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Analysis of Blockchain Based Visual Communication Design Information Management System under 5G Communication Network Technology

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Abstract: At an international design conference, visual communication design became popular, mainly including the design of newspapers, magazines, posters and so on. Later, it gradually extended to film, television, advertising and other media, which mainly expressed content through visual presentation. Visual communication design was relatively late to develop in China, but it had developed rapidly. Traditional graphic design did not meet the current new market demands. In this regard, this paper introduced D2D technology under 5G communication, and compared it with traditional visual communication technology in terms of network signal-to-noise ratio, throughput, number of users, and user satisfaction. The comparison results have shown that, in terms of signal-to-noise ratio, the channel resources under 5G communication were simpler than those of traditional visual communication techniques. The number of users has also increased significantly, by about 48%. Throughput has also increased by 33.4% and user satisfaction has increased by 25%. It has shown that in the new era, 5G communication could make a good progress in visual communication design. People could also have a better effect in visual communication design. Design could be better displayed and better meet people's needs.

1. Introduction

Visual communication under 5G communication has changed from the past. Starting from all directions, it combines graphics, images, videos, sounds, animations, etc. The traditional pattern has been more diversified, and the constraints of traditional communication methods have been broken, which allows visual communication to have a greater space for development in the new era and also brings new changes to traditional communication technology and modern communication technology.

This paper compared the cellular technology in traditional visual communication with the modern 5G communication technology. By comparing the results, it is found that the signal-to-noise

ratio is more resource-saving. There has also been a considerable increase in the number of users. The throughput has been improved by 5.8Mbits, and the communication quality has also become better. There have also been good improvements in user numbers and satisfaction. Modern 5G communication is more beneficial to the current society and could be tailored to suit the communication design requirements better.

2. Related Work

IMS is an information management system, which can run the functions of computer hardware, software, network communication equipment and other office equipment for information collection, transmission, processing, storage, update, expansion and maintenance. It is omnipotent and omnipresent. Intoxication information management system (AIMS) is widely used in many hospitals. Given the installation and maintenance costs of the equipment, it is necessary to evaluate its performance and suitability for the end user. Palaniswamy S evaluated the completeness of the human data and its possible predictions one year after the implementation of the AIMS system. A complete review of 1000 neurosurgery patients was performed, 41 of which were prespecified. The result was a better degree of completeness of anesthesia records [1].

The aviation industry was currently faced with technological and security issues. In this regard, Narayanan M discussed the technological and security aspects of aviation through big data and studied them by building a network model of compliance. The results showed that aviation safety could be better ensured if aviation information was understood.[2]. When metal-based materials were tested by test instruments, the information needed to be verified against the test results to ensure that they were of acceptable quality before they could be placed on the market. Since the current test instruments did not meet the requirements, Wang H proposed a new and safe test instrument which guaranteed the safety and robustness of the inspection in a new way and allowed visualisation of the changes in the test instrument data. [3]. Yang S explored the model of ward doctor order review based on "clinical pharmacist". The review was carried out according to the doctor's orders of the cardiology department of Xinhua Hospital from April 2015 to March 2016. Through the review of doctor's orders, there were 112,812 prescriptions and 1,898 unreasonable prescriptions. The result was that the CPIMS-based ward doctor's order review model could ensure the safety and effectiveness of patients' medication [4]. The functionality of IMS has also been verified, but related scholars have not conducted research on 5G communication networks.

In terms of 5G communication network, there are also many professional scholars studying it. Aside from communications technology, the most significant advancement in wireless networking is the density of network deployments. In particular, as the density of access point users increases, and the cell size decreases, spatial reuse is significantly enhanced. Therefore, the capacity of the network is improved. But will over-dense and over-deployment improve the performance of wireless networks? In response to this problem, Liu J studied the short-distance propagation characteristics in dense deployment, and proved the correctness of the method with experiments [5]. Current information technology was continuing to advance, and these would provide a solid foundation for future society. The second step in the current information age, the formation of complete communication technology, had been achieved. Kim J would also continue to explore this through research into the patterns and systems of our everyday mobile phones in order to make them more favourable and convenient for users. [6]. In this research, Kim developed a hybrid control algorithm for SBS (SBS) and designed communication, caching, and computing techniques. In order to better combine communication, caching and computing algorithms, this paper introduced game theory to describe cooperation and competition. The main contribution of this project was that, on a fully integrated basis, the ultimate synergies were identified and excellent

adaptability and flexibility for various performance needs were provided. Simulation experiments showed that the algorithm improved by 5%~15% compared with the existing schemes in terms of bandwidth utilization, access delay and system throughput [7]. The 5G communication network has played a great role in our life, entertainment and travel, and also has a huge effect on the information management system.

3. Visual Communication Design under 5G Communication Network

3.1 5G Communication Network and Visual Communication Design Overview

The fifth generation mobile communication network (hereinafter referred to as 5G) is a technology brought about by the rapid development of mobile data explosion. Since 2012, the European Union has officially launched METIS (METIS). Since then, countries around the world have carried out research work on 5G technology [8].

5G is the result of the development and solid foundation of past generations of mobile phone technology. The main differences between 5G technology and previous mobile communication technologies are: (1) The peak rate is higher, and it supports large-scale data transmission such as high-definition video and virtual reality. (2) The delay is about 1 ms, which can realize real-time operation such as unmanned driving and telemedicine. (3) It has sufficient network capabilities to connect hundreds of billions of devices to support the Internet of Things communication. (4) The user experience rate can reach 100 Mbit/s. (5) The degree of intelligence of the system is improved. With the popularization and commercialization of 5G technology, 5G has a great impact on the development of medical, broadcasting, urban management and other fields [9].

Visual communication design refers to the act of conveying information accurately and completely to the subject through the purposeful and planned use of images. Visual communication naturally includes two levels of "visual symbols" and "communication" [10]. Over time, the media of visual communication design has also changed in different periods. In the past, most visual communication media used print as the medium. With the advent of TV movies, the communication of the media is no longer purely print. At the same time, the expansion of the media makes the content of the dissemination also change from a simple plane to a static visualization. The medium of visual communication also goes from PC to mobile phone. With the continuous development of virtual reality technology, people's demand for visual works is not only the dual needs of vision and hearing, but also has a closer relationship with other aspects.

The digital media and digital technology in the 5G era have brought greater development space for visual Communication Design [11]. The visual Communication Design of the media is richly displayed. In the case of 5G communication, the intermediate process of information transfer is considerably shortened. The degree of coordination is also higher, and the carrying capacity is also greater. Therefore, in the visual communication design, the presentation medium also moves from "real" to "virtual".

The sense of visual communication design is enhanced. Since digital vision entered the era of new media, it has been expanding the perception field of visual communication design. With the close integration of visual communication and other design fields, the problems to be solved by visual communication design are not limited to visual experience, but involve the audience's perception at multiple levels such as vision, hearing, touch, and smell.

Communication with the audience is enhanced [12]. In the past, the interaction between visual communication design and audience was often one-way, and it was impossible to form a closed loop of interaction. Today, with the continuous development of visual Communication Design, its interaction methods are becoming more and more abundant. In many exhibitions in China, the use of visual Communication Design, somatosensory interaction, and installation interaction has

become very common, which undoubtedly greatly strengthens the interaction between visual communication design and the audience.

3.2 Basic Characteristics of Visual Communication Design under 5G Communication Network

Under the support of new technology, traditional visual communication design is a new creative space, which is a kind of inheritance and development of traditional visual communication design [13]. Contemporary visual communication design is not completely separated from traditional visual communication design, but has continuity and particularity. Modern communication design is an important branch of today's visual communication design, and its design principles, design processes and design methods are similar in principle to other visual communication designs. The basic principle of visual communication design is the theory of visual enhancement, weakening, visual center, visual rhythm, visual balance, and color coordination proposed by the Society of Visual Physiology and Visual Psychology, which can still be applied in contemporary visual communication design [14]. However, the means of dissemination, design and development of modern communication design are different, thus it has unique design features and requirements.

The uniqueness of the visual design lies in the following points, as shown in Figure 1.

Cooperate. Visual communication design integrates the communication effects of various media such as sound, text, image, video, animation, communication, etc. to form a design image that combines audio-visual, transmission and reception. The technical basis for realizing collaboration is to transform various information forms into a unified digital information technology that can be processed by computers.

Comprehensive: In addition to using a lot of graphic design and traditional animation and film and television performance means, contemporary visual communication design also uses computer graphics, computer audio, network communication technology and performance means. Modern visual communication design requires the collaboration of designers, engineers, musicians and other parties, mobilizing a large number of design, production strength and information resources [15].

Interactive: Interactivity refers to the interaction and communication between people and machines in contemporary visual communication design works, so that the audience can adjust and control the methods and processes of information according to their own needs. Therefore, the design of a good interactive function and interface is very important for today's visual communication design, and it is also a key factor that determines its success or failure.

High tech: The media used in modern visual communication design include computer hardware, software, digital communication network, digital video and audio equipment, CD storage, etc. Contemporary visual communication design is in a stage of change and continuous development both in content and form. Similarly, modern visual communication design also requires sufficient application software and corresponding technology. Because they are always at the forefront of the development of information technology, they can also reflect the characteristics of high technology.

Transmitted image: Until now, most of the modern visual communication methods were delivered by display devices (computer monitors, digital device displays) and sound output devices, and received user feedback through touch screens, light pens, mice, keyboards or joysticks. Although contemporary vision includes traditional print media such as images and text, it is ultimately presented in the form of video systems, colors, and pixels.

It should be pointed out that the contemporary and traditional visual communication design styles are not a single development, but show a trend of mutual influence, integration and common development. First of all, design is a process of accumulation and innovation. Its changes come from patterns that we are familiar with. It is mainly the inheritance of traditional graphic design and

animation design of film and television. Secondly, as an important tool for information dissemination, visual communication design has a close relationship with the times, economy, technology and other aspects. The influencing factors of visual communication design are shown in Figure 2. No matter what form of design style, it reflects this characteristic. With the rise of information age messages, it has penetrated into people's life. Modern design gives designers a new way of artistic expression and space, and also gives designers unlimited opportunities for creativity.

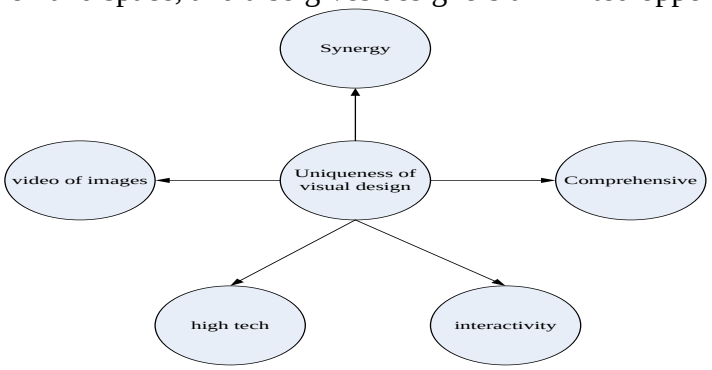

Figure 1: Uniqueness of visual design

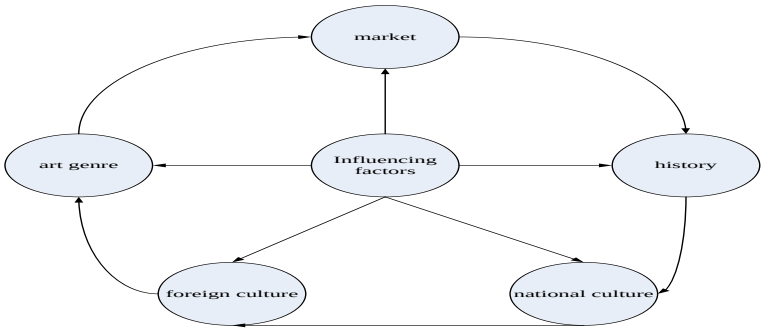

Figure 2: Influencing factors of visual communication design

3.3 Application of 5G Communication Network Technology in Visual Communication

At present, the key technologies of 5G network are still in the research and development stage, and it is not clear which key technologies can meet the needs of 5G in the future. According to the basic needs and development trends of 5G development, this article focuses on summarizing some key technologies used in 5G networks. Table 1 lists the main technologies of 5G network [16]. This article illustrates the use of D2D in these two situations. The two models are introduced technically to establish an information management system. In this way, the differences between traditional visual communication design and modern visual communication design are compared. In terms of signal-to-noise ratio, throughput, number of users, and user satisfaction, traditional visual communication technology is used for comparison.

Table 1: Main technologies of 5G network

key technology	frequency band	process status
high frequency transmission	high	developing
New multi-antenna transmission	medium	developing
Simultaneous co-frequency full duplex	high	developing
D2D	Low	developing
dense network	medium	not developed
new network architecture	high	not developed

Mobile cloud. Mobile cloud refers to a new dissemination mode of IT information or data services in which cloud computing technology is integrated into the mobile Internet [17]. Figure 3 shows the basic architecture of cloud computing technology. In mobile cloud computing technology, because mobile devices need to complete larger-scale computing and data storage, the mobile phone cloud can reduce the power consumption of mobile devices and alleviate the shortage of funds. In addition, internal information and applications can be placed on a decentralised device, thus avoiding the loss of data and applications. At the same time, it can also help users to provide users with a long-distance security service when there is no time.

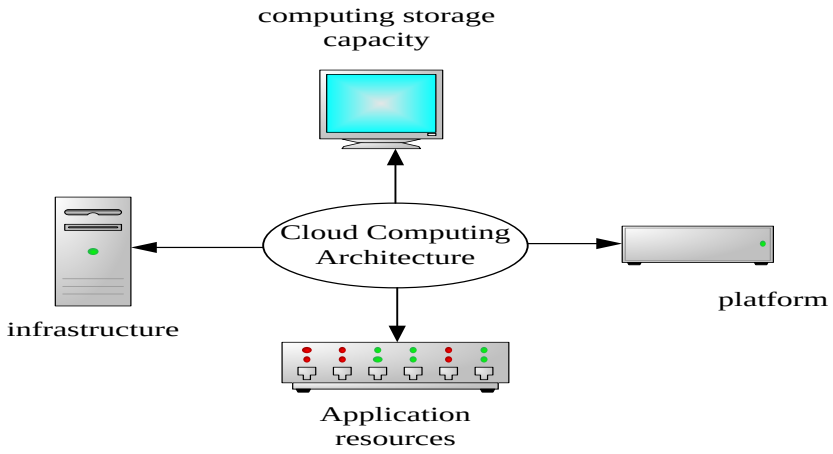

Figure 3: Cloud computing architecture

SDN/NFVSDN (Software Defined Networking)/NFV (Network Function Virtualization) is a new implementation method of network architecture. The concepts of "data separation", "softwareization" and "virtualization" proposed by him put forward a new idea for breaking through the current network security problems [18].

The internal feature of SDN is a relatively open and cost-effective architecture with degrees of freedom, and it is modifiable [19]. Figure 4 shows the SDN architecture, recommended by the ONF organization. It consists of three parts, and contains a lot of basic equipment at the lowest level of the structure, which mainly deals with network information. These devices integrate and send and receive information in accordance with the principles and regulations issued by the control layer. The middle is the control core layer. Its task is to organize the resources in the network, which mainly controls the network situation and plays a dynamic adjustment role [20]. The top layer is the program application, which mainly extracts and enters the internal application to adjust the internal network. SDN layers the structure, which can implement global control, reduce the complexity of the program, and strengthen the management. System operation is lightened and operational efficiency is improved. SDN does not increase the speed of the Internet, but it can simplify all infrastructure, reduce operating expenses, and improve work efficiency. In the 5G network, it is necessary to realize the separation of control and forwarding, and to better manage them, so that SDN becomes the backbone of the entire network.

Digital communication (D2D), the full name is Device-to-Device, and D2D for short in the text. In 5G communication, the current network technology has been greatly improved, which will also provide people with a better experience. Among them, D2D is a good technology for these problems, which can improve user efficiency and reduce the internal operation of the system. The development of this technology is also a focus in the current era.

D2D communication is a direct communication technology based on mobile phones [21]. The dialogue information under this technology can also be transmitted through the site, and a management system for maintenance, storage, search and identification is established. These are

handled over traditional networks. In 5G communication, the application range is relatively wide, and it can be processed without permission, which is its advantage. The demonstration diagram of its communication system is shown in Figure 5.

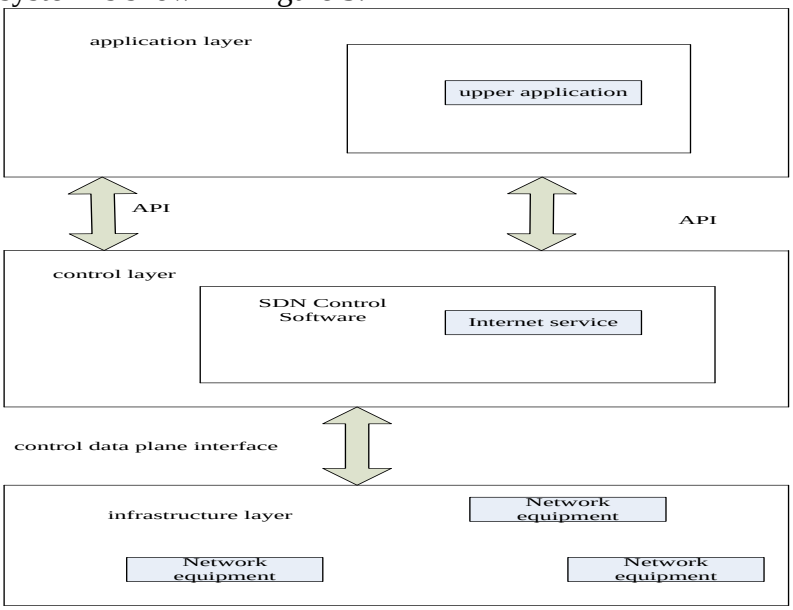

Figure 4: SDN architecture

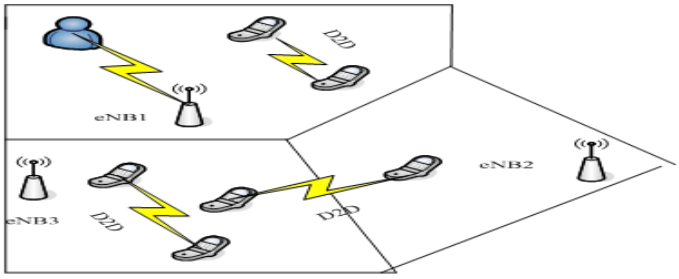

Figure 5: Schematic diagram of D2D communication system

3.4 D2D System Model

The site can collect all the information, as well as the status of the information, and can make resource allocation according to the user's situation. D2D can generally transmit information through three modes. The article mainly describes two types, one is the cellular mode, and the other is the D2D mode. In D2D mode, resource allocation can be achieved by using power and control distance, and the use of user data over distance can be achieved.

i represents a user in D2D, indicating that users i and j are sharing resources, which is prone to signal interference. Therefore, in order to reduce these effects, the following provisions have been made: When it is 1, it indicates that the resource is being shared. Conversely, it means that resources are not shared, so it is 0. It is assumed that the volume of customers that exist using D2D technology is M, M< N, and:

$$\sum_{j=1}^{N} x_{ij} = 1 \quad (1)$$

$$\sum_{i=1}^{M} x_{ij} \leq 1 \quad (2)$$

The formulas from top to bottom represent one-to-one and group-to-group resource reuse

respectively.

Mode properties. When different users in D2D share resources, it will affect the signal, and the information status under the site will also have an impact. However, the advantage of the site is that it is relatively stable. Different problems of the signal are dealt with and the unstable fluctuation of the signal can be controlled. In the downlink multi-path, the user is easily interfered at the receiving end, and it is also difficult to control. In order to protect users from these influences, two modes are described in this paper and a comparative study is conducted on the signal-to-noise ratio.

D2D link can be divided into downlink and uplink when it is realized by traditional cellular network method. In traditional cellular mode, the user's uplink SNR and downlink SNR are:

$$r_{up} = \frac{P_d G_{dbs}}{N_0} \tag{3}$$

$$r_{down} = \frac{P_{bs} G_{dsd}}{N_0} \tag{4}$$

Among them, P_d represents the transmit power of the user and P_{bs} is the output power of the base station when transmitting. G_{dbs} and G_{dsd} describe the cellular mode and the user's mutual channel increase. N_0 is the channel noise power during transmission. Maximum signal-to-noise ratio under this method:

$$r_{cell} = min\{r_{up}, r_{down}\} \tag{5}$$

D2D specific method (orthogonal sharing method). Signal-to-noise ratio in this way:

$$r_{ded} = \frac{P_d G_{dd}}{N_0} \tag{6}$$

In D2D proprietary multiplexing mode, the channel gain between D2D direct links is G_{dd}. The D2D multiplexing model is presented in this figure. D2D multiplex transmission mode. The ratio between the two at this point is

$$r_{re} = \frac{P_d G_{dd}}{N_0 + P_c G_{cd}} \tag{7}$$

Among them, G_{cd} represents the interference of the D2D user to the signal channel resources of the mobile user; P_c represents the transmission capability of the mobile phone user. In different ways, different signal-to-noise ratios will affect the transmission of the image, and thus the transmission of the video is affected.

3.5 Resource Allocation in Different Modes

In the D2D communication resource sharing mode, the use of orthogonal shared resource scheduling simplifies the channel state information of the D2D link, so higher spectrum utilization is achieved. The method aims to improve spectrum utilization and system throughput. This paper proposes a communication method selection based on D2D users in the cell scene. By calculating the channel conditions of each link, the base station determines the communication mode of each user and assigns the best channel to the user, which turns the problem into an integer linear optimization problem. The solution process is divided into 3 stages to simplify the problem.

1) Prioritize them according to different customer business requirements.

2) The allocation of the line transmission mode is carried out in the optional mode; the signal-to-noise ratio of D2D orthogonal multiplexing and the conventional cellular communication mode are compared.

3) Because of the reduction in information, different information resources are divided up for customers with different signals, and the corresponding resources are also matched to the situation.

In order to match the user with the right resources, the ratio between the two is adjusted, the throughput in the system is compromised and also the situation of the network site needs to be considered comprehensively, so that the best signal is finally delivered to the customer. In the M group of D2D users, when user z communicates in two ways, its signal-to-noise ratio is:

$$r_{ded,ik} = \frac{P_{d,ik} G_{dd,ik}}{N_0} \tag{8}$$

$$r_{cell,ikk^*} = min\{r_{up,ik}, r_{down,ik}\} \tag{9}$$

Here, k and k^* represent the user's channel resources assigned to the downlink on cellular. $r_{ded,ik}$ and r_{cell,ikk^*} represent the optimal signal-to-noise output of user i in different modes.

The optimal throughput of D2D user z in the corresponding mode is obtained from the relevant formula theorem in the case of optimal channel resources and signal-to-noise ratio.

$$c_{ded,ik} = Blog_2(1 + r_{ded,ik}) \tag{10}$$

$$c_{cell,ikk^*} = 2Blog_2(1 + r_{cell,ikk^*}) \tag{11}$$

These two formulas show the transmission bandwidth B in orthogonal mode and cellular mode under optimal resource allocation, respectively. The integer linear optimization problem with the goal of maximizing system throughput can be expressed as:

$$\mathrm{J} = \max \sum_{\mathrm{i}-1}^{\mathrm{M}} \sum_{\mathrm{k}-1}^{\mathrm{K}} \mathrm{y_i x_{ir}} c_{ded,ik} + 2(1 - \mathrm{y_i}) \mathrm{x_{ik,k^*}} c_{cell,ikk^*} \tag{12}$$

$$\mathrm{s.t.} \sum_{\mathrm{k}-1}^{\mathrm{K}} \mathrm{x_{ir}} \leq 1 \tag{13}$$

When y_i=1, it means to communicate in the normal way. When y_i=0, it means to communicate in cellular mode. The Formula 12 satisfies the restriction of Formula 13. $\mathrm{x_{ik}}$ and $\mathrm{x_{ik,k^*}}$ represent D2D users communicating using resource k or k^* in orthogonal mode and cellular mode, respectively. y_i represents the communication method between the D2D user and i. In different modes, it has the best channel resource k. While ensuring service quality and service effect, it can also provide greater throughput. Therefore, y_i, and $\mathrm{x_{ik}}$ or $\mathrm{x_{ik,k^*}}$ refer to the optimal way to decide and allocate channel resources under the condition of meeting the maximum throughput.

4. Comprehensive Comparison of the Two Modes

In this paper, the simulation is carried out on the computer through the information management system, and the questionnaires are carried out on the local users under different usage patterns. The number of questionnaires is three times, and users' satisfaction with these two modes is collected. The signal-to-noise ratio and throughput, as well as the number of users in both modes, can be obtained from the simulation data on the computer. The main parameters in this paper are shown in Table 2:

Table 2: Main parameters of the system

parameter	Numerical value
geographical radius	1000m
D2D User Radius	20-50m
Road loss from terminal to station	256+36 lgdkm
path loss between terminals	196+38 lgdkm
D2D users	40
bandwidth	180KHz
noise power	-168dBm/Hz

Figure 6 shows the signal-to-noise ratio of D2D for cellular communication in traditional mode (denoted by C in the figure) and 5G communication (denoted by G). Through multiple simulations of users, it can be seen from the figure that the signal-to-noise ratio in the 5G communication mode is relatively low, and the signal-to-noise ratio in the traditional cellular mode is relatively high. And the specific distance between users is between 20-50 meters. The distance will also be changed accordingly. The signal-to-noise ratio will also be affected. Only simple channel resources are needed in 5G communication, which saves many channel resources compared to cellular mode.

The simulation survey was carried out in different time periods in a place with a radius of 1km, and there are also obvious differences in the number of users in the two modes, as shown in Figure 7. The number under 5G communication was investigated 3 times. The average number of users using 5G communication is 85, 98 and 87. The numbers using traditional cellular mode are 56, 58, 63 households. The number of users increased by nearly 50% in traditional cellular mode. It also shows that under 5G communication, the visual communication design will be more in line with users and users will be more trustworthy.

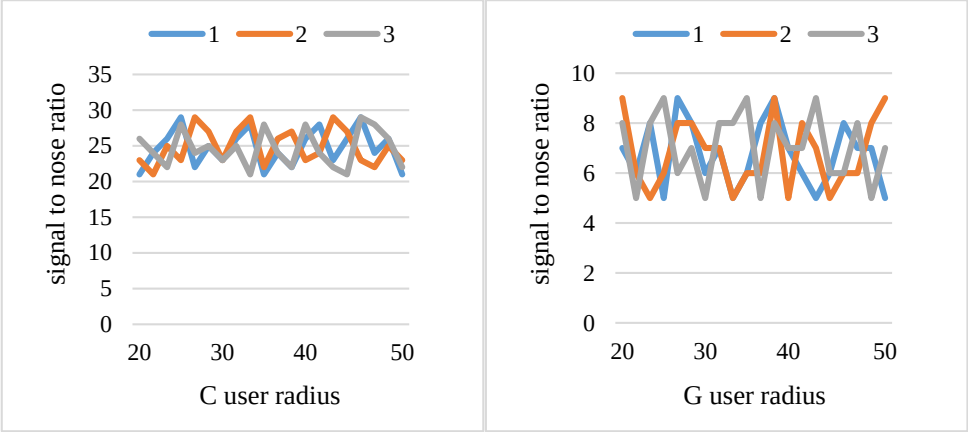

Figure 6: Signal-to-noise comparison diagram

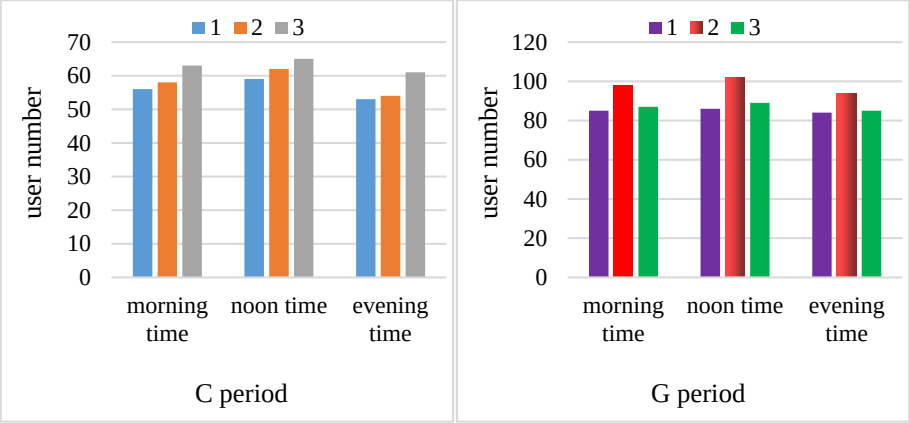

Figure 7: Comparison of the number of users

Figure 8 shows the throughput comparison of the two modes. It can be seen from the comparison chart that the throughput under 5G communication is more than that of the traditional mode. Throughput is related to communication quality and utilization. The higher the throughput, the better the wireless communication quality. 5G communication is a good complement to the shortcomings of the traditional mode.

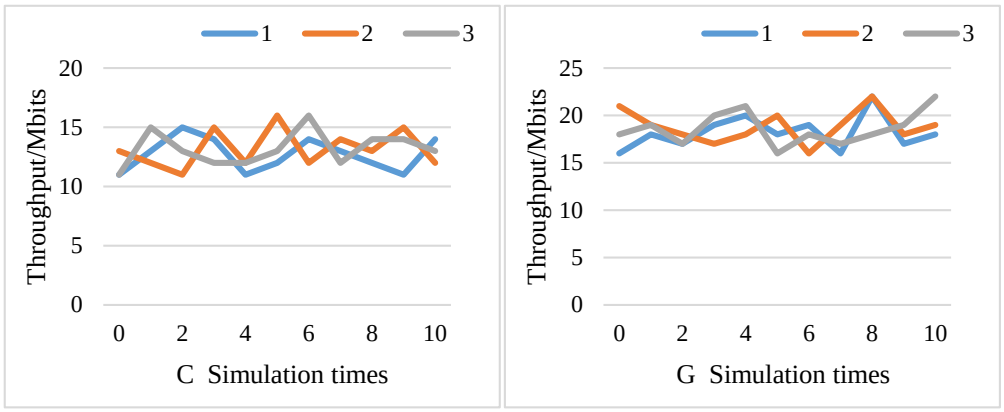

Figure 8: Throughput comparison

According to the questionnaire survey of the area with a radius of 1km, an analysis is carried out on the satisfaction of the surrounding users in these two modes. In this paper, the satisfaction comparison chart of the two modes is obtained mainly through the questionnaire of 100 users. As shown in Figure 9.

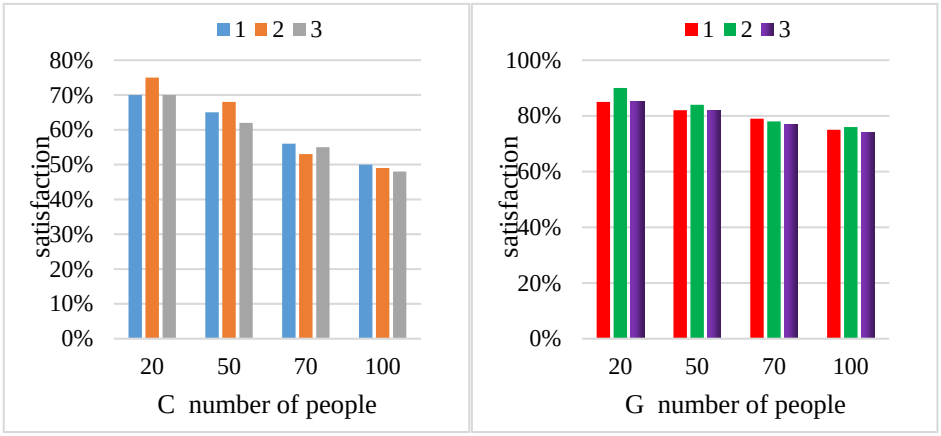

Figure 9: Satisfaction Comparison

Through the comparison of the two groups of questionnaire data, it can be found that in the traditional mode of cellular communication, the satisfaction rate reaches 75% when the number of questionnaires is small. However, with the increase of the number of questionnaires, the satisfaction is in a downward trend, and the downward trend is relatively large. Finally, out of 100 people, the satisfaction rate was 50%. In the case of user satisfaction under 5G communication, the satisfaction rate under the initial population base reached 85%. As the base increases, although satisfaction has declined, the trend is not obvious. The final satisfaction reached 75%. Compared with the user satisfaction under the traditional cellular mode, the user experience under 5G communication is significantly improved by 25%. This also shows that in the modern communication situation, the visual communication design will also be more satisfactory.

5. Conclusion

This paper mainly compared the visual communication design with the traditional visual communication design under 5G communication. By establishing an information management system, the technology under the communication network was explained. Signal-to-noise ratio, throughput, number of users, and user satisfaction were analyzed. Judgment was made after collecting and arranging the information. In this paper, the characteristics of 5G communication network and visual communication design were explained, and the application of current

communication technology in visual communication and the key technologies used in current communication were supplemented. In this paper, D2D technology and traditional cellular technology were mainly compared. By modeling the D2D system, the data was analyzed and processed. Finally, it is concluded that under the 5G communication network, the visual communication design will be more satisfactory. There have also been greater progress in image analysis and data processing. The styles of visual communication will also become more diverse and better meet people's various needs. The inadequacy of this paper is that all three methods under D2D are not described in detail. Over time, these technologies will also be used. And there is no full description of the communication technology, only a few key points are said.

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