

Research Article

The Design of A Digital Family Multi-Service System Based on Triple-Play Technology

¹Yi Lu, ²Yupan, ³Yong Liu and ³Lixin Zhou

¹ Department of Electricity and Information Engineering,

²Quality Control Department, Jiangsu Teachers University of Technology, Changzhou 213001, China

³Digital Television Department, Wujin Broadcast Television Information Network Limited Company, Changzhou 213001, China

Abstract: Under the background of three-net fusion, this study introduces a design of digital home multi-service system and elaborates from the perspective of digital TV broadcasting operation platform, interactive TV operation platform, home gateway and digital TV home multi-service terminals. This design is aimed to promote the two-way transformation of cable digital Television and the construction of operation platform. This will effectively help to accelerate the development of digital home service and broadcast television technology in Wujin.

Keywords: Bidirectional interaction, digital family, IPQAM, triple-play, UTI

INTRODUCTION

China enjoys a fast development of household internet application. According to the latest statistics, there are 380 million netizens, including 340 million broadband users and 250 million users centered on network video. The average access bandwidth is 1M and is expected to surpass 10M in the next three years, which is 100% bidirectional. The direct online shopping reaches to 206 yuan (apart from network costs) in the monthly per capita consumption. Today, network video accounts for more than 90% in the global Internet. China has 450 million household TV users, including 163 million cable TV users and 70 million digital TV users. However, most of the TV is one-way and the average access bandwidth is 5000 times wider than the telecommunication network. According to the forecast of official statistics agency, the domestic household network market will reach 500 billion yuan in the next 5 years. Thus, digital home intelligent terminal based on three-net fusion is bound to have a promising further market. The Wujin district of Changzhou has a whole coverage of cable broadcast television network. In 2009, its overall rate of cable digital TV conversion passed 98%, becoming one of the first places to assess cable digital TV to every family. At present, there are 310,000 cable TV users in the district and 500,000 STB installed. The rapid development of digital television value-added service and data service offers a good market for the operation of this system. Chengqian (2010) study the technological analysis of interactive VOD system. Huang (2010) shows the broadcast television VOD service plan and IPQAM inter-cut debugging under new

competition. Xu *et al.* (2006) have a study of the Tianbo EPG system professional edition of technology white paper. Wang *et al.* (2009) collect the papers of 2009 international transmission and coverage seminar.

In this study, we introduce a design of digital home multi-service system and elaborate from the perspective of digital TV broadcasting operation platform, interactive TV operation platform, home gateway and digital TV home multi-service terminals. This design is aimed to promote the two-way transformation of cable digital Television and the construction of operation platform. This will effectively help to accelerate the development of digital home service and broadcast television technology in Wujin.

OVERALL SYSTEM DESIGN

This study elaborates on digital home multi-service system based on three-net fusion, which comprises digital TV broadcasting operation platform, interactive television operation platform, optical fiber backbone network, broadband access network, home gateway and digital home multi-service terminals. Terminals include DVB-C STB separated from UTI, CBHD high-definition CD player, 10/100M ethernet card, Wi-Fi and high-capacity (500~1500GB) hard disk and support e-Jiajia of independent Chinese standards.

Overall transformation of digital TV has been realized in Wujin district. At present, there are 11 programs and 141 HD programs transmitted in the system. AVS HD and 3D signal source of independent AV standard will be added into the design of digital home multi-service platform based on three-net fusion.

Corresponding Author: Yi Lu, Department of Electricity and Information Engineering, Jiangsu Teachers University of Technology, Changzhou 213001, China

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The interactive service platform adopts a distributed structure with the ability of configuration, expansibility and sustainable updating, supporting the change in user scale increase and new service requirement. The system, at the same time, adopts an open structure, supporting third-party value-added service assess, user management, authentication, charging and other functions. The downriver video stream adopts IP-QAM. Demanding pages, orders and interactive information are transmitted through two-way network. Resources are shared by connecting the system with Jiangsu IP-QAM resources management system. Users are offered value-added services such as VOD, time-shifting TV, online shopping, distant education, online payment, buying and selling of stocks, e-government, media information, family security and visible communication. An all-around coverage of interactive TV backbone transmission network is achieved from the provincial DWDM line to city DWDM line and to the central computer room in the district. According to the network condition and distribution of users, the design adopts 3 assess modes, namely: EPON+EOC, EPON+LAN and CMTS. The two-way network is covered by stages and reformed into a reliable network with high-bandwidth, high bearing capacity, easy management and operation.

Digital home gateway is one of the key equipment of the digital home multi-service system based on three-net fusion. The digital home gateway in this design adopts e-Jiajia standards as the basic structure and constructs a multi-service application system for families and offices. It is equipped with system routing and network management and realizes wired/wireless network interconnection between domestic home equipment, mutual discovery and dynamic management. This home informationized network structure takes full consideration of the current situation and the future demand. In order to transmit high-speed information stream like multimedia, the system constructs a major home network by adopting high-speed transmission rate, Ethernet of low cost, 802.11 wireless network, 3G networks and cable TV network. At the same time, according to the control demand of traditional household appliance, lighting control and other facilities with low-information flow, the system adopts a home control subsystem of low cost, low transmission rate and standard components, connected with the main network. The basic function of home gateway includes equipment registration realization, equipment control, equipment state management, address, QoS and security and so on. This is a HD multi-media digital and intelligent home terminal based

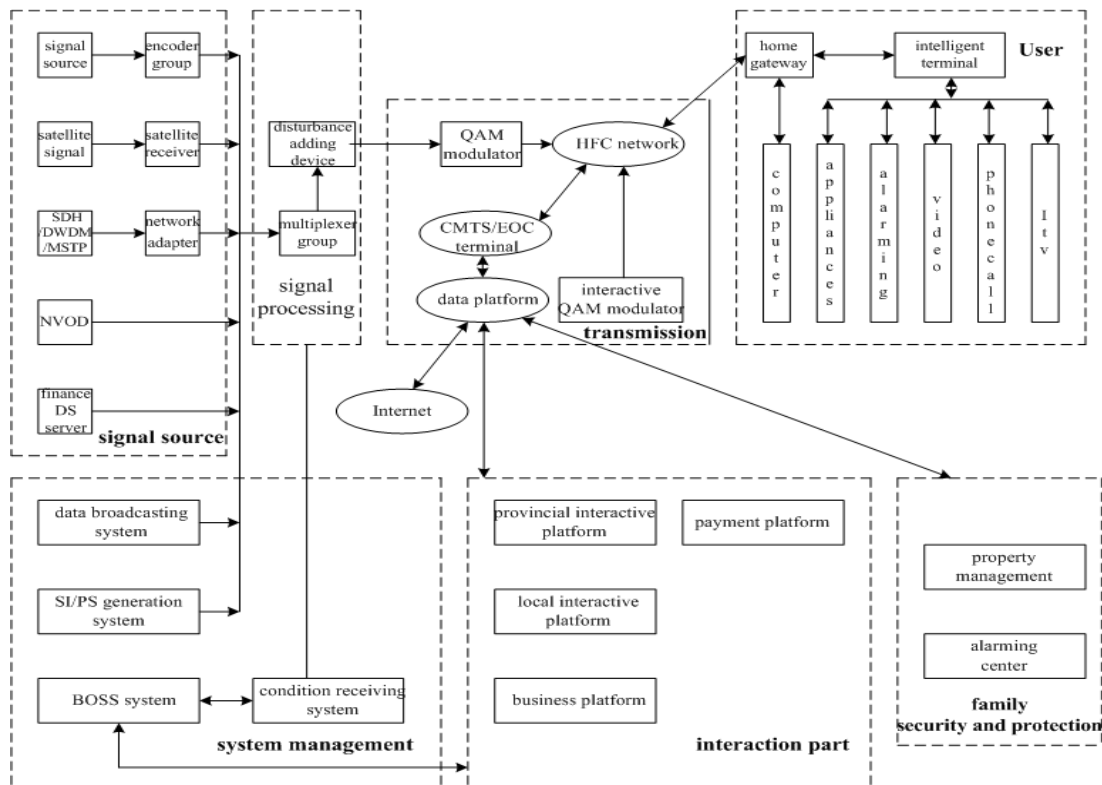


Fig. 1: The overall structure of digital home multi-service system based on three-net fusion

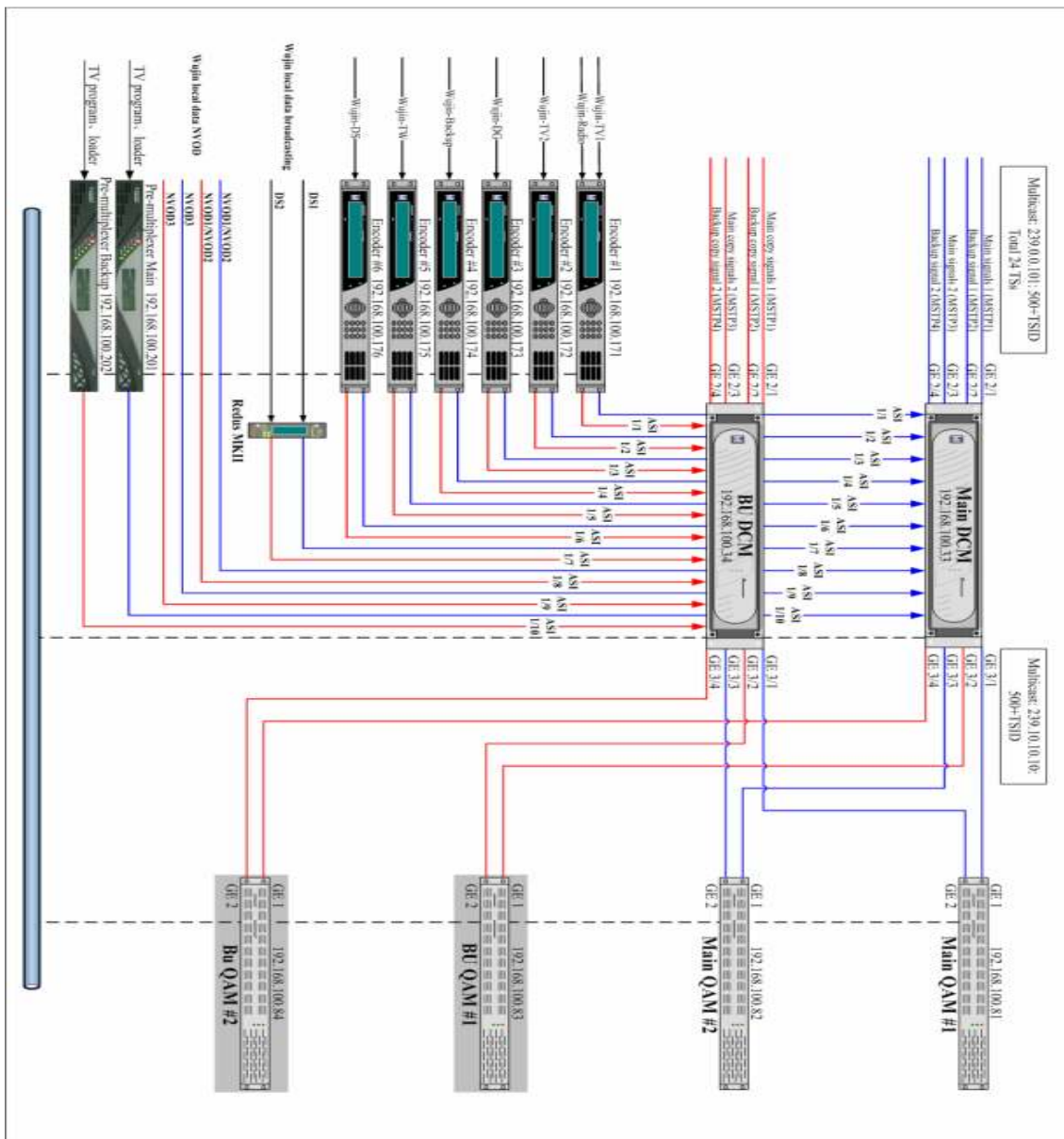


Fig. 2: The structure of digital TV brocasing platform

On three - net fusion, which comprises DVB-C, CBHD, e-Jiajia home subsystem controllers and high-capacity hard disks. It supports e-Jiajia of independent Chinese standards. At the same time, the terminal uses modular design, constructing a embedded platform with high-performance multi-CPU chip and Linux operation system. The modulat hardware structure enables flexible matching of hardware function module for the needs of various levels of consumption and the convenience of new function expansion.

SYSTEM OPERATION DESIGN

The operation design of digital home multi-service system based on three-net fusion is shown in Fig. 1.

- **Digital TV broadcasting operation platform:** The operation design adopts the existing digital TV broadcasting platform. The specific platform structure of Wujin district is shown in Fig. 2
- **Interactive service platform:** Interactive service platform devide the entire network into three areas

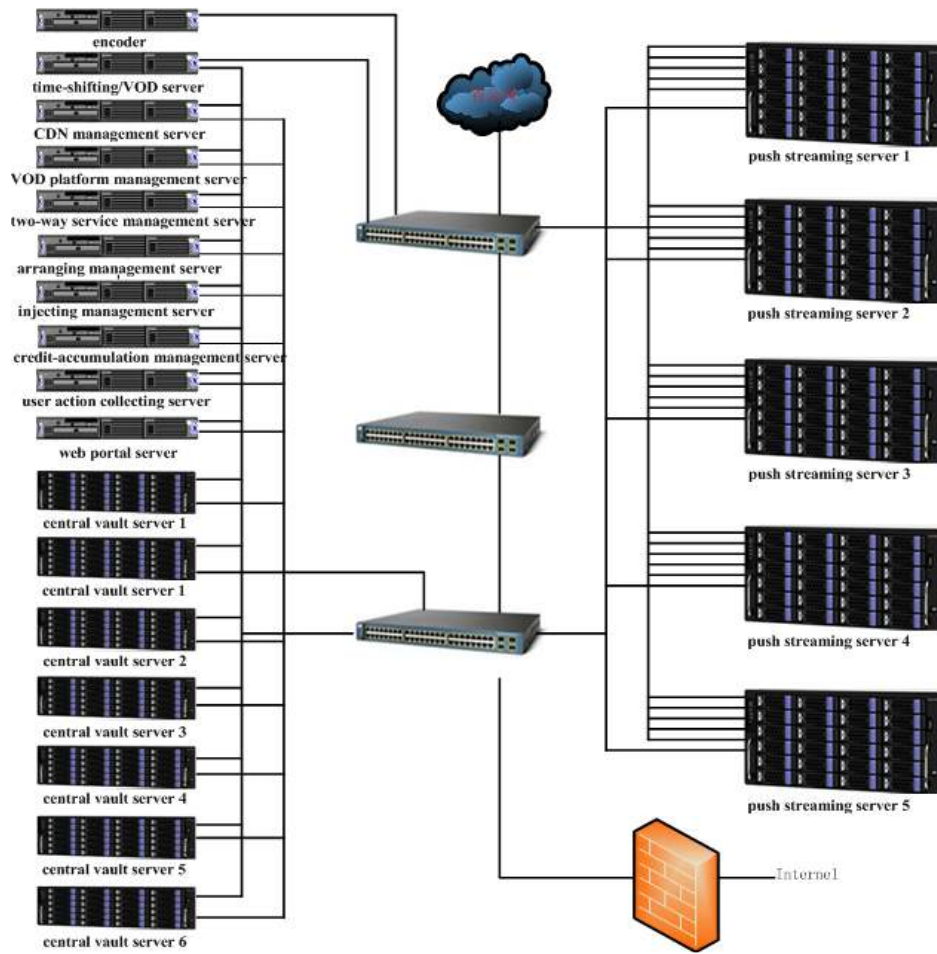


Fig. 3: The schematic diagram of digital interactive service platform

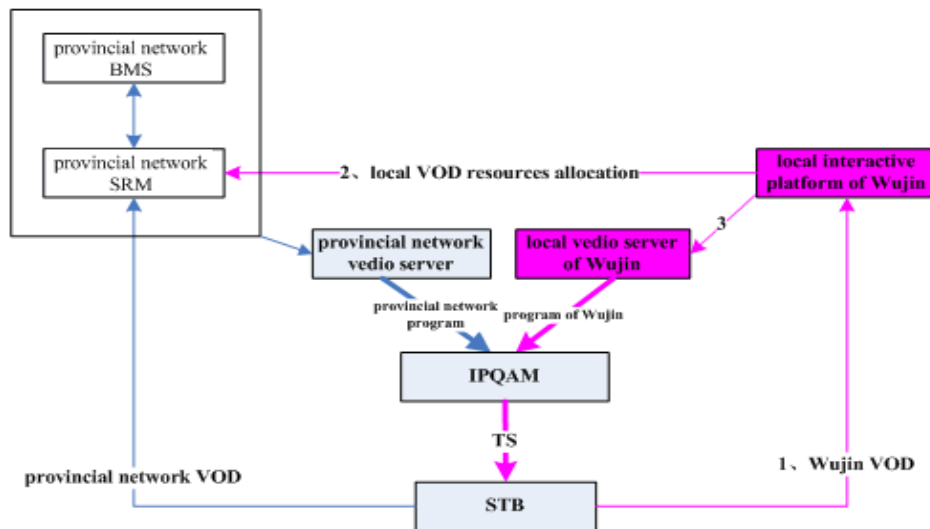


Fig. 4: The schematic diagram of frequency distribution

according to the functions, including: resources distribution area (connected with the provincial network), two-way function area, updating area. The specific schematic diagram is shown in Fig. 3. Due to the lack of RSM resources management server in Wujin district, the system is connected with the provincial network. There are 16 IP-QAMs and Service group in each town in Wujin, with uniform frequency distribution by the provincial company. The specific schematic diagram of distribution is shown in Fig. 4.

The system supports MPEG2, H.264, AVS encoding technology in the interactive service platform. MPEG2 is used in SD interactive video programs and H.264 in HD interactive VOD for its high compression efficiency. At the same time, the system is added with programme sources of AVS standard with independent intellectual property rights.

- **Access network technology:** The backbone transmission network of interactive television uses the existing backbone transmission network. The access network chooses HFC network based on frequency band of 860MHz. FTTB+EPON+LAN is used in newly-established network design and construction, FTTB+EPON+EOC in case of no solution for the accessing of category V. FTTB+EPON+EOC is preferred in the two-way transformation of one-way network. FTTC+EPON+EOC can be adopted for the rapid two-way network transformation. For those networks that have already been designed and constructed according to two-way HFC standard, the route of two-way HFC continues to be used for network upgrading to gradually meet the technological demand of the above-mentioned FTTC+CMTS plan. As a result, the reliability and service quality of the network will be further improved. Here the operation plan of EPON+LAN is expounded. Its network plan adopts a structure featured by "optical fiber to the building, light machine to the users, EPON transmission, composite cable accessing of category V coaxial-cable lines, Ethernet access". HFC network transmission uses frequency band of 860MHz. The topological structure chooses first-level 1550 nm annular optical link, second-level 1310 nm or 1550 nm star optical link. Building-below access network directly covers the users with coaxial-cable by using optical receiver. The coaxial-cable network conforms to the design principle of "one-way transmission, concentrated access". The two-way network adopts point-to-multipoint light

Ethernet transmission technology based on EPON technology. Category V is used from the building to the users. Its network structure includes access network routing hub head end, access circuit from hub head end to the neighborhood, neighborhood access point, access circuit from the neighborhood to the buildings, building access point, access circuit between the buildings to the users and the user terminals. According to the different wavelength configuration of HFC network, it can be divided into 1310 nm, 1550 nm over 1310 nm and 1550 nm over 1550nm+ Δ . The application environment of these three ways are as follows: 1310 nm uses first-level 1550 nm optical link and HFC network of second-level 1310 nm optical link. The other two ways adopts first-level 1550 nm optical link and HFC network of second-level 1550 nm optical link. The difference between them lies in the optical wavelength inserted by local signal.

- **Home gateway implementation plan:** The digital home gateway consists of network connection function module, access function module, service control function module, multimedia service function module, data service function module and so on. The network connection function module connects the terminals and facilities of household network. The access function module connects the household network with the external networks. The service control function module controls all the service in household network. The multimedia service control function module provides multimedia service to the household network. The data service function module provides all the data service to the household network. The structure of the gateway equipment adopted by this system is shown in Fig. 5.
- **Terminal implementation plan:** The terminal module uses the technical implementation plan of DVB-C cable digital TV receiver separated from UTI machine card, which includes STB and CAM. Its structure is shown in Fig. 6.

The host machine includes: channel unit(tune and channel demodulation), source unit(MPEG-2 decoding and AUDIO/VIDEOS output) and UTI main interface unit. The UTI main interface unit enables UTI physical interface, TS/USB protocol processing, information control processing and TS data stream in-out processing and so on. The CAM is also called UTI, including CPU, UTI sub interface, TS processing, descramble and intelligent card interface, etc. Its basic functions are as follows:

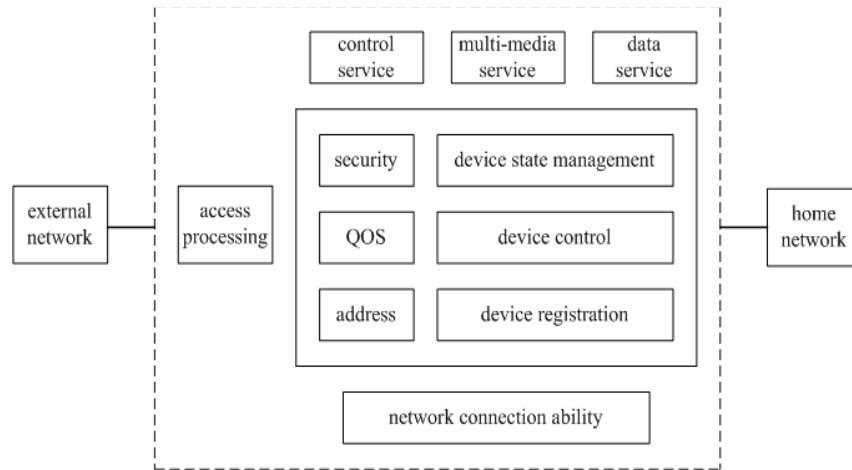


Fig. 5: The structure of gateway equipment

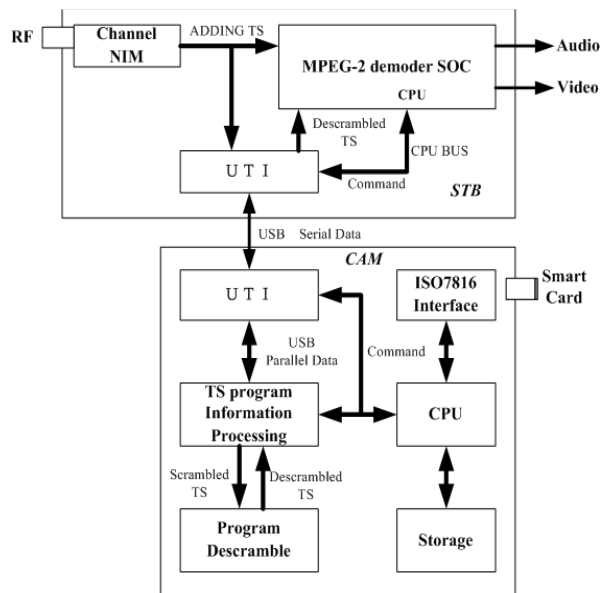


Fig. 6: The structure of DVB-C cable digital TV receiver module separated from UTI card

- Obtaining, authenticating and updating the user information
- Analyzing and filtering the received program stream
- ECM and EMM decoding and getting descramble control word (CW)
- TS or PES data descramble operation

Besides, it has such extended functions:

- MOBILE or specific CAS descramble operation or updating descramble operation
- EPG information display and updating

- Media data storage
- IP data decoding

Because of the upgrading and updating of the existing various CA systems, the CA module can also include an intelligent interface. In such cases, EMM and ECM decoding is conducted by intelligent card and the communication protocol between CA module and intelligent card conforms to that between the existing STB and intelligent card. The UTI card software mainly includes embedded operating system, driver and firmware or software downloading and application software.

CONCLUSION

In this study, we aim to promote the two-way transformation of cable digital Television and the construction of operation platform. This will effectively help to accelerate the development of digital home service and broadcast television technology in Wujin. The Wujin district of Changzhou has a whole coverage of cable broadcast television network. In DEC,2009,its overall rate of cable digital TV conversion passed 98%, becoming one of the first places to realize the assess to cable digital TV in every family. At present, there are 310,000 cable TV users in the district and 500,000 STB installed. The digital television value-added service and date service also have seen a rapid development. All this completing physical foundation is bound to create a favorable condition for the application of this design. With the gradual improvement of the design, the digital household service will be greatly promoted, spurring the improvement of broadcast television technology in Wujin district.

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