Application of IP Streaming Technology for Webcasting in Traditional Baseband Television Broadcasting: A Postprint

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Abstract

With the maturation of network live streaming technology and the widespread adoption of various live streaming platforms and applications, live programs have become increasingly popular among broad audiences. However, the television broadcast trucks required for live programs cannot be popularized at the county level due to their exorbitant costs and technical complexity. To address this challenge, our converged media center has, through several years of practical experience, successfully achieved an organic integration of new media network live streaming technology with traditional television broadcasting technology, thereby realizing all-media live broadcasting. This solution demonstrates high operability and practicality, and has received favorable feedback from industry peers. It represents an innovative live broadcasting approach within the field of radio and television.

Full Text

Preamble

Title: Application of IP Streaming Technology from Web Broadcasting in Traditional Baseband Signal Television Live Broadcasting

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Abstract: With the maturation of web broadcasting technology and the proliferation of live streaming platforms and mobile applications, live programs have gained immense popularity among audiences. However, the television OB vans required for live broadcasting are prohibitively expensive and technically complex, preventing their adoption at the county level. In response to these challenges, our converged media center has successfully integrated new media

web broadcasting technology with traditional television broadcasting through several years of practice, achieving all-media live broadcasting. This solution is highly operable and practical, has received positive feedback from industry peers, and represents an innovative approach in the radio and television broadcasting field.

Keywords: network; live broadcasting; IP stream; television; encoder; decoder

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1. Current Situation

To satisfy audience demands for immersive live programming, traditional television live broadcasting has long been a common transmission method. While live coverage of breaking news provides viewers with a compelling sense of presence, such events are characterized by rapid, unpredictable changes. To address this, television media typically maintain detailed emergency protocols and robust technical capabilities to ensure broadcast security and protect the organization' s reputation and influence. Well-funded major stations employ professional OB vans equipped with advanced technology and sophisticated devices, including comprehensive signal processing systems, communication command systems, and backup power systems capable of program recording, real-time editing, live subtitling, slow-motion replay, 3D effects, and more. With strong technical support and professional equipment, these systems offer high stability and security. However, OB vans are extremely expensive, categorized as large, small, or micro-sized based on functionality, with prices ranging from hundreds of thousands to tens of millions of RMB.

Although burgeoning new media has gained widespread popularity, television maintains irreplaceable advantages in news dissemination power and influence due to its mature distribution channels and complete transmission chain. However, traditional TV OB vans rely on baseband signal technology that, despite decades of development toward maturity and stability, suffers from inherent limitations. The high cost and complex technical requirements of traditional television live broadcasting have restricted its adoption in small and medium-sized stations.

1.1 High Costs

The expense of OB vans, ranging from hundreds of thousands to tens of millions of RMB, combined with multiple professional cameras costing tens of thousands of RMB each, represents an unaffordable burden for small and medium-sized television stations.

1.2 Resource Intensive

For real-time coverage of breaking news, large-scale galas, or major events, television news live reports and real-time gala broadcasts typically require satellite OB vans, leased satellite links, or leased fiber optic links with optical transceivers to transmit real-time HD/SD baseband signals to the control room or broadcast center. These traditional methods involve substantial workload and extremely high equipment costs, consuming significant human and material resources. Satellite links and fiber optic links must be applied for in advance, requiring advance wiring and construction. Video broadcasting costs are high, with network leasing prices essentially monopolized and poor cost-effectiveness. All three field transmission methods—satellite, fiber optic, and microwave—consume expensive resources and costs [**?**].

1.3 Time Consuming

Each broadcast requires one to two days for venue setup, audio-video system construction, on-site debugging, microphone operator and assistant assignment, and testing of director communication command systems. All equipment and links must be thoroughly tested to ensure proper operation.

1.4 Labor Intensive

A single live broadcast event requires at least 20 personnel, from technical support to filming, directing, line inspection, and power supply assurance.

1.5 Inflexible

Traditional methods can only broadcast fixed events. When breaking news occurs or when covering emergency events, the system cannot be flexibly mobilized or repositioned. Outdoor video broadcasting is highly restricted, resulting in a poor live broadcasting experience.

1.6 High Technical Expertise Requirements

Television broadcasting requires multiple professional camera operators to handle complex professional cameras, as well as professional directors and technical maintenance personnel for full-time support.

Integrating the advantages of emerging new media with traditional television to complement each other' s strengths represents the mission of our genera-

tion of broadcasting professionals. With the rapid development of radio and television technology, China' s television industry has achieved unprecedented progress. The scientific and rational application of web television live broadcasting technology, with its obvious timeliness and real-time characteristics, can enable rapid development of China' s radio and television industry. To address the shortcomings of traditional television broadcasting, we must introduce currently popular web IP streaming technology to learn from each other' s strengths. By leveraging virtual IP streaming switchers built on IT technology and capitalizing on the convenience of web broadcast cloud platforms for IP streaming transmission and forwarding, we can employ widely available mobile phones for rapid reporting during emergencies, thereby equipping traditional television broadcasting with the low-cost, high-efficiency, convenient, and fast characteristics of web broadcasting. This would solve the problems of high cost and cumbersome operation in traditional television broadcasting, providing a convenient, economical, fast, and efficient broadcasting solution for television stations at all levels—particularly suitable for small and medium-sized stations with insufficient funding, limited personnel, and weak technical capabilities.

2. Background

Since 2017, Zongyang County Converged Media Center has been using the "Xinhua Live Cloud" platform for web field broadcasting. This IP streaming-based web broadcasting technology is extremely flexible and convenient. For field interview broadcasting, only a smartphone with a dedicated live streaming App is needed to push the stream to the cloud platform via 4G data signals. The cloud platform playback address is then published, allowing audiences to watch programs in real-time through computer web pages, WeChat public account clients, and other means. For small-scale event broadcasting at fixed urban venues, any digital camera plus a compact mobile encoder can be used to push streams to the platform when 特写 shots requiring zooming are needed. For large-scale galas or important events like Two Sessions meetings requiring multiple camera positions, multiple digital cameras equipped with mobile encoders can be used to shoot the main venue scenes, supplemented by several mobile phone positions for interviewing audiences and delegates. After multiple signals are simultaneously pushed to the platform, a laptop or desktop computer can utilize the cloud platform' s IP switcher to switch shots in real-time, achieving program directing. The director can operate from anywhere without needing to be at the noisy event site [**?**].

After multiple uses of web cloud broadcasting, our converged media center was deeply impressed by its convenience, flexibility, and low cost. Completing a broadcast requires only three to four people. In contrast, our previous Spring Festival galas and Two Sessions meetings required renting OB vans at a cost of tens of thousands of RMB per event, plus extensive cabling for audio-video transmission and director communication, advance arrangements for leased fiber optics from Anhui Broadcasting Network and dedicated network lines from

telecommunications providers, and numerous security personnel at the broadcast site to protect cables, temporary fiber lines, telecommunications dedicated lines, and power supply—security staff alone numbered 10 people. Including directors, camera operators, and technical personnel, a single broadcast required approximately 30 people. This represents a huge difference compared to Xinhua Live Cloud' s web broadcasting.

After multiple operations, we considered whether this "Live Cloud" broadcasting technology could be transplanted to television broadcasting—a significant innovative idea.

3. Technical Approach

Before contacting the Xinhua Live Cloud platform, we had already been using our converged media center' s own new media cloud (some centers use Dolphin Cloud) and discovered that IP network broadcasting based on cloud platforms was extremely convenient. The initial limitation we found with most cloud platforms was their support only for single-camera broadcasting, unable to perform multi-camera switching like traditional television broadcasting. If we could combine web broadcasting with traditional television broadcasting, learning from each other' s strengths to achieve all-media broadcasting, this would certainly be the best approach for media broadcasting.

Through research of multiple cloud platforms, we discovered that "Xinhua Live Cloud" features a virtual IP streaming switcher supporting up to four IP stream inputs. During broadcasting, the software-based IP streaming virtual switcher can freely perform IP stream transmission and switching. Director input signals can be any IP stream signals from other cloud platforms, camera signals, mobile phone signals, or even notebook computers with cameras—any pushed IP stream signals can be used, including insertion of local advertisement videos and program clips. Real-time subtitling is also supported, with powerful functionality. Only an internet-connected notebook is required, allowing the director to operate from anywhere. Broadcasting costs are extremely low, less than one percent of OB van costs.

However, IP data packet video streams cannot be directly mixed with baseband signals in the broadcast control room or studio. Encoder-pushed web broadcast IP stream signals can only be transmitted and forwarded over networks. Our solution direction was to enable mutual conversion and mixing between web broadcast IP stream signals and baseband signals.

After experimentation, using professional decoders to convert IP streams into HD or SD baseband signals allows entry into standardized broadcast control rooms for transmission. The process involves first decoding the IP stream into 1920\$×108050$iHDor$720×\$576 50i SD signals, then passing them through a digital frame synchronizer for frame synchronization before connecting to the broadcast control room or studio switcher. This approach fully leverages IT-based network broadcasting technology, using software IP streaming virtual

switchers to switch multiple pushed streams, thereby enabling television broadcasting.

4. Equipment Selection and Technical Details

This broadcasting method requires no cabling throughout the entire process, involves low hardware investment, and is extremely convenient to operate. After ensuring broadcast security and conducting multiple trials, we have developed a mature set of technical details and protocols.

4.1 Camera Position Selection

Depending on event scale, large events typically employ two close-up positions, one medium shot, and one wide shot—four positions total. If mobile interview capability is needed, an additional mobile phone broadcast point is added for flexible mobile interviewing.

4.2 Network Signal Selection

When network is available on-site, dedicated lines are the preferred transmission channel, followed by 4G data signals (5G will be even better in the future). WiFi signals are not recommended as we have found them extremely unstable over long-term use. With limited WiFi channels and devices like Bluetooth and wireless keyboards/mice operating in the 2.4GHz band, crowded audiences can easily cause interference. When subjected to co-frequency interference, wireless routers frequently hop channels, causing signal blocking. Although dual-band wireless routers have a less-interfered 5GHz band, the stable transmission distance for 5GHz signals is very short—only a few dozen meters—making wired Ethernet more stable. When using 4G data signals, different operators' SIM cards must be tested on-site for signal strength. Using Android phones as an example, navigate to Settings → My Device → All Parameters → Status Information → SIM Card Status to view signal strength, then test upload speed using mobile speed test software. Test upload speed specifically to the cloud platform address. Through long-term use, we have found that as long as telecommunications operator signals are stable, network speeds are generally sufficient, with mobile operators being secondary [**?**].

4.3 Broadcast Control Software Installation and Parameter Configuration

Log in to the Live Cloud backend management page at http://livecms.xinhuaapp.com/index.html. Configure the broadcast promotion interface, select the switcher on the right side, fill in the director account, activate the switcher, and download the professional version V3.0.0 (requires Windows 7 64-bit system, i7 CPU, 16GB memory). Log in using the director account. In the "Broadcast_{Video} Live" section at the bottom left of the interface, select the current live event. In the channel settings, select the video equipment used for broadcasting, typically

the live personnel account configured in the Live Cloud backend. Network input supports HLS/RTMP/HDL network protocols as input. Video can be input from cameras, camcorders, and other devices; audio can be input from cameras, microphones, and other devices. Enable audio output exclusive mode, with PGM output using the channel audio. DDR/logo/subtitle/clock settings will not be detailed here.

4.4 Mobile Software Installation and Encoder Parameter Configuration

The Live Cloud App broadcasting method is simple: open and log in to the Live Cloud App, and configure live streaming parameters according to the usage guide. Using the Tianchuang Hengda 3G/4G streaming encoder with a 4G SIM card as an example, first use a notebook to wirelessly connect to the encoder. All settings for the Tianchuang Hengda 3G/4G streaming encoder are managed through wireless network login. Use IE browser to log in to the management page at 192.168.0.1, select the 3G/4G wireless routing mode in the work mode menu, and view mobile data operator signal strength and other parameters in the system status column. Then log in to the encoding settings page at 192.168.0.31. Select the HDMI interface, set the playback resolution, enable RTMP streaming, and set the bitrate to 1500-2048Kb/s. If signal quality is excellent, the maximum can be set to 12000Kb/s with a minimum of 16Kb/s. Configure the streaming address using a three-part format: upload server address, upload directory name, and upload node.

4.5 High-Definition Web Media Decoder Debugging

Our converged media center uses the TDV7001 decoder from Beijing Yishitang Technology Co., Ltd.

Connect the relevant signal cables and access the device through a browser by entering the device IP address in the address bar to reach the login interface. Click on "stream" to configure the decoder stream address. This device supports UDP, RTMP, TSHTTP, and RTSP transmission protocols. Select the corresponding transmission protocol and port. "Decode" can set video buffer time and video synchronization mode. Click "Status" to view input signal connection status. The "Stream Connect" column displaying "Yes" indicates normal device operation. View the decoded picture through a display monitor. The Status column contains two sub-columns: "stream" and "System," indicating current workflow information and device system information respectively, enabling users to monitor device operation status in real-time. In the Display column, device output display parameters can be configured. "HD Display" sets the output resolution for HD interfaces (SDI, HDMI), supporting up to 1080p60. "SD Display" sets the output resolution for analog interfaces, supporting up to 576i50. We select 1080 50i SDI output. With this, decoder configuration is complete.

4.6 Baseband Signal Synchronization

The 1080 50i SDI signal output from the decoder is connected to our station' s synchronizer. After signal synchronization, it enters the matrix of the broadcast control center for normal transmission. For security, it can also be broadcast through a delay device [**?**].

5. Application and Promotion

Since platform activation in September 2017, our converged media center has successfully conducted over 60 live broadcasts to date, covering topics including culture, people' s livelihood, firefighting, tourism, poverty alleviation, charity, and more, with each episode achieving remarkable success.

On the night of October 4, 2017 (Mid-Autumn Festival), we first used the "Live Cloud" platform for full live video broadcasting of the "Beautiful Zongyang, All-for-One Tourism" Liu Songbing original songs concert. We also successfully completed four gala broadcasts for our county' s Spring Festival and Lantern Festival galas in 2018 and 2019, as well as live television broadcasting tasks for the opening ceremonies of the Zongyang County Two Sessions meetings in 2018 and 2019. Programs such as "Live Selling of Local Products," "Let' s Be Happy Together in 2018," "Live Visit to Qilin Siblings," "Let Good People Be Rewarded, Spread Positive Energy with Love," and "Watch Dragon Boat Racing, Listen to Folk Stories!"have received widespread acclaim from all sectors of society. Particularly in January 2018, we conducted emergency reporting for the first time on a major severe weather theme– "Fighting the Snowstorm, Zongyang in Action" –in collaboration with newspaper offices and 22 township correspondents through continuous live broadcasting. This innovative approach not only won praise but also received the First Prize of the 2017 Tongling Municipal Government News Award and the Provincial Top Ten Public Welfare Projects.

The live broadcast program "Zongyang Love for You" utilizing this technology was selected as a 2020 typical case of online poverty alleviation by the China Federation of Internet Societies, a 2020 national online poverty alleviation typical case, an excellent case of county-level media anti-epidemic efforts, one of the national "Top 50 Volunteer Poverty Alleviation Cases," and the 2019 Annual Public Welfare Project at the Ninth China Public Welfare Festival. It also won the Provincial "Top Ten Public Welfare Projects," Provincial Online Public Welfare Annual Innovation Project, 2018 Anhui Province Radio, Film and Television Science and Technology Innovation Award, and Xinhua "Live Cloud" 2018 Excellent Integration Award.

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(Editor in Charge: Yang Hua)

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