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4G Mobile Network Planning in Seiyun City to Upgrade the Existed Networks

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***Abstract*—** This paper presents the results of a research effort on the present and future of the current government cellular communications network in the city of Seiyun in terms of coverage, signal strength, and service provided. In recent times, Seiyun city has experienced an increase in population, a reduction in network coverage, and insufficient capacity from corporate stations to service certain areas. Many 4G stations have been planned and established in Seiyun as a result of the growing demand for mobile data consumption brought on by new applications like video chats, live streaming of sporting events, faster online browsing, and other heavily streamed material. The goal of the fourth generation of radio technologies, or 4G, is to increase speed and capacity. It can handle broader channels up to 20 MHz, shorter transmission times, and better wireless access technologies. For this research, we have designed a 4G network that will be established over the course of the next ten years, and even beyond. Furthermore, this research has involved comparing the signal levels and throughput values of our network, which covers the entire city of Seiyun, with current networks.

***Keywords*—**4G Network, 4G coverage, Network planning, throughput.

I. INTRODUCTION

We currently live under the shadow of a massive revolution that is distinct from the revolutions that came before it in terms of its breadth of effect and its ties to numerous facets of public life [1]. Communication systems have become essential to the operations of both individuals and institutions, to the point where a network outage lowers the quality of service offered [2]. The city of Seiyun has experienced a decline in service and a weakening of the signal as a result of the considerable rise in mobile phone users over time. Traditional mobile phones have rapidly shifted from being used just for voice conversations to being used for data usage, including file sharing, streaming the internet, and other activities.

The main motivation for this research was to conduct a survey and evaluation of the performance of the current mobile phone network in the city of Seiyun in terms of coverage, signal strength, and quality of service provided. Accordingly, it is proposed to update the network by introducing the fourth generation network and to provide an integrated vision of the fourth generation network in terms of the number of base stations and their locations to ensure full coverage of the city using the Atoll simulation program. In many cases, this traffic has already surpassed audio calls. The polytheists hope to offer a wide range of services, fast loading and download times, large data capacities, and affordable data delivery to expanding markets. The aspirations of the subscribers together resulted in the reinforcement and advancement of the wireless communication infrastructure [3][4]. According to this study on 3G (the third generation), the introduction of new mobile network technology does not imply the discontinuation of older ones. We refer to it as 3G. The emergence of 3G marks the start of mobile cellular communication technologies that provide simultaneous data and voice transmission. It is a direct advancement of GSM technology and enables connection speeds ranging from 384 kilobits per second to 2 megabits per second[5][6]. Because CBD is a wider bandwidth system (up to 20MHz), it allows it to deliver data at very fast transmission speeds.

II. RELATED WORK

A similar research was done in [7]. The LTE Radio network planning which involved coverage estimation and capacity evaluation was presented. In this project the coverage estimation is done with consideration of the real environment information at its nominal stage to obtain better estimations. The research's main goals were to describe the pertinent LTE features, provide the fundamental models for radio propagation planning, and calculate the number of network elements and coverage. In this case, link level simulator—which provides the special ability to employ both predictions and real-time network data throughout the network planning and optimization process—was used in accordance with the normal radio network planning technique.

In [8] a research was done for LTE network planning. This work includes a thorough capacity and coverage analysis of the LTE radio network in order to develop radio planning guidelines that take into account potential network implementation in Khartoum city's density. It has been determined that the three elements of an LTE network—coverage, capacity, and quality—are critical to its success. The evaluation of dropped calls and congestion that has been eliminated through appropriate optimization is the basis of capacity. Eliminating influence from internal and external sources has enhanced quality. Atoll is using the digitized map of Khartoum as an input for the radio planning step. In-depth Atoll simulations with coverage forecasts and traffic simulations have been performed on the Khartoum digital map. Once more, a point analysis tool.

III. PLANNING STAGES

When creating and deploying wireless communication networks, including 4G mobile phone networks, radio planning is a crucial step in the process. The goal of radio planning is to optimize the wireless network's performance and coverage.

The steps involved in radio planning for an 4G network are as follows:
Site evaluation: A thorough examination is carried out for the location that the network is meant to cover. This entails researching the topography, adjacent structures, buildings, and other obstructions that may have an impact on signal delivery [9].

Strategic tower placement: Appropriate sites for communication tower and antenna installations are identified. These sites were selected taking into account the topography, buildings, population distribution, and required coverage [10].

Wireless coverage analysis: To evaluate coverage in the target area and study signal distribution, specialized instruments and software are employed. It is decided what the expected signal levels and ideal signal strength are in certain places [11].

Capacity planning: The amount of traffic that is anticipated, the number of users, and the various applications are used to establish the network's capacity requirements. To accommodate the anticipated demand, the number of base stations is decided upon and dispersed accordingly[12].

Channel and frequency assignment: The frequency bands that are available are identified and distributed among the base stations. Based on the anticipated capacity and service requirements, the necessary channels and frequency assignments are decided [13].

Performance optimization: To enhance network performance, radio parameters are changed. In order to improve service quality and network capacity, this involves modifying the transmission timing and strength as well as applying strategies like Coordinated Multipoint (CoMP) and Multiple-Input Multiple-Output (MIMO) [14].

Verification and analysis: To confirm the network's functionality and service quality, field testing are carried out. This include assessing network performance parameters and monitoring signal strength, coverage, and data throughput.

IV. SYSTEM DESIGN

The approach proposed in this paper was created using the Atoll software. First, the 11 base stations that currently operate in Seiyun City and its surrounding area were planned for using a simulation. Following this, a new design based on the proposed base station palling was established in order to overcome the current coverage signal. Figure 1 shows the main Atoll interface.

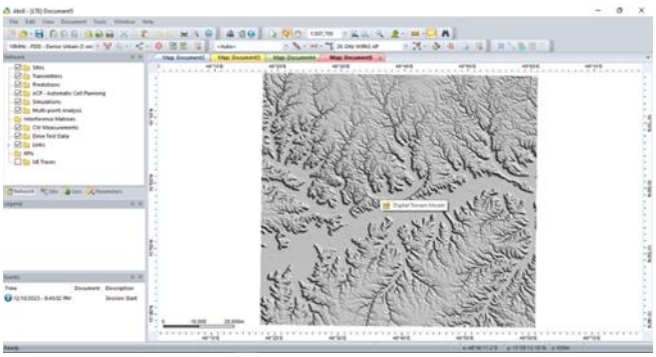

Fig.1 Display simulation template in atoll.

The parameters setting for the designed system in Atoll software displayed in table I.

Table.1. COMPARE BETWEEN NETWORKS

Name Network	4G	4G Project
Number Stations	12	44
Band	1800 MHz	1800 MHz
Band Width	20 MHz	10 MHz
Type of Jumper Used	7/8 at 1800 MHz	1/5/8 at 1800 MHz
TMA	x	✓
Number of RRU	3 Per Station	3 Or 6 Per Station
MIMO	4×4 or 2×2	4×4 or 2×2
Repeater Used	x	✓
Diversity Used	✓	✓
Number of Sector Per Site	3	2 or 3 or 4

V. RESULT AND DISCUSSION

Seiyun and surround area are in great depth about those findings. The gathered information was thoroughly researched and reviewed in order to determine the most

important variables influencing network performance and coverage as well as ways to enhance the services offered to residents of cities. There are no issues with delivery or the reasonable charge at the telecom firm because the stations are dispersed throughout Seiyun City and the distance between two of them is at least 500 meters.

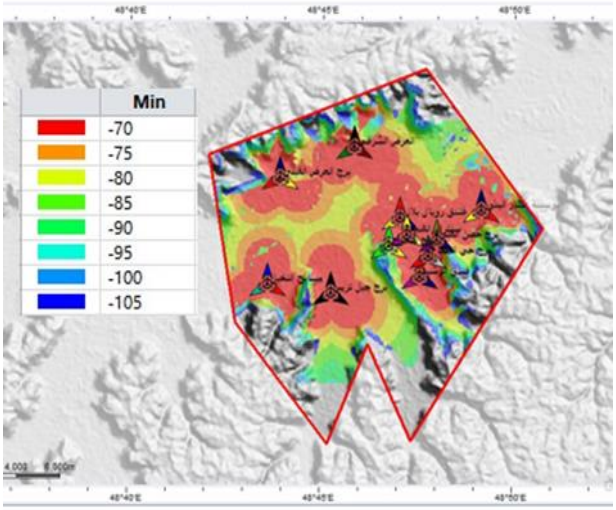

Fig.2 Simulating of the current coverage based on the signal level for the city of Seiyun

The planning coverage of base stations in Seiyun City and its environs is depicted in Fig. 2. It is evident that the designated signal is not fully covered by the signal; certain areas are partially covered and certain areas have a weak signal that is colored yellow. As a result, in order to obtain enough coverage, base stations must be rebuilt and expanded. It should be mentioned that allowed individuals there have the position for the current station token

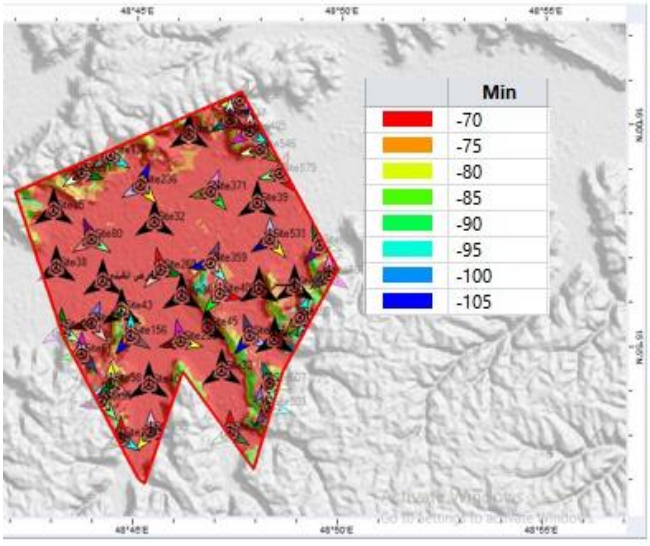

Fig.3 Simulating coverage for our proposed planning based on the signal level in Seiyun city.

Fig. 3 illustrates the designated region covered with a strong signal; nearly all of it is colored red, signifying a stronger signal. Furthermore, it is evident that there are no covered areas other than a little area close to the mountain's edge. About 40 base stations are included in the proposed distribution plan for the entire region. Using the Attol software, the base stations are automatically distributed throughout the 3GGP propagation channel.

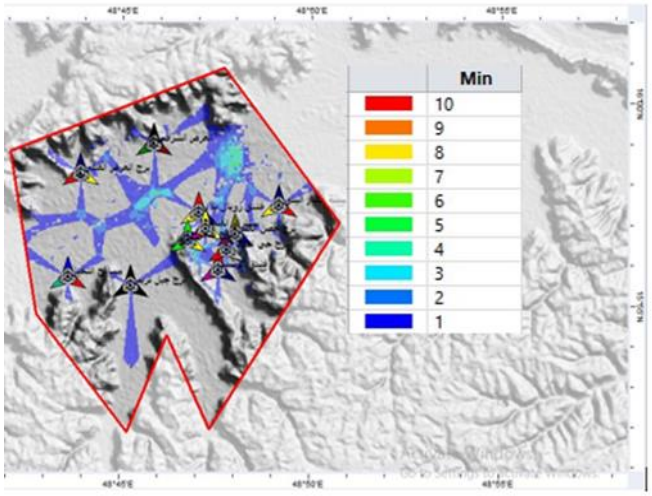

Fig.4 Simulating of the current signal interference for Seiyun city

Figure 4 shows the interference caused by this present station, which should be minimized because it causes lag in certain areas and affects signal strength.

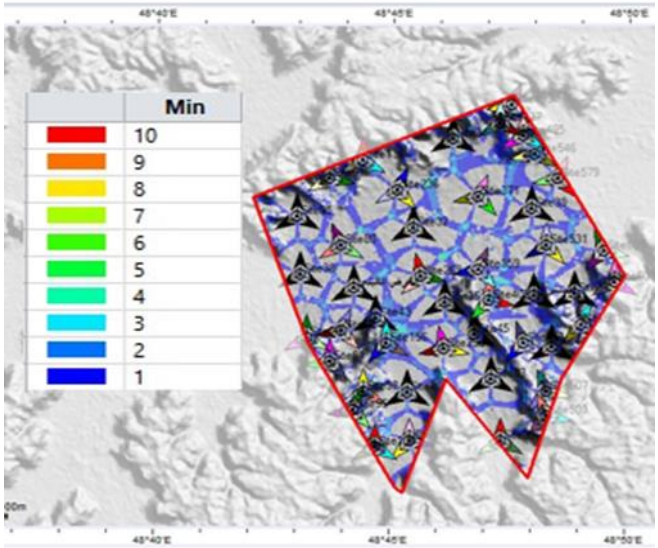

Fig. 5. Simulating signal interference for the proposed planning in Seiyun city.

Interference is taken into consideration when planning a network's coverage. Fig.5 shows the interferences in the planned 4G network planning. The interference between base station coverage is shown as being minimal with a blue color, the lowest value in the figure. This serves as a sign of effective base station distribution and planning. Even with the minimal number of base stations, the existing distribution of base stations appears to be significantly more than the planned planning. This is illustrated in Fig. 6.

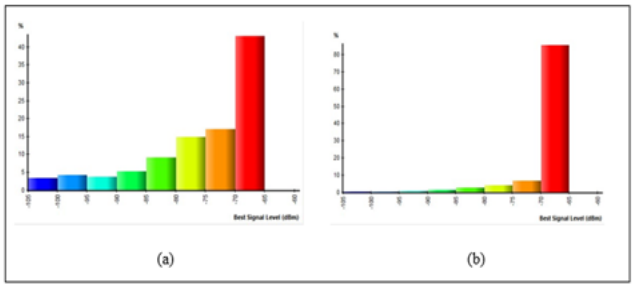

Fig. 6 Compare between networks of signals level for Seiyun area

Figure 6 shows the signal levels for the current and proposed signal plans. It is evident that the new plan has a very strong signal, almost red, and a small level with weaker signals, whereas the current situation has all colors appear, indicating that there are many areas covered by weak signals.

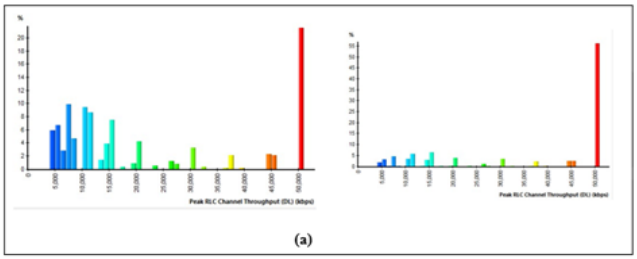

Fig. 7 Compare between Throughputs of networks of DL for Seiyun area

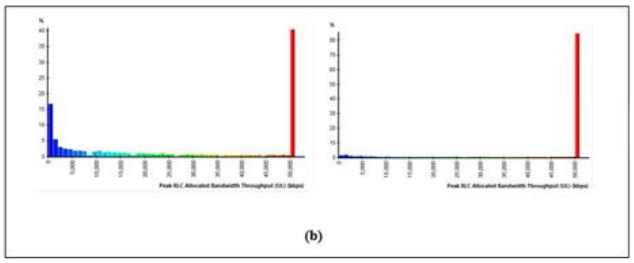

Fig. 8 Compare between Throughputs of networks for UL in Seiyun area

Fig. 7 and 8 show the network throughput for both upload and download. The higher throughput achieved from the proposed planning coverage is evident from the fact that the majority of the covered area has a high throughput, indicated by the red color. In contrast, less throughput is visible in the exciting planning, and the upload throughput has lower values than the download throughput.

VI. CONCLUSION

Using the Atool simulation program, we infer from the 4G network design project for the city of Seiyun the significance of combining cutting-edge technology with meticulous planning to satisfy the city's growing communication needs. The project's design produced a network that can offer all citizens quick and dependable communication services, with an emphasis on offering wide coverage and a fair distribution of network resources. In order to improve the project's performance and lower infrastructure and maintenance costs, simulation was essential in anticipating problems and resolving them before the implementation phase.

The simulation's favorable results demonstrate that the proposed network will provide exceptional performance and an enhanced user experience. This project strengthens Seiyun's reputation as a center of cutting-edge technology and is a big step toward embracing new communication technologies. The study can also be used as a model for successful planning based on pragmatic and scientific principles, and it can be a reference for initiatives of a similar nature in other cities.

The research concludes by highlighting the significance of communication networks' ongoing development and enhancement in accordance with the most recent international standards in order to ensure progress toward a prosperous digital future where everyone may take advantage of the newest and greatest services.

DATA AVAILABILITY

Not applicable

CONFLICT OF INTEREST

There exists no conflict of interest.

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AUTHOR'S CONTRIBUTION

Dr. K.S. Bin Sahaq offered guidance and technical writing assistance for this paper. His expertise and insights were essential to the project's success.

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