

## Postprint: Application of AVS+ Technology in Terrestrial Digital Television

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### Abstract

With the rapid advancement of China's informatization construction, digital media technology, with digital television as the primary application form, has undergone in-depth development and entered widespread application, providing a tremendous impetus for regional economic and social development in China, and constituting an indispensable and significant aspect of current smart city construction and related initiatives. At the current technological level, AVS+ technology plays a pivotal role in the field of terrestrial digital television construction and represents a crucial core technology. Compared to previous digital decoding technologies, AVS+ technology exhibits excellent performance in many aspects, offering significant advantages in both encoding efficiency and decoding quality, effectively improving channel utilization efficiency, ensuring high accuracy of information transmission, and demonstrating excellent compatibility and extensibility for the future proliferation of digital technologies.

### Full Text

## AVS+ Technology Application in Terrestrial Digital Television

### Abstract

With China's rapid informationization construction, digital media technologies centered on digital television have developed deeply and entered widespread application, providing tremendous impetus for regional economic and social development, and becoming an indispensable aspect of smart city construction. Currently, AVS+ technology plays a key role in terrestrial digital television construction and represents crucial core technology. Compared to previous digital decoding technologies, AVS+ demonstrates excellent performance in many aspects, with significant advantages in both encoding efficiency and decoding

quality, effectively improving channel utilization efficiency, ensuring high information transmission accuracy, and offering good compatibility and expansion potential for future digital technology popularization.

**Keywords:** AVS+ technology; terrestrial digital television; application

## 1. AVS+ Technology Overview

After China's digital construction has reached a certain level, it is necessary to optimize and upgrade the equipment and technical system on the existing foundation, adopting more powerful encoding and decoding technologies to provide stable technical support for digital television and related application fields. This is an inevitable trend that must be strengthened, including considerations for future high-quality informationization construction.

### 2.1 AVS+ Technology Application Status

Terrestrial digital television represents just one application domain of AVS+ technology in practical implementation. In the field of digital audio and video construction, terrestrial digital television signal transmission employs a one-way broadcast mode, making it relatively easier to implement compared to other communication technologies. However, digital television's primary performance requirement is ensuring adequate data capacity and transmission quality, which imposes specific and demanding standards on encoding and decoding technologies. Compared with existing cable digital television and satellite television systems, AVS+ demonstrates significant advantages in playback and transmission performance. Currently, insufficient deployment of AVS+ technology applications has led to scarce frequency resources, though its strengths are particularly evident in serving specific geographic regions and demographic groups, especially in the mobile television market where it shows outstanding application advantages.

AVS+ technology evolved from AVS technology, which constitutes an innovative technical standard with independent intellectual property rights in China, holding crucial strategic value for national development in related fields. For information transmission, encoding and decoding technical standards are particularly vital. Possessing proprietary standards prevents external constraints and provides greater flexibility and freedom in system development and application. As the scope of application continues to expand, this technical specification's influence will grow increasingly significant. System upgrades and optimizations can proceed according to China's own pace and timetable, without concerns about technical vulnerabilities or hidden risks.

Presently, AVS+ technology has achieved internationally recognized standards, becoming one of three video standards approved by the International Telecommunication Union. As the digital television video encoding and decoding standard actively promoted by China, it has been extensively developed and applied

in broadcasting and television construction across multiple countries. Leveraging this technology, China has transformed from a passive recipient to an exporter of digital audio-visual technologies, with related industries gradually growing stronger and playing an increasingly important supportive role in the overall technological innovation process.

### 2.2.1 AVS+ Technology Framework Design

From a technical perspective, both AVS+ and MPEG technologies adopt a hybrid encoding framework design. Within this framework, functional modules including quantization transformation, entropy encoding, intra-frame and inter-frame prediction, and loop filtering are integrated. These modules ensure excellent compatibility with mainstream video and audio content, providing stable support for primary technical approaches. Unlike MPEG, AVS+ technology incorporates additional innovations in optimization techniques, offering high-performance standards suitable for low-complexity scenarios while maintaining equivalence with international standards and possessing framework advantages derived from independent intellectual property rights.

The core framework design of AVS+ technology encompasses several characteristic technical components: intra-frame prediction, integer transformation, data quantization processing, precision pixel interpolation processing, inter-frame prediction motion compensation, two-dimensional entropy encoding, and deblocking loop filtering. Through these framework functions, AVS+ technology defines standards for three types of video processing frames: I-frames, P-frames, and B-frames. Typically, I-frame macroblocks employ intra-frame prediction, while P-frames and B-frames require both intra-frame and inter-frame prediction. Following these prediction algorithms, residual integer transformation and digital quantization are performed, with scanning tasks completed according to quantization standards. Scanning obtains one-dimensional arrangement coefficients, enabling entropy encoding of quantization coefficients. Video quantization and format conversion functions under the AVS+ technical standard are achieved through addition, subtraction, and shift operations, requiring only 16-bit calculation precision to satisfy algorithmic and functional requirements. The framework design also addresses video standard image filtering in AVS+ technology by employing loop filters as basic filtering units for image creation, effectively eliminating noise interference and blocking effects. This design and algorithm significantly improve image quality while maximizing encoding operational quality and efficiency.

### 2.2.2 Power Module Design

The power module constitutes the most fundamental functional unit in AVS+ technology-based terrestrial digital television network systems, ensuring that central processors and digital processing units can effectively handle system data. As system functional integration deepens and stability requirements for

equipment power consumption continue to increase, the importance of power modules becomes more prominent. The primary design requirements focus on output current stability and voltage peak value standards. For power system design in AVS+ technology-based terrestrial digital television applications, beyond employing more sophisticated hardware designs with low capacitance and high capacity, AVS+ technology can introduce power systems with higher thermal design quality, achieving voltage output with smaller fluctuations and shorter recovery periods. These design approaches effectively address module requirements for rapid response and dynamic control, making them particularly suitable for applications with large currents and low voltages.

### 2.2.3 AVS+ Technology Application Workflow

For functional systems meeting closed-loop AVS+ technical standards, the configuration must provide several basic components, primarily including three parts: the power control module APC built into the system motherboard's data processor, the slave management unit module integrating PWI functions, and the serial bus completing connection and data transmission functions. These functional units each play their role, forming overall system function optimization and improvement. Specifically, function realization includes the following key steps.

First, information collection. The information collected by the system is closely related to load conditions. The system calculates operational status by obtaining this information, with the entire calculation process automatically completed by dedicated software, while hardware devices provide effective support during this process. Effective software function performance requires benign compatibility with the operating system, using functions for application program calls and counting and recording the number of calls. Different algorithms measure the working status of various hardware devices in the system. The central processor completes data calculation and processing functions, effectively predicting load usage and performance, such as the Freescale integrated software system i.Mx3.1, which uses core unit signal collection to determine resource utilization states including Cache, bus, and memory. The information collection function can provide calculation completeness and precision while reducing the burden on central processor resources, demonstrating excellent performance advantages during video data stream processing.

Second, demand prediction. Prediction and forecasting are common design methods for improving system operational efficiency. Accurate and efficient prediction requires high-quality data organization and processing functions from system application software. Specifically, it is necessary to analyze data on the status of various functional units under system operation, predict the system's upcoming performance based on analysis results and normal conditions, and timely adjust resource allocation procedures according to predictions, forming pre-operation steps that ultimately enhance overall system operational levels.

### 3.1 AVS+ Technology Terrestrial Digital Television Application Schemes

When applied to terrestrial digital television systems, AVS+ technology offers three primary application scheme options. In the architecture design of these three schemes, AVS+ technology-based source compression decoding does not require intermediate system decoding processes. AVS+ encoding compression architecture technology can also cooperate with MPEG-2/H.264 and MPEG-2 formats, though AVS+ technology requires decoding during the process. These designs ensure full compatibility in practical applications, representing a technical consideration that system equipment must address.

#### 3.1.1 Source Encoding and Terminal Decoding Application Scheme

In this application scheme, AVS+ technology implements end-to-end encoding and decoding functions. The system employs AVS+ encoding technology for data compression at the source signal output, while the terrestrial digital television application terminal performs decoding operations on received data using AVS+ technology. The entire process utilizes AVS+ encoded data streams, eliminating the need for intermediate conversion and decoding operations. At the terrestrial digital television receiving end, all television programs are received via SDI ports, with audio-visual information delivered to AVS+ encoders. The AVS+ encoder completes program encoding and outputs data streams through communication interfaces in TS format, which are then transmitted to multiplexers via ASI interfaces. During this process, relevant business information is transmitted to the multiplexer via a generator, which completes optimized data selection and continues sending program data to the modulator. The TS data stream completes data transmission tasks after full modulation. Finally, the received signals are demodulated and decoded by AVS+ decoders, with program content output on televisions.

#### 3.1.2 AVS+ Source Encoding Application Scheme

This scheme design employs AVS+ technology encoding at the source end, with the signal front-end using AVS+ compression format throughout the transmission process, while the terminal receiving equipment uses MPEG-2/H.264 format for data processing and reception. This application scheme requires transcoding operations on transmitted signals in intermediate links to satisfy system requirements for effective data information control. Terrestrial digital television program data information is directly transmitted to receivers for demodulation after effective modulation. Following demodulation, data is sent to transcoders, which use ASI interfaces to transcode signals in TS format. During transcoding, the system re-encodes audio-visual information in program content according to MPEG-2 or H.264 formats. Through this process, program streams can be converted into differently encoded signals, with transcoded data streams formatted as MPEG-2 or H.264, which can be directly used at user terminals.

### 3.1.3 Source MPEG-2 Encoding Application Scheme

This application scheme utilizes MPEG-2 encoding at the source end and AVS+ format for reception at terminals, requiring program signal transcoding during transmission. These program signals are delivered via SDI interface to MPEG-2 encoders, which then transmit program information to multiplexers via ASI interfaces. During this process, business information generators automatically create data stream-related information and send it together with MPEG-2 encoder signals to multiplexers. The multiplexer then optimizes and integrates received information, after which this data is transmitted to terrestrial television receivers for data demodulation. Subsequently, data signals are transmitted via ASI to transcoders, which complete data stream format conversion, transforming the data format into AVS+. Using effective channel methods, program signal streams are delivered to AVS+ decoders for data decoding, ultimately outputting high-definition television programs on user televisions.

### 3.2 AVS+ Technology Terrestrial Digital Television Application Example

According to national departmental plans, China aims to achieve comprehensive nationwide terrestrial digital television broadcast coverage by 2020, at which point all terrestrial analog television signals can be discontinued. This work is currently proceeding in an orderly manner. Taking H Province as an example, the construction of terrestrial digital television networks using AVS+ technology architecture has effectively promoted comprehensive development in this field. Geographically, H Province features numerous hills and mountains, with relatively low coverage rates for cable and network television. However, due to social demand, paid wireless digital television has developed rapidly in recent years, resulting in chaotic wireless frequency application and management and extremely harsh electromagnetic environments. Consequently, terrestrial digital television coverage network construction has become particularly necessary.

H Province's terrestrial digital television network construction began in 2013, with most construction projects essentially completed within one year. During the initial construction phase, the H.264 encoding format was selected, using 18M bandwidth to carry 16 standard-definition television programs. However, due to excessively high patent fees, achieving public welfare development of wireless digital television proved difficult. Based on this situation, China independently innovated and developed the AVS technical encoding with independent intellectual property rights. However, through actual playback testing and comparative effect evaluation of 16 standard-definition television programs, the encoding and decoding effects using AVS technology were slightly inferior to H.264 format when viewed intuitively. To resolve playback quality issues, relevant construction units in H Province introduced AVS+ technology encoders manufactured by Guangzhou Keweixin that meet national new technical standards through the 2013 CCBN exhibition. Under identical conditions, compara-

tive tests were conducted among three application modes including H.264, AVS, and AVS+. The overall performance of AVS+ encoding and decoding technology was clearly optimal. Based on these results, H Province selected AVS+ technology for terrestrial digital television construction.

Currently, China is comprehensively deploying AVS+ technology construction in terrestrial digital television systems and other fields. To this end, the national broadcasting and television administration has specially issued relevant guidance standards and construction plans, clarifying construction content and related procedures. As these project constructions gradually advance, they greatly promote China's informationization construction. AVS+ technology is an independently developed technical standard in China. Its comprehensive application in terrestrial digital television and other fields not only facilitates the deep implementation of digital construction but also promotes the promotion and development of domestic related technologies, providing substantial assistance for the development of the entire information product industry, and significantly contributing to China's independent innovation capabilities and comprehensive social development.

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