Discussion on Heterogeneous Converged IoT Networking Scheme of CBN in Hotel Field

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Keywords: 5G, The Internet of Things (IoT), China Broadcast Network (CBN), Heterogeneous Network, Application Server IoT Gateway.

Abstract: The Internet of Things (IoT) is a business area that the four major domestic operators must compete in the 5G era. How to build a hotel IoT solution based on China Broadcast Network (CBN) without affecting the transmission of video information in the hotel industry is an urgent problem. Under the conditions of internal transmission networks, integrating a networking solution into the CBN IoT is a key for this problem. This paper proposes a heterogeneous networking scheme combining the common transmission medium conditions in the hotel with the conventional network architecture of the IoT, CBN video transmission network and hotel transmission network together. This should be a new idea for the hotel CBN IoT business.

1 INTRODUCTION

Driven by the country's policy of "Three-Network Integration", CBN has become the fourth network operator in China, and has subsequently carried the heavy responsibility of 5G network and application construction. As an important application in the field of 5G, the IoT will cover all walks of life and penetrate into all aspects of people's lives (Jaber M., Imran M., Tafazolli R., 2017). In the application of IoT, the construction of the IoT basic network, utilization of existing basic network and reducing the secondary investment have become difficult problems, which are also the focus of industry attention.

CBN network operator has accumulated a large number of hotel users through years of accumulation, and has a long-term accumulation in the video field (Jiujun Bai, 2018). In the 5G era, it has pre-emptive resource advantages of the IoT in hotel field. At present, most IoT services of CBN operator have a system of "Cloud---Pipe---Terminals" architecture through metro fiber network and the network near users (Jiujun Bai, 2018). The system and servers are deployed in CNB operator's "cloud." A "pipe" connects to the server, then the users enjoy the services through "terminals" such as gateways, IoT hardware, mobile phones, and set-top boxes (STB). Realization of hotel room IoT based on CBN network mainly include cloud service deployment, metro optical fiber network connection, hotels integrated network construction, guest room gateway and IoT hardware control (Imran A., Zoha A., Abu-Dayya A.,2017).

The IoT business in hotels is difficult to implement. The main problem is the complicated condition of hotel head-end computer rooms, in-building transmission networks, and guest room terminals, from hotel construction ages, construction standards, investment scale and other factors (Shanlan, Cheng., 2014). After CBN operator's optical fiber carrying the IoT service is connected to the hotel's head-end computer room, the two-way interworking networks required by the IoT information to reach each room in the hotel are not all qualified, and the network or coaxial cable laid by the hotel as the medium is mainly carrying video services, and it is difficult to add or re-lay cables through rewiring. Therefore, the establishment of a network between a cloud-compatible IoT server, a two-way interworking network with the terminal gateway and the IoT hardware, and the original transmission video network in the hotel become the key to solving the problem, which is under the premise of not increasing the line construction between the hotel's head-end computer room and the guest room. It can not only

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integrate complex hotel internal network resources, but also can solve the two-way service transmission from the hotel room to the room at a low cost. The establishment of a converged network can comprehensively utilize the existing coaxial network and wired or wireless IP network of the hotel. Under different basic conditions, while ensuring different business needs, the independent networks are merged together to enhance the use of the hotel's existing investment. And reduce redundant construction of information and communication infrastructure.

2 ARCHITECTURE OF DIFFERENT NETWOKS

2.1 Network Architecture of Conventional IoT Applications

In the current technology form, the conventional IoT architecture consists of three parts: the IoT cloud application server, the IoT gateway, and the IoT terminal device, which are connected through various wired and wireless network methods in Figure 1.

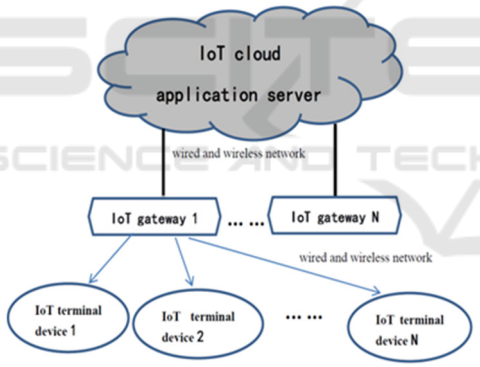

Figure 1: Network architecture of conventional IoT applications.

The IoT Cloud Application Server is generally on a public or private cloud, which carries background services for the IoT business. It is responsible for certain IoT terminal device docking requirements that require "cloud-cloud docking" in the cloud (L, Wang., Y, Chen., et al. 2016). For example, after the intelligent voice speaker receives an unrecognizable voice control command locally, it needs to query the command through the cloud server of the voice library of the speaker manufacturer and return the corresponding control command in the IoT application server. The IoT gateway is connected to the background application server, which is responsible for the transmission of instructions and data. Meanwhile it is connected to the IoT terminal devices and interconnects with terminal devices such as air conditioners, switch panels, and televisions in a protocol-interconnected manner. Some complex IoT gateways even play a role of edge servers (H, Zhang., C, Jiang., J, Cheng., et al .2015).

2.2 Network Architecture of CBN Video Transmission

Based on the CBN network video transmission network architecture, the video cloud of the provincial CBN operator pushes the video source from the provincial bureau to the head-end of each city branch through the optical fiber, and then pushes it to the regional head-end to the building optical station. After photoelectric signal conversion and video signal field strength adjustment, it can send to the home or hotel room STB to achieve the purpose of viewing in Figure 2.

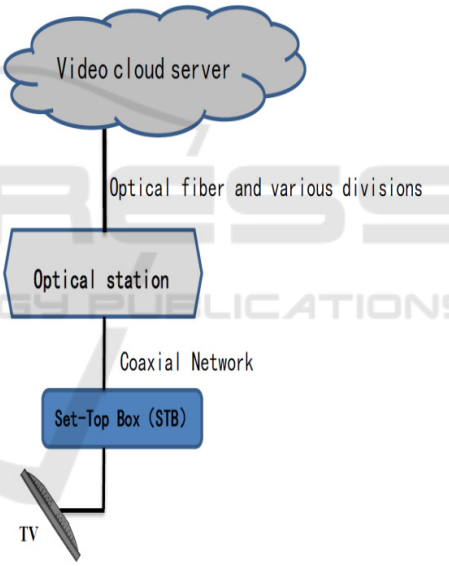

Figure 2: Network architecture of CBN video transmission.

The traditional video transmission method based on the CBN network has the characteristics of stable video signals, clear images, and rich channels. It is the main method of video transmission and used widely in hotel field, extremely in upscale hotels.

2.3 Architecture of Traditional Hotel Transmission Network

The network architecture in the hotel is very different from that in the family. Generally, a head-end computer room is set up at a designated location in the hotel. Then external resources such as various types of

video, broadband, and data are uniformly connected to the computer room. At last the coaxial network, category-5 line (Cat-5), and wireless networks transmit data and resources to hotel rooms. (Figure 3).

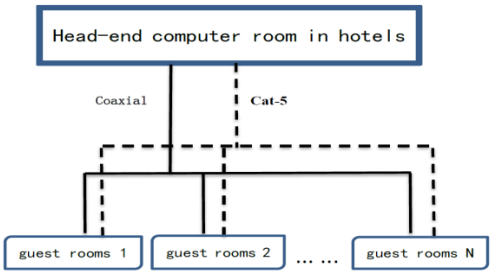

Figure 3: Architecture of traditional hotel transmission network.

At present, the common transmission networks in hotels include coaxial, Cat-5 dual-line access, single coaxial cable, and single Cat-5 to access guest rooms. The transmission network wiring in hotels is mainly done during the decoration period before. The hidden lines in the wall are difficult to change later (Linqiang, Xu., 2016). But because of video viewing is a rigid demand for hotel guests, how to realize the smooth data exchange between the room IoT gateway and the connected IoT devices, the cloud IoT server through the hotel's existing internal transmission network while taking into account the transmission of room video viewing services. That is the main problem we want to solve.

3 HETEROGENEOUS FUSION NETWORKING SCHEMES FOR DIFFERENT TRANSMISSION NETWORK SITUATIONS

Since the transmission of CBN networks is based on ensuring the secure broadcast of video, general IoT application servers will be deployed in the cloud server of the provincial network operator, which will be connected to the access network equipment of the hotel room through optical fiber. It can connect the other objects to the device's cloud server and set up multiple levels of security in the cloud. (As shown in Figure 4, Figure 5 and Figure 6.

3.1 Coaxial and Cat-5 Dual-line Access Networking Scheme

The method of coaxial and Cat-5 cable dual-line access to guest rooms is a commonly used for new hotels in recent years. Coaxial cables are used for video service transmission. Cat-5 cables were originally used in the guest's room to access the Internet. Now, most of the Internet access in guest rooms are changed into wireless, such as access through mobile phones or PAD and other equipment, so Cat-5 can be used as a data transmission channel for the IoT gateway in the room, connected to the cloud server through the head-end GPON equipment in the hotel room. (Figure 4).

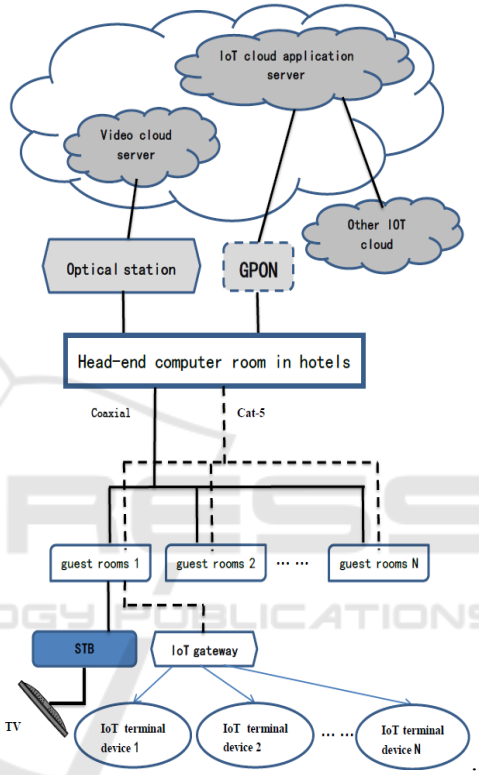

Figure 4: Coaxial and Cat-5 cable dual-line access networking scheme.

After the video cloud and IoT cloud of CBN are connected to the hotel head-end computer room through optical fiber, the video information flow is converted into optical signals through the optical station in the hotel. It transmitted to the guest rooms through the coaxial network, and then connected to the terminal STBs to play video programs. The IoT application information flow is a photo electrically converted through GPON equipment, and transmitted to each guest room through Cat-5, also connected to the guest room gateway, which is connected to the guest room IoT device in a wired / wireless manner, and the two services are running at the same time.

3.2 Single Coaxial Network Access Scheme

Some hotels built more than ten years ago has only a small number of network applications in the early ages of construction, so they only prelayed a single coaxial line to access the rooms during wiring system for guests watching video programs. There was no two-way communication channel between the hotel room and the guest's room. Even if an IoT gateway is placed in the room, it cannot connect to the computer room and the IoT application server in the cloud, which restricts the hotel's informatization and intelligent development. (Figure 5).

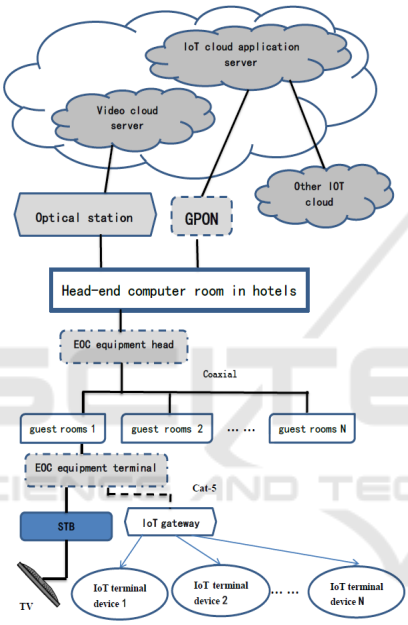

Figure 5: Single Coaxial Network Access Scheme.

Due to the limitation of a single transmission medium, we have added the EOC equipment head-end in the hotel room and the EOC equipment terminal in the room in order to realize the video information flow and the IoT application information flow in the hotel. In the axis network, the EOC terminal is separated in the room, the room set-top box and the IoT gateway are connected separately, and the gateway is connected to the terminal IoT device to realize the simultaneous operation of the two services in the hotel room.

3.3 Single Cat-5 Line Access Network Scheme

With the competition for customers in various operators' industries, under the guidance of major telecommunications operators and their business agents, many new hotels are no longer distributed coaxial cable among "head-end computer room, hotel-floor room and the guest rooms", an IP network with only Cat-5, just one transmission medium, intentionally blocks the way that CBN network operators continue to provide services to hotel users through the traditional STB deployment model. Under this condition, we need to make full use of the five types of lines that have been installed in hotel rooms to integrate the IoT and video services. The specific scheme is as follows in Figure 6.

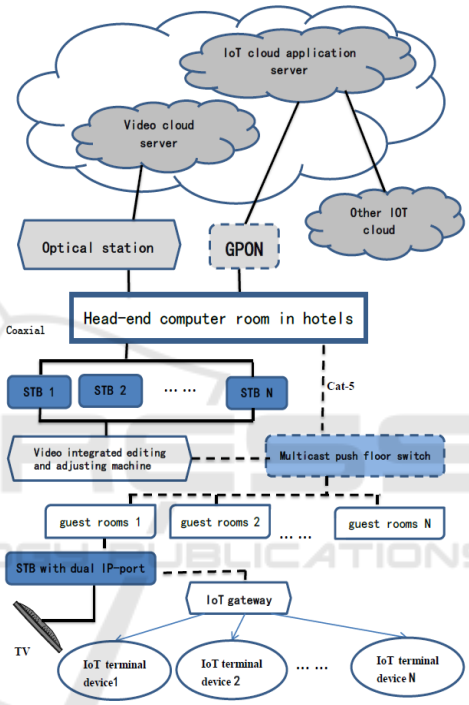

Figure 6: Single Cat-5line access network scheme.

Since there are only Cat-5 as transmission media from the computer room to the guest room, we will first decode the video signal converted from the optical station through the STB to decode the channel, and cooperate with multiple video integrated editing and adjusting machines to output one channel in accordance with the way of one STB, turn it into an IP signal and connect it to a Multicast push floor switch with a multicast function to transmit the video stream to each guest room to realize the video transmission. At the same time, the GPON equipment is connected to the IoT application information flow in a manner of VLAN division, and is logically isolated and connected to the hotel's push floor switch. At last, send IoT information to the gateway in guest rooms and connect the IoT terminal device.

Because of the different IP addresses of the upstream services of the two services in the hotel's internal network, the same type of Cat-5 transmission medium can still achieve the purpose of simultaneously running the two types of services in hotel rooms(Jia, Y, J., Chen, Q., A, Wang., et al. 2017).

4 COMPARISON OF THREE CONVERGED NETWORKING SOLUTIONS

In order to provide more suitable IoT networking solutions for hotels with different internal network profiles, we will put business separation methods, input cost situations, and problems that may be encountered during business operations into comparative analysis.

From the comparison, we can see the different solutions have their own advantages and disadvantages. Based on comprehensive analysis, the physically isolated networking method is more suitable for hotel users to access and run TV and IoT services at the same time in CBN network condition.

5 CONCLUSIONS

Table 1: Analysis of different problems encountered.

Number	Hotel internal network transmission media	Business separation	Input costs	Problems that business may encounter
1	Coaxial and Cat-5 dual-line access to guest rooms	Physical isolation	Low	Services are run separately in different transmission networks in the hotel without affecting each other, but not all hotel internal networks can meet the requirements of media conditions.
2	Single coaxial network access to the guest room	WDM	High	The coaxial network may feed noise signals and interfere with the transmission quality of the network. As a result, the connection between the IoT gateway and the cloud server will fail, making the IoT devices in the guest room unable to respond to user instructions in time
3	Single Cat-5 access to guest rooms	Logical isolation	Higher	After converted to IP streaming, the video signal will occupy a lot of transmission resources, which will cause network congestion. IoT gateway and IoT devices in the guest room will delay to respond to user instructions, and affect the user's experience.

China is entering the era of 5G application. The widespread application of information, intelligence, and networking of hotel field have driven people's demand for hotel IoT applications (Peng, M., Li, Y., Zhao, Z., et al.2015). However, the problem, two-way data communication, the IoT system and TV transmission system can't run simultaneously under the existing transmission medium conditions, has been restricting the development of the IoT business in the hotel field. Under the long-term exploration, testing, summarizing of the heterogeneous converged networking solution of IoT of CBN in the hotel field, no matter what kind of network situation the hotel faces, it can use the hotel's existing transmission network to connect the terminal device in hotel guest rooms to the IoT application server. Also, the solutions don't affect the use of the existing video transmission system. The implementation of this solution can save a large amount of capital investment for hotel operators and help them enter the IoT operation camp at an early date.

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