Analysis and Considerations on the Construction of Terrestrial Digital Television Broadcasting Coverage Networks: Postprint

Authors: Tianming Ma

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

Abstract

In 2012, the State Administration of Radio, Film and Television (SARFT) promulgated a document concerning the development plan for China's terrestrial digital television, aiming to achieve comprehensive coverage of terrestrial digital television broadcasting. Numerous enterprises across various regions of the country have already invested in research and development for terrestrial digital television broadcasting. For instance, Shanghai Media & Entertainment Group Interactive Media Co., Ltd. has taken the lead in digital television wireless transmission and mobile reception, achieving notable economic benefits; Beijing Radio and Television Media Company has also deployed its digital mobile reception services. The market for terrestrial digital television broadcasting possesses considerable appreciation potential and tremendous growth prospects, attracting an increasing number of companies to enter and develop the market, striving to capture this vast potential market.

Full Text

Analysis and Reflection on the Construction of Terrestrial Digital Television Broadcasting Coverage Networks

In 2012, the State Administration of Radio, Film and Television (SARFT) issued a policy document outlining China's development plan for terrestrial digital television, aiming to achieve full coverage of terrestrial digital TV broadcasting. Numerous enterprises across various regions have already invested in research and development for terrestrial digital TV broadcasting. For instance, Shanghai Media Group has taken the lead in digital TV wireless transmission and mobile reception, achieving considerable economic benefits, while Beijing Radio and Television Media Company has also launched its digital mobile reception service. The terrestrial digital TV broadcasting market offers substantial room for

appreciation and holds tremendous potential, attracting an increasing number of companies to enter and develop the market in an effort to capture this vast opportunity.

As the national terrestrial digital TV broadcasting coverage network gradually reaches completion, viewers can access a wider selection of programs with higher clarity. This significantly enhances the viewing experience and effectively improves people's quality of life. Terrestrial digital TV broadcasting coverage networks constitute a major component of national infrastructure planning and represent a prerequisite for building an information-based, digital society. Therefore, we should conduct more in-depth research on this technology, accelerate the expansion of terrestrial digital broadcasting coverage, and enable more people to enjoy the benefits of technological progress. The *Development Plan for Terrestrial Digital Television Broadcasting Coverage Networks* states: "China has now promulgated and implemented mandatory national standards for terrestrial digital television, with supporting standards being rapidly improved, the digital TV industry continuously expanding, and the national terrestrial digital TV coverage network further extending. The conditions for vigorously developing terrestrial digital television are now in place. Accelerating the development of terrestrial digital television and stepping up the construction of terrestrial digital TV broadcasting coverage networks for programs at all levels to promote the great development and prosperity of radio and television has become an important and urgent task." [2]

1.1 Concept of Digital Television

Digital Television (DTV) refers to a television system that employs digital technology to process, compress, and encode moving images, sound, and other signals for storage or real-time broadcasting, enabling reception and playback by users. Digital television is primarily divided into three categories: terrestrial digital television, satellite digital television, and cable digital television, corresponding to Europe's DVB-T, DTM-TH, DVB-S, and DVB-C standards. In recent years, as the construction of terrestrial digital TV broadcasting coverage networks has gradually improved, the digital television market has expanded rapidly with enormous potential. However, most digital TVs currently available on the market are not true digital televisions in the strict sense. They represent modifications to existing analog TV production processes that incorporate digital signal processing techniques to reduce noise and enhance clarity, bringing image and audio quality closer to digital standards. Nevertheless, these are not genuine digital TVs and cannot be compatible with digital TV signals. True digital television can receive both analog and digital signals, and can accommodate users' network service needs beyond television viewing, enabling services such as distance learning, online shopping, and medical appointment booking.

1.2 National Support for Terrestrial Digital Television Broadcasting Construction

In February 2007, SARFT issued the *Notice on Further Standardizing Technical Trials of Terrestrial Digital Television Systems*. In January 2008, the mandatory national standard for terrestrial digital TV parameters was implemented. By the end of 2012, the State Administration of Press, Publication, Radio, Film and Television had formulated the *Development Plan for Terrestrial Digital Television Broadcasting Coverage Networks*, providing strong policy support for the technology's advancement.

2. Advantages of Terrestrial Digital Television Broadcasting

Compared with traditional television technology, terrestrial digital television offers numerous unique advantages. First, it possesses strong anti-interference capabilities. While analog television is highly sensitive to environmental conditions and susceptible to external interference that significantly degrades picture quality, digital television effectively resolves this issue through channel coding and orthogonal multiplexing, enabling it to adapt well to most environments. Second, terrestrial digital television employs a single-frequency network (SFN) architecture, unlike the traditional multi-frequency network (MFN) model. Third, it achieves high spectral efficiency thanks to data compression technology. Fourth, it exhibits distinct signal degradation characteristics. Finally, it allows for clearly defined coverage areas, enabling more precise calculation of service coverage ranges.

3.1 Services of Terrestrial Digital Television Broadcasting Coverage

According to relevant data, approximately two-thirds of digital TV users in China receive television signals through analog wireless means, with most residing in non-urban areas. Due to their special geographical environments, these users experience extremely unstable broadcast signals and urgently require stable signal sources to access more television programs. Terrestrial digital TV broadcasting can address this critical need as a primary service offering for such users.

The basic requirements for terrestrial digital TV broadcasting coverage manifest in four key aspects: greater transmission power, broader coverage area, more stable playback, and clearer picture quality. It must also satisfy the requirements for point-to-multipoint transmission and continuous broadcasting. Since analog television serves as the foundation for current digital TV applications, the construction of terrestrial digital TV broadcasting coverage networks must also coordinate with analog TV transmission needs. Spectrum planning, with coverage range and effectiveness as its core elements, must support SFN mobile

reception speeds of no less than 250 km/h.

With increased national investment in terrestrial digital TV broadcasting infrastructure, the viewing experience will gradually improve, enabling viewers to access more programs with higher spectral efficiency. For example, through digital signals, a single terrestrial TV channel can broadcast two high-definition programs or 20 standard-definition programs simultaneously. Moreover, service offerings will become more diversified, providing both standard- and high-definition options. Additionally, employing other high-tech equipment can enable mobile client television services.

3.3 Terrestrial Digital Television National Standard Technology

On August 30, 2006, the Standardization Administration of China released the mandatory national standard GB 20600-2006 *Framing Structure, Channel Coding and Modulation for Digital Television Terrestrial Broadcasting Transmission System*, which officially took effect on August 1, 2007. China's current terrestrial digital national standard comprises seven modes, and all local governments must transmit digital signals according to these standard modes.

3.4 Terrestrial Digital Television Transmission System

The terrestrial digital transmission system consists of three relatively straightforward components: the terrestrial digital signal source front-end, the terrestrial digital TV transmission front-end, and the transmission network. The transmission network primarily performs end-to-end 100% transparent transmission of ASI streams. The terrestrial digital TV transmission front-end mainly handles ASI stream splitting and program stream modulation, enabling ASI stream distribution and network transmission configuration without altering the original stream.

For example, in the pilot area of Xinjiang's "Hu Hu Tong" project, each signal transmission station operates at 1,000 watts with transmission antennas mounted over 100 meters high. Receiving antennas provide 7 dBd gain at heights of 3-10 meters. Under fixed terminal reception conditions, the effective coverage radius exceeds 60 kilometers in flat areas. Through satellite transmission, farmers and herders in Xinjiang can access at least 40 free radio and television programs, including more than 10 Uyghur and Kazakh language programs. [3][4]

3.5 Terrestrial Digital Television Wireless Coverage Modes

Current terrestrial digital TV broadcasting wireless coverage technology employs two networking modes: Multi-Frequency Network (MFN) and Single-Frequency Network (SFN). MFN refers to a signal transmission mode where transmission stations use different frequencies, commonly applied in analog TV

broadcasting. To avoid interference from identical signals, stations within a certain range cannot use the same frequency. SFN refers to a signal transmission mode where multiple networked transmission stations simultaneously broadcast identical signals on the same frequency during the same time period. SFN represents the primary networking form for terrestrial digital TV broadcasting today. Under the SFN model, multiple transmission points broadcast signals on the same frequency simultaneously, enabling joint coverage of the same area by multiple transmission stations. Considering both power efficiency and the digital signal cliff effect, SFN largely resolves co-channel interference issues that cannot be solved through analog coverage methods. However, SFN requires transmission stations to broadcast signals on unified frequencies simultaneously, imposing strict requirements. Additionally, the distance between adjacent transmission stations cannot be too close; construction must follow guard interval requirements to avoid co-channel interference in signal overlap areas. Program distribution methods include direct fiber connection, microwave, and SDH, among others. The process involves modulation using a modulator before transmitting the modified RF signal. Therefore, a fundamental principle for adjusting terrestrial digital SFN is to mitigate multipath interference formed by overlapping coverage areas from various transmission points.

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(Author's Affiliation: Shache County Radio and Television Station, Kashgar Prefecture, Xinjiang)

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