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INTEGRATIVE DEVELOPMENT OF RESEARCH TRAVEL AND CULTURAL HERITAGE PROTECTION BASED ON 5G COMMUNICATION AND MOBILE BASE STATION FROM THE PERSPECTIVE OF GEOGRAPHY – TAKING LUSHAN WORLD GEOPARK AS AN EXAMPLE

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Abstract. Energy efficiency is one of the important issues that must be taken into consideration at the beginning of 5G communication design; in this study, the base station energy consumption model is selected for subsequent network energy efficiency assessment. With the increasingly strict requirements for base station antennas, the design of base station antenna units has been put forward with higher requirements. This thesis tracks the latest research advances in 5G communication requirements and key technologies from various research organizations at home and abroad. The world cultural heritage research trip integrates cultural heritage with heritage tourism and youth heritage education in the present environment of the merger of culture and tourism. The interpretation and presentation of legacy, as exemplified by Mount Lushan World Geopark, serves to communicate to the general public the significance of heritage. According to this study, heritage education is an activity that management agencies, research institutes, and local community members arrange either alone or in collaboration with other tourism and educational institutions with the goal of raising public awareness of heritage and educating people about heritage through research excursions. This document outlines this idea and lists the organizers, research objectives, range of activities, and learning materials for cultural heritage research excursions. The optimized MIMO-D2D system model is demonstrated to be effective in Lushan World Geopark by the experimental findings. This report suggests five strategies and actions for cutting-edge study abroad programs and the preservation of China's intangible cultural heritage.

Key words: 5G communication; Mobile base station; Research travel; Cultural heritage protection; MIMO-D2D system model optimization

1. Introduction. Intangible heritage is a precious historical heritage of mankind [1]-[2]. As a precious memory of traditional culture, intangible cultural heritage has special value for human existence and development [3]-[4]. Looking at both the inside and the outside, harmonious culture must depend on excellent traditional culture, which is the foundation and root of the construction of a harmonious society and a harmonious culture in China. World cultural heritage research and study tours help young people better understand the world cultural heritage. China is a treasure in the history of human culture and a reflection of the culture with national characteristics [5]-[6]. Social harmony is not only the goal that humans pursue together, but also the guarantee for sustainable development of human society [7]-[8].

Promoting young people's awareness of world heritage is the goal of both UNESCO's World Heritage Youth Education and the World Heritage Center's World Heritage Education Program, which was established in 1994. Taking Mount Lushan World Geopark as an example, research trips can be employed as a new form of world heritage teaching activities. One of the best methods to combine tourism and culture is through study travel, and a well-liked tourist destination is World Heritage [9]-[10]. Thus, the focus of this book is the practice of study travel, or the merging of tourism, education, and cultural heritage. It makes cultural heritage conservation, heritage tourism, and worldwide youth heritage education easier [11].

Examine the device's current condition to determine whether it is normal. Then, use parameter settings to suitably adjust the network status to enhance service performance and guarantee [13]. Control is based on monitoring, and monitoring is the basis of control. Consequently, WinForm-based mobile base station device management and management, together with other relevant technologies, can be used to achieve device management and detection [14]. Its main job is to collect operational parameters and status data from various network nodes and devices and deliver it to the mobile base station's device administrator in an understandable

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visual format. Simultaneously, the mobile base station operator or equipment administrator transmits control instructions to the network's devices to establish configuration parameters, carry out network monitoring and configuration tasks, and guarantee that the devices function as needed. Differential protection for distribution networks is one of them. The three 5G communication slice network application scenarios all have fairly consistent uRLLC. Large coverage eliminates the need for new line construction, which contrasts sharply with optical fiber's high laying cost [15].

Research on research travel focuses on geographical research, research policy analysis, regional research practice[16]. Whether it is cultural heritage or research travel, the academic research perspective is increasingly rich. Some scholars have proposed to carry out research travel activities for primary and secondary school students relying on regional cultural resources[17]. Taking the Lushan World Geopark as an example, some scholars have begun to discuss the application [18]. This study fully considers the multiple cultural heritage resources in the study area, as well as the supporting research tutors, transportation conditions, regional development level and other auxiliary factors to carry out research travel, so as to enrich the theoretical research perspectives and ideas of cultural heritage and research travel [19]-[20].

2. Comparing and analyzing many cases. We will compare a number of cases from different geographic or cultural contexts to improve the generalizability of the conclusions in this research. These examples include research on the Grand Canal's cultural legacy, Wuqiao's acrobatics, and Qingxian's martial arts. We can better examine the universality of fusing study tours with cultural heritage by looking at these situations.

2.1. Examining the Grand Canal's Cultural Legacy. The Grand Canal, which connected Beijing and Hangzhou and included a rich cultural legacy along its course, was a significant water conservation project in ancient China. Work together with regional administrations to create a guideline for educational excursions centered around Grand Canal culture. Programs for design studies that address the canal's engineering technology, history, and culture. Provide boats and additional modes of transportation, as well as qualified guides and interpreters. However, planning transportation is challenging due to the Grand Canal's geographic expanse. Study visits are divided into portions, and to increase productivity, contemporary transportation is employed.

2.2. Wuqiao Acrobatics Research. Wuqiao has a rich cultural history in acrobatics and is the home of Chinese acrobatics. Create regulations to safeguard and advance the culture of acrobatics. Create a curriculum that incorporates historical explanations of acrobatics, practice sessions, and performances. Provide performance spaces, practice equipment, and acrobatic study bases. But acrobatic instruction needs expert supervision, and safety concerns are common. To guarantee safety, employ qualified coaches and acrobats and closely oversee the training regimen.

2.3. Research on Martial Arts in Qing County. Qing County is rich in martial arts cultural materials and is considered one of the birthplaces of traditional Chinese martial arts. Work together with martial arts associations and the local government to create policies that will support martial arts culture. creating courses covering Wushu's history, fundamentals, and performance evaluation. establishing a camp for wushu research and training with the goal of offering qualified instructors and training supplies. Wushu training does, however, come with a danger of injury and demands a high level of physical condition. Provide medical staff and create a scientific training program that will guarantee a progressive increase in training intensity.

By comparing the aforementioned numerous cases, we are able to confirm the broad applicability of the study tours and cultural heritage combination as well as provide an overview of potential implementation challenges in various geographic and cultural contexts and their corresponding strategies for resolution. This will improve the findings' applicability and generalizability and serve as a useful guide for upcoming model replications in other areas. The research in this paper will be more broadly relevant by including these case studies from various geographic and cultural contexts. Additionally, readers will be provided with the problems that may arise in practice and their resolution solutions.

3. MIMO-D2D system model optimization. When there are MIMO system, the signal can be expressed as:

$$y_k = H_k v_k s_k + \sum_{i=1, i\neq k} H_k v_{S_i} s_i + \eta_k, k = 1, 2, \ldots, K \tag{3.1}$$

where y_k is the received signal vector, H_k is the channel gain matrix, V_k is the transmit signal vector, s_i is the noise vector.

Compared with ZF precoder, the algorithm has higher complexity. According to the minimum mean square error theory, the target user's precoding matrix can be obtained:

$$v^{opt} = \arg\min E\left[\|s - s\|_F^2\right] = \arg\min E\left[\left\|s - \frac{1}{\beta}(Hvs + \eta)\right\|_F^2\right] E\left[ss^H\right] = NT\sigma^2 \tag{3.2}$$

where v^{opt} is the precoding matrix, Hvs is the conjugate transpose of s, $NT\sigma^2$ is the noise variance, and F is the unit matrix.

The path loss can be described by mathematical expression:

$$P_r(d) = \frac{P_t G_t G_t \lambda^2}{(4\pi)^2 d^2 L} \tag{3.3}$$

ZF and MMSE precoding schemes have certain restrictions on the number of antennas at the receiver and transmitter. In contrast, the maximum SLNR based scheme has no limit on the number of antennas and is not limited by the application scenarios. Its basic idea is to maximize the ratio leaked to other users and channel noise power, so as to enhance the target signal while weakening the signal leaked to other users. The formula of signal-to-noise ratio can be expressed as:

$$\mathrm{SLNR}_k = \frac{\|H_k v_k\|_F^2}{\sum_{i=1,i=k}^{K} \|H_i v_k\|_F^2 + \sigma^2} \tag{3.4}$$

4. Methods.

4.1. Data selection. With Lushan Mountain accounting for 18. the total number of mountains in the region is 100.The Ministry of Culture and Tourism has named five batches of national intangible cultural heritage representative project inheritors, with 15 people in Lushan Mountain; Hebei Provincial People's Government has released 6 groups of provincial intangible cultural heritage lists, with Lushan Mountain accounting for 102 items. There are 117 individuals (alive) in Lushan Mountain among the five groups of representative inheritors of the province's intangible cultural assets that have been disclosed by the Department of Culture and Tourism. The Lushan area's intangible cultural heritage resources are abundant in variety and number, particularly when it comes to the categories that are part of provincial initiatives, as indicated by the statistical results presented in Table 4.1. The variety of intangible cultural heritage project types is highlighted by the seven study topics, which span more than five categories. Tangible space resources of cultural heritage research resources include cultural relics protection units, patriotic education bases, red tourism classic scenic locations, research practice bases, and A-level scenic spots. These tangible spaces already have the necessary infrastructure, which can meet the basic conditions for carrying out research travel, greatly reduce the difficulty of developing research travel, save human, material and financial resources.

It is worth mentioning that Lushan, as the city with the longest mileage in the cities that the Beijing Hangzhou Grand Canal flows through, has a high historical status and research value. Because it has certain tangible space, taking Lushan World Geopark as an example, it is classified as tangible space resources in this study, further enriching the types of tangible space resources in Lushan area. As Table 4.1 for their differences.

The buffer zone and protection barrier established by the World Cultural Heritage are not the extent of the research trip's operations. The division of administrative regions will not limit the scope of the world cultural heritage research trip's operations to the cultural region in which it is located. The concept and content of the activity, which is often linear and has a clear tourism route planning, define the extent of the World Cultural Heritage study trip. In essence, MIMO technology is a mathematical abstraction of a multi-antenna mobile communication system. Multipath effect has historically been a negative issue impacting system performance in communication systems. The difference is that in MIMO systems, multipath becomes a favorable factor. It can obtain multiple data stream gains between devices, making information transmission more accurate. The MIMO system can be shown in Fig. 4.1- taking the Lushan World Geopark as an example.

Table 4.1: Comparison of Short Range 5G Communication Technologies.

Parameter name	Wi-Fi Direct	Bluetooth 4.0	D2D
Standard	802.11	Bluetooth SIG	3GPP;LTE- Advanced
Frequency band	2.4GHZ	2.4 GHZ	Authorized frequency band
Frequency band	5 GHZ	2.4 GHZ	Authorized frequency band
Maximum data rate	250Mb/s	1 Mb/s	1Gb/s
Maximum transmission distance	200M	10-100m	10-1000m
Device Discovery	ID broadcast	Manual pairing	Base Station Collaboration
Device Discovery	Embedded Soft Access Point	Manual pairing	Base Station Collaboration
Application	File sharing	Peripheral equipment	File sharing; Local video; Public safety; Cell relay
Application	Device connection	Discover Connections	File sharing; Local video; Public safety; Cell relay
Application	Group competition	File transfer	File sharing; Local video; Public safety; Cell relay

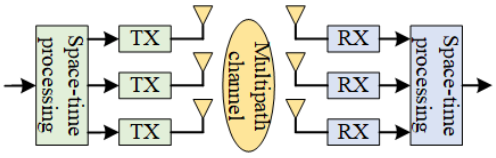

Fig. 4.1: Schematic Diagram of MIMO System.

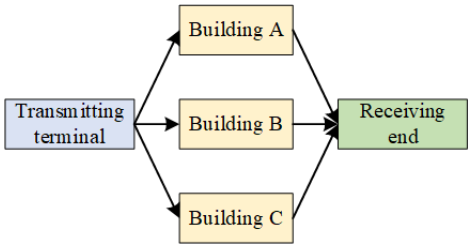

Fig. 4.2: Multipath Effect of Cultural Heritage Protection.

The wireless channel has the characteristics of multi-path effect, fading and Doppler effect. The result of multi-path effect is that the original signal is distorted or even wrong. The main reason is that the transmitter signal arrives at the receiver through different paths in the channel. Because the time of arrival at the receiver is different, the signal phases of each path overlap during signal synthesis. The process of multipath effect is shown in Fig. 4.2.

Understanding the world heritage and the need to safeguard it is one of the key goals of the World Cultural Heritage Study Tour. Recognize the nature, traits, importance, and background of the world; Recognize the world's knowledge, the veracity and historical information conveyed by cultural heritage, and the height at which it reflects as the primary subject. We can further study cultural heritage in the domains of art, history, society, and science by using actual data on the global cultural heritage. The learning content includes knowledge about art, archaeology, ancient architecture, religion, nature, and science. World cultural heritage research travel can meet the trainees' needs for experience and experience of culture and heritage, provide high-quality information for trainees, and meet their spiritual needs. In the end, students can obtain a valuable, satisfactory and pleasant experience. Fig. 4.3 shows the system model of MIMO-D2D. The transmitted signal of the cellular user through the multipath channel gain, and the D2D communication signal can also be more accurately transmitted to the

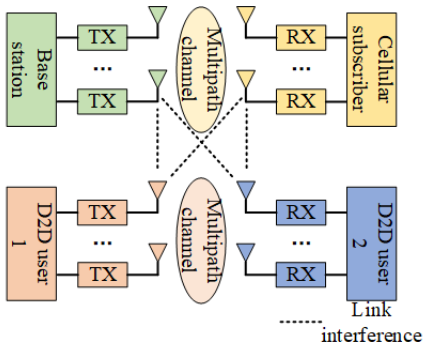

Fig. 4.3: MIMO-D2D system communication model optimization.

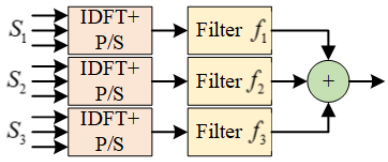

Fig. 4.4: UFMC System Model Optimization.

target D2D user.

4.2. Research assumptions. The current distribution network protection mostly adopts simple over-current and over-voltage protection methods, which do not need communication channels and cannot achieve sectional isolation, resulting in a large power failure range and difficult recovery after failure. Distribution network communication points are wide and highly dispersed. If optical fiber is used in a large area, the cost will increase dramatically. While wireless communication is fast deployed, widely covered and easy to be modified, 5G communication is fully feasible as a differential protection channel. Fig. 4.4 shows the entire bandwidth contains M subcarriers and is divided into B subcarriers, each subcarrier is composed of m subcarriers.

Intangible cultural heritage reflects a country's or a nation's self-identity and the extent to which it is recognized by the world. It is a key link to maintain a nation's or group's civilization. However, if we really want to turn various protection declarations and regulations into practical actions and make them have obvious effects, we can never easily achieve them. If we fail to achieve scientific, planned, up-to-date and sustainable protection, we may get twice the result with half the effort, hinder or even destroy these cultural treasures that we have inherited for several years. The simulation environment is completed in MATLAB, and the number of simulation experiments is 10000, as is shown in Table 4.2.

The main optimization points of balanced throughput in high throughput and low algorithm complexity, but they ignore the poor performance of large equipment connectivity in the 5G era, that is, the poor performance of system connectivity probability. The method of resource allocation algorithm based on power adjustment are given,as is shown in Fig. 4.5.

5. Simulation Result Analysis. The simulation scenario is that D2D users selectively reuse uplink resources of cellular users in a single LTE cell with a radius of 1km. The main simulation parameter settings are shown in Table 5.1. By comparing the proposed resource allocation (TPRA) method with the random resource allocation (RRA) method and the resource allocation (RCRA) method considering the D2D rate, the system throughput and power allocation under different algorithms are mainly compared.

Utilizing the cultural heritage resources of Mount Lushan area to create an atmosphere of study and travel, and to create a new business card of Mount Lushan in culture, education and tourism. Through the development

Table 4.2: Simulation Parameter Setting.

Parameter	Parameter value
Cell radius R/m	$10 < R < 500$
D2D pair distanceR_d/m	$10 < R_d < 25$
Number of simulations/time	10000
System bandwidth B/MHz	100
Carrier frequencyf_c /GHz	5.0
Noise power N/dBm	-112
Maximum transmission power of cellular users/dBm	26
Minimum SNR/dBm for cellular users	12
D2D user minimum signal-to-noise ratio/dBm	7
Path loss between any communication terminals	$22\log_{10}(d)$+44.4, 10<d<410;$40\log_{10}(d)$ +87.7, 410<d<500

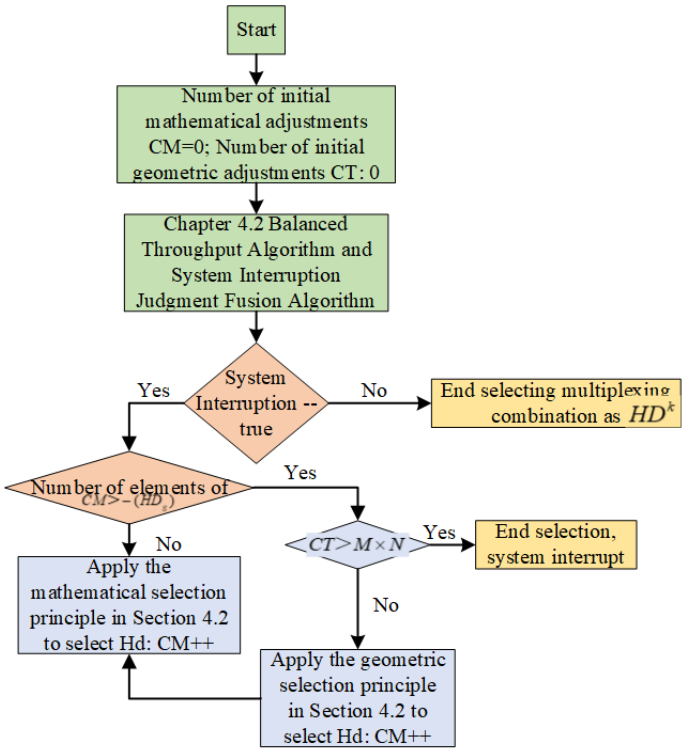

Fig. 4.5: Optimization flow chart of channel allocation algorithm based on 5G communication power adjustment management model and sub model.

and improvement of all kinds of study projects, improve the visibility of study, gradually expand the influence of Mount Lushan, the formation of Mount Lushan area unique study brand, and in the canal research, Wuqiao acrobatics research, Qingxian Wushu research and other outstanding areas of cultural heritage research IP, centered on the urban area of Mount Lushan. Ultimately, through the "tourism + education" form of study tours, the inheritance and development of values, while cultivating local primary and secondary school students' national sentiment, traditional culture and values education, and enhance cultural self-confidence - Lushan World Geopark as an example. Fig. 12 compares the CDF distribution of system throughput under the two algorithms.RRA is significantly lower than TPRA because the RRA algorithm fails to reasonably allocate the

Table 5.1: Simulation Parameter Setting of Mobile Base Station.

Parameter	Parameter value
Cell radius/km	1
Short distance communication distance/m	25 50
Bandwidth of one RB/kHz	180
RB quantity/piece	50
BTS transmission power/dBm	44
Cellular subscriber transmission power/dBm	25
Road loss/dB	$35.26+35\ \log_{10}(d)$
Number of D2D users	1 30
D2D maximum transmission power/dBm	25
Targetλ /dB	15
Gaussian white noise density/dB/Hz	-172
Iterations	32

resources of primary and secondary users, and the interference between primary and secondary users is not effectively controlled.

The TPRA (Throughput Prioritized Resource Allocation) algorithm aims at resource allocation by prioritizing system throughput. Although TPRA performs well in improving system throughput, its complexity is mainly due to the following aspects:

1. Computational complexity: TPRA must determine each user's priority inside each time slot and allocate resources according to these priorities. This calls for a lot of processing power, particularly when there are a lot of users.
2. Scheduling of Resources: For TPRA to guarantee that system throughput is optimal, resource allocation must be continuously monitored and adjusted. This puts a lot of pressure on network administration and control.

The following elements may have an impact on TPRA's real operational efficiency in large-scale networks:

1. Latency issue: In large-scale networks, TPRA latency may be considerable due to the requirement for intricate computations and real-time modifications, which can negatively impact user experience.
2. Hardware requirements: In order to guarantee that the algorithms can operate effectively, stronger hardware support is required due to the high computational demands of TPRA.
3. Scalability: While TPRA works well in small networks, as the number of users rises in large networks, its computational complexity and resource scheduling becomes more challenging, necessitating improvement to increase scalability.

Use the cultural heritage resources in Lushan area to create a research travel atmosphere, and create a new name card for Lushan in terms of culture, education, tourism, etc. Through the development and improvement of various research projects, we will improve the popularity of research, gradually expand the influence of Lushan , form a distinctive research brand in Lushan area, and create cultural heritage research IP in outstanding areas, such as Canal Research, acrobatics research in Wuqiao, martial arts research in Qingxian and other places with Lushan downtown as the center. Finally, we will inherit and carry forward the value in the form of "tourism + education" research travel, while cultivating the family and country feelings, traditional culture, values education of local primary and secondary students, and strengthening cultural self-confidence - take the Lushan World Geopark as an example. Fig. 5.1 compares the CDF distribution of system throughput under the two algorithms. RRA is significantly lower than that of TPRA. Because RRA algorithm does not allocate resources to primary and secondary users reasonably, the interference between primary and secondary users is not effectively controlled.

The overall path is to "issue standardized policies, formulate research plans", "focus on significant resources, customize research with characteristics", "focus on departmental linkage, improve research facilities", "integrate science and technology into tradition, and lead research through innovation". Then provide targeted research development path according to the above comprehensive potential index. When the signal-to-noise ratio in-

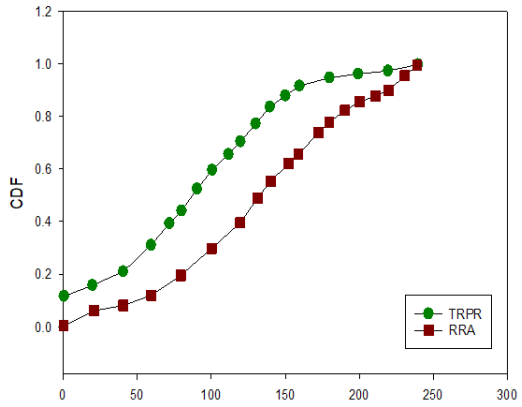

Fig. 5.1: System Throughput Comparison of Different Algorithms.

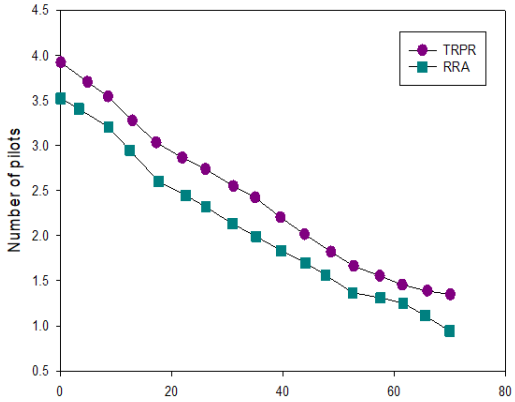

Fig. 5.2: Bit Error Rate of UFMC Constant SNR Compression Sensing Algorithm.

creases to a value that can be considered that the channel is distortion free and noise free, the reconstruction accuracy of the four algorithms is similar. At low SNR, RSAMP algorithm has the best performance, while OMP algorithm has the worst performance,as is shown in Fig. 5.2.

By prioritizing resource allocation to maximize system throughput, the TPRA algorithm efficiently enhances system performance. Regardless of the circumstance, the TPRA algorithm offers superior throughput, as evidenced by its higher and steady CDF curve.

Lower and unpredictable system throughput are the result of the RRA algorithm's inability to properly control inter-user interference because it distributes resources randomly. This suggests that in real-world applications, it is challenging to match the high throughput demand of the RRA algorithm.

Optimization based on the TPRA algorithm can be performed to further enhance system performance. This includes introducing an intelligent scheduling mechanism and a dynamic resource management strategy to increase the system's throughput and energy efficiency.

This thorough examination of Fig. 12 helps us to better understand the variations in system throughput under various algorithms as well as the direction of optimization, which serves as a crucial foundation for further study.

The higher the communication quality of high priority users. However, this algorithm will also have some impact on other low priority users. The more spectrum the mobile base station gets, the more obvious the

Table 5.2: Communication Rate of Low Priority Users under Different Spectrum Divisions.

Spectrum division (MHz)	$W_{MBS} = 2$, $W_{cf} = 18$	$W_{MBS} = 3$, $W_{cf} = 17$	$W_{MBS} = 4$, $W_{cf} = 16$	$W_{MBS} = 5$, $W_{cf} = 15$
Average rate of low priority users (Mbits/s)	24.1466	22.8047	21.4637	20.1222

impact will be, as shown in Table 5.2.

6. Conclusion. Higher technological demands are placed on base station antenna units due to the ever stricter regulations on base station antennas. This study traces the most recent developments in 5G communication requirements and essential technologies from both local and international research organizations in order to meet this background.

Research travel, especially when considering the integration of culture and tourism, integrates cultural heritage with heritage tourism and youth heritage education in terms of protecting cultural heritage. For instance, in the case of Mount Lushan World Geopark, the public is made aware of the significance of heritage through the interpretation and presentation of the site's legacy. The goal of heritage education and research tours is to increase public knowledge of heritage through the work of management agencies, research institutes, and members of the local community, either on their own or in conjunction with other tourism and education groups.

In general, research tours and studies on cultural heritage aid in the integration of tourism, education, and cultural heritage while providing young people with a deeper understanding of the world's cultural heritage. The study revealed that research trips were carried out with the assistance of local cultural resources, which enriched the theoretical research perspectives on research excursions and cultural heritage. Furthermore, the algorithm illustrates the benefits of system transmission performance under various SNR conditions by analyzing the UFMC constant SNR compression-aware algorithm. These benefits are particularly noteworthy in 5G and future wireless communication networks, as they offer high spectral efficiency and low bit error rate.

Data Availability. The experimental data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest. The authors declared that they have no conflicts of interest regarding this work.

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