional media. The industry should study and formulate priorities for broadcasting cable network participation in converged media platform construction at national, provincial, and regional levels, forming a nationwide 联动 layout to leverage the channel and technical advantages of broadcasting cable networks as digital cultural dissemination networks and occupy the active position that new digital cultural dissemination networks should hold.

Third, research on standards, specifications, and implementation guides for broadcasting cable network big data technology applications. The industry needs to study unified big data technology standards, specifications, and implementation guides to achieve converged media business innovation through interconnected big data platforms and enable precision marketing for users and unified sharing of various businesses nationwide.

Fourth, research on standards, specifications, and implementation guides for broadcasting cable network 5G technology applications. The industry should make overall plans for 5G technology infrastructure layout and business application directions, planning wired-wireless converged and broadband-narrowband

coordinated new-generation digital economy foundation networks to launch relevant businesses according to established plans once 5G licenses are obtained.

Fifth, research on the industrial ecosystem layout for broadcasting cable network IoT applications. The focus should be on IoT platforms, terminals, and application ecosystem integration, leveraging internal and external resources, selecting quality partners, and jointly cultivating IoT applications to form end-to-end solutions shared by national broadcasting cable networks and build core competitiveness for future government-enterprise customer market competition.

Sixth, research on issues related to large-scale IPv6 deployment in broadcasting cable networks. On the basis of basically completing national broadcasting cable network IPv6 address allocation planning, the industry should seize the opportunity of promoting the National One Network to establish refined IPv6 address management control systems and technical support systems. Combined with supporting new business forms like IoT and industrial internet applications, the industry should deepen the use of software-defined network technology and release the huge dividends of IPv6 large-scale deployment in broadcasting cable networks through orderly promotion.

Seventh, research on the strategic layout of accelerating cloud service platform standardization construction. Cloud platform construction and operation have special requirements for environment, investment, service capabilities, and scale efficiency. Many issues remain to be resolved in national broadcasting cable network cloud computing applications. In the process of accelerating construction and development, the industry should conduct national unified planning, standardization, and management of broadcasting cable network service cloud platforms, promoting the evolution from local clouds to aggregated clouds, ultimately forming a pattern of 2-3 highly centralized cloud service platforms nationwide.

Eighth, research on promoting cross-technology domain integration development of broadcasting networks. The industry should accelerate the 融合 innovation of broadcasting cable networks with new-generation information and communication technologies including mobile internet, IoT, big data, artificial intelligence, SDN/NFV, LTE/5G, and IPv6. In areas with favorable conditions, the industry should build smart converged all-media service trial networks, carry out application demonstrations, extend traditional wired broadcasting television to wireless fields, achieve wireless-ization of wired businesses, and explore intelligent collaborative coverage of wired, wireless, and satellite networks, intelligent perception of content, services, terminals, and locations, and intelligent allocation of network resources to enhance network intelligent transmission capabilities and meet the business requirements of ubiquitous, cross-network 联动, and multi-screen interaction for broadcasting converged media.

3.5 Promoting Digital Transformation for Smart Broadcasting

The deep integration of broadcasting cable networks and the internet is an inevitable trend for future development, and internet-oriented digital transformation has become an inevitable requirement for achieving economic development kinetic energy conversion. "Smart Broadcasting" requires broadcasting cable networks to deeply integrate broadcasting networks with the internet across traditional business domains to meet increasingly diversified user needs, achieving the principle that "thinking leads to change, change leads to adaptation, and adaptation leads to longevity."

Digital transformation for Smart Broadcasting is not just technological evolution but a deep-level transformation across the entire industry from national, provincial, and municipal levels to frontline operations in management, services, and marketing models. The intelligent transformation of broadcasting cable networks requires more policy orientation and institutional mechanism reforms to release development potential, stimulate innovation 动能, identify breakthrough points, and systematically promote Smart Broadcasting transformation.

The most fundamental issue in promoting digital transformation for Smart Broadcasting is talent. During this process, the industry should intensify efforts to cultivate and introduce talent in Smart Broadcasting network information security, content production, technology R&D, capital operation, and business management. The industry should fully mobilize and leverage the enthusiasm, initiative, and consciousness of practitioners in promoting Smart Broadcasting development, stimulate innovation vitality, and create a favorable environment for entrepreneurship and innovation.

3.6 Emphasizing and Cultivating Specialized Cybersecurity Talent for the Broadcasting System

The most significant source of cybersecurity threats is people, and the most reliable guardians are also people. Due to the scarcity of network information security talent, the broadcasting system suffers explicit and implicit economic losses from cyber attacks annually. In the past three years, China' s universities have trained only about 30,000 cybersecurity professionals, with fewer than 15,000 trained in 2018. Competition for cybersecurity professionals across industries is fierce. With a relatively late cybersecurity system construction, the broadcasting system' s cybersecurity professional talent is far below that of the three major telecom operators and BAT internet companies, with a severe shortage of top cybersecurity experts.

Therefore, the broadcasting system should attach great importance to cybersecurity discipline and professional construction, improve cybersecurity learning systems, build security range platforms, conduct research on security prevention

for broadcasting industry-specific equipment, security protocols, and smart terminals, strengthen industry professional training, exercises, and competitions, promote learning and practice through competitions, intensify cybersecurity professional training, and enhance the capability levels of broadcasting system security technical personnel.

Acknowledgments: This paper is adapted from the "China Broadcasting Cable Network Technology Annual Development Report (2018)" organized by the Cable TV Comprehensive Information Technology Sub-committee of the Chinese Institute of Electronics and the Secretariat of the Science and Technology Committee of the National Radio and Television Administration. During the report' s preparation, speeches and manuscripts from some broadcasting authorities' leaders, industry experts, and professional research institutions were consulted. Leaders and experts including Yang Xiaodong, Tang Dehui, Zhou Yi, Li Ge, Peng Jin, Liang Hong, Li Li, Mai Shangbao, Li Xiaolan, Gu Chunlin, Bai Hua, and Li Zhongzhao participated in discussions and revisions. Ha Bing, Wang Qiang, Lei Hao, Ding Yi, Le Jun, Xue Bin, Zheng Siyuan, Chen Ming, Zheng Bizhang, and Wei Jun participated in manuscript compilation. Hubei Broadcasting and Television Information Network Co., Ltd. and China Cable Network Co., Ltd. and its Hainan Branch provided strong support during the report' s preparation. Sincere thanks are extended to all.

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