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Future Prospects of 5G and 6G Networks in Libya and comparison between them

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الآفاق المستقبلية لشبكات الجيل الخامس والجيل السادس في ليبيا والمقارنة بينهما

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Abstract:
We know that in Libya, all communication networks are still operating with fourth-generation networks, but it is imperative to move from the next-generation networks of the fifth-generation networks existing in several countries to the sixth-generation networks by 2029, due to its tremendous evolutionary leap in terms of speed of development and high speed that aims to achieve better performance and efficiency, faster data transfer and more efficient services than its predecessors from the current networks from 2 MHz to 1 terahertz. The use of broadband data has also increased at a very fast rate, and to keep pace with the latest future applications and the rapid development of technology, especially smart devices and machines, the system bandwidth has been widely increased, and in fifth-generation mobile phone networks, including the sixth generation, and solutions to problems in previous communication network technology have been found. This article briefly discusses the architectures of 5G and 6G networks, most notably the security associated with 5G and 6G networks and information protection, and the advantages of 5G and 6G networks as energy-efficient networks compared to previous networks, as 6G networks will provide data speeds of up to 1 Tbps and wide frequency ranges from 99 GHz to 2 THz and a bandwidth of 300 GHz, and we will also provide a comparison and also the main technological problems and areas of difference between 5G and 6G. 6G technology will also provide the needs and requirements of 3D communications, the hyper universe, and others in the future, and smart cities, and automated driving, whether in aviation, traffic, or remote control.

Keywords: 5G, 6G, Libya.

الملخص
نعلم أن جميع شبكات الاتصالات في ليبيا لا زالت تعمل بشبكات الجيل الرابع، ولكن من الضروري الانتقال الى شبكات الجيل القادم من شبكات الجيل الخامس الموجودة في عدة دول إلى شبكات الجيل السادس بحلول عام 2029، وذلك لما حققته من قفزة تكنلوجية هائلة من حيث سرعة التطور والسرعة العالية التي تهدف إلى تحقيق أداء وكفاءة أفضل ونقل بيانات أسرع وخدمات أكثر كفاءة من سابقاتها من الشبكات الحالية من 2 ميجا هرتز إلى 1 تيرا هرتز. كما زاد استخدام بيانات النطاق العريض بمعدل سريع للغاية، ولمواكبة أحدث التطبيقات المستقبلية والتطور السريع للتكنولوجيا، وخاصة الأجهزة والآلات الذكية، تم زيادة عرض النطاق الترددي للنظام على نطاق واسع، وفي شبكات الهاتف المحمول من الجيل الخامس، بما في ذلك الجيل السادس، تم إيجاد حلول لمشاكل في تكنولوجيا شبكات الاتصالات السابقة. حيث تتناول هذه الورقة بشكل مختصر بنية شبكات الجيل الخامس والسادس، وأبرزها الأمن المرتبط بشبكات الجيل الخامس والسادس وحماية المعلومات، ومزايا شبكات الجيل الخامس والسادس كشبكات موفرة للطاقة مقارنة بالشبكات السابقة، حيث ستوفر شبكات الجيل السادس سرعات بيانات تصل إلى 1 تيرابايت في الثانية ونطاقات تردد واسعة من 99 جيجاهرتز إلى 2 تيراهيرتز وعرض نطاق 300 جيجاهرتز، وسنقدم أيضًا مقارنة وأيضًا المشاكل التكنولوجية الرئيسية ومجالات الاختلاف بين الجيل الخامس والجيل السادس. كما ستوفر تقنية الجيل السادس احتياجات ومتطلبات اتصالات ثلاثية الأبعاد في المستقبل، وفي المدن الذكية والقيادة الآلية سواء في مجال الطيران أو المرور أو التحكم عن بعد ان شبكات الجيل السادس تستهدف

التحكم عن بعد في مجال الطائرات بدون طيار والقيادة الالية وفي مجال الطب في الجراحة عن بعد وكذلك ربط المدن والدول وأهمها الدكاء الاصطناعي والشؤون العسكرية والتي قد تصل سرعة نقل البيانات إلى صفر.

الكلمات المفتاحية: 5G، 6G، ليبيا.

Introduction

With the rapid development, the first reliance was on developing communication networks from the current third-generation networks to fourth-generation networks, and now the fifth-generation technology targets communication between machines and from there to sixth-generation networks shortly, from the Internet of Things AR on a large scale and augmented reality VR or virtual reality, and connecting things, cities and countries. The fifth-generation technology can also be used to achieve holography, unmanned driving, remote operation, and others. It has also achieved the connection between people and machines. The sixth generation technology will also push society towards a digital world that is a virtual and real twin. Every object and person in the real world will have a map or agent in the virtual world. In the virtual world, humans can simulate the operation of real society in order to make the necessary predictions and interventions in the future of the real world. What happens in the virtual world can directly affect the physical world, and can affect and touch behavior within the physical world. The goals of the sixth generation technology are mostly artificial intelligence (AI) and extended reality (XR), which combines virtual reality (VR), augmented reality (AR) and mixed reality (MR). However, although 6G technology will be very advanced, some people think that 5G technology is enough for humans and 6G technology is not necessary. There will also be a comparison to understand the difference between 5G and 6G in key performance indicators and technology.

This article emphasizes the necessity of transitioning in Libya from 4G technology to 6G technology without passing through 5G technology by analyzing the potential changes and benefits that 6G technology will bring to people's lives from an upward development. The research in this article enriches the relevant academic content to some extent, and provides a certain foundation for subsequent technology research. The problems of 5G networks are very complex, especially in maintenance. To solve these problems, many researchers have begun to find solutions to move to an advanced world at the speed of light, in this frightening progress that 6G networks will bring. This article introduces the features and requirements of 6G, the current technical challenges facing 5G, 6G network architecture, and the future 6G spectrum. In 5G networks, virtualization (NFV) and deterministic programming (SDN) technologies are used to achieve their goal. 5G is certainly faster than the current network in terms of data exchange and transmission speed, reaching 9 gigabits per second.

Architecture

5G is 99 times faster than 4G and 4G-LTE networks. 5G technology surpasses broadband networks (Internet of Things). Another important advantage of 5G technology is the latency of less than a millisecond (ms), which is almost zero. Unlike current Internet services (Internet of Things), it can connect devices, so a large ecosystem, "smart grids", can be created. 5G technology is expected to bring about huge changes in the energy industry. 5G is a deep and complex network, especially in its maintenance, as it focuses on improving the signal from interference and moving to small cells, so it was necessary to expand the frequency range above 9 GHz, which is represented in the equation from Chano's theory. One reason for changing to another range is the ease of the spectrum near millimetre signals, so 9 THz was chosen so that it would not be harmful to humans as in equation (1).

$$R = Blog2(1 + SINR) \qquad (1)$$

Lines are also best if you are a domain name operator.

The points that the domain is associated with in 5G networks.

It is associated with three:

- Enhanced Mobile Broadband (eMBB)
- Massive Machine-Type Communications (mMTC)
- Ultra-Reliable Low Latency Communications (URLLC)
- eMBB shows a very small improvement over the much better 6G network, which encourages its uptake.
- mMTC hints at the utility of a wide range of devices, such as remote controls, actuators and tracking systems. This includes the low cost of the system in terms of power usage, to extend battery life, which is a big leap forward.

URLC is not fast enough for data transfer times for applications such as industrial and automated driving and virtual surgery. Such systems need sub-millisecond latency with a response rate of less than one packet loss in 100 packets.

5G and 6G network architecture.

In 5G and 6G networks, small cell (millimeter wave); femto cell and Wi-Fi; using (M-MIMO); and matching between device to device (D2D) and machine to machine (M2M). MANO is a component of the European Telecommunications Standards Institute's NFV architecture.

vEPC stands for Virtual Evolved Packet Core. It is used to switch and process data for mobile networks. Multiple virtual network functions (VNFs) emulate the functions of LTE Evolved Packet Core (EPC). To provide virtualization, for the 5G and 6G network systems. Infrastructure design, which is a complete IP model for compatibility between wireless and cellular networks. The architecture contains a computer station and independent radio system technologies. Through the RAT technology inside it. The following figure (1) shows the architecture of 5G and 6G networks.

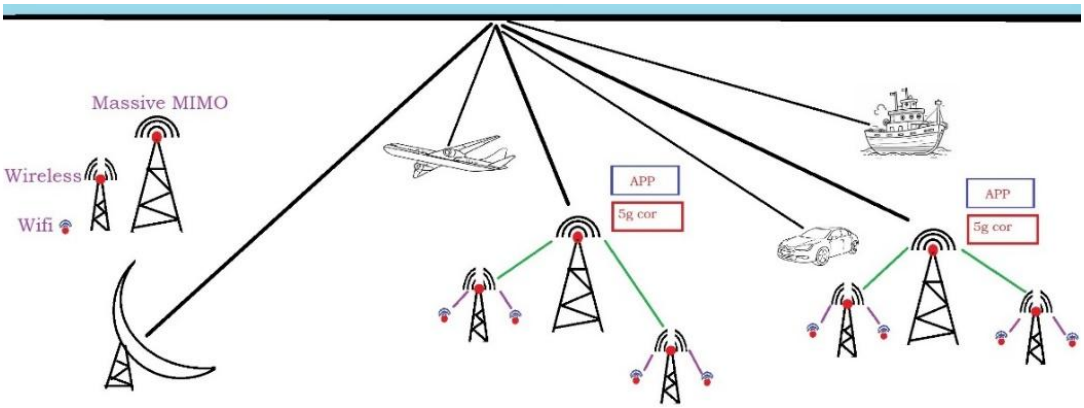

Figure 1 5G technology including small cell (millimeter wave); femto cell and Wi-Fi; using (M-MIMO); and the relationship between devices (D2D) and devices (M2M).

In 5G and 6G networks, most base stations remain inactive for 24 hours and about 80% of the power is used to save energy. During the station's activation period, subsystems and components are activated to conserve energy in the idle state of Long Term Evolution Advanced (LTEA), the core network is in a search state by hopping from the femtocells used for the wake-up signal that the user is connected to. From the transport circuit and the microchip by saving up to 80 percent of the Power. With OFDMA, the power of femtocells over the coverage radius is

$$Pf = \min(Pm + G - PLm(d) + PLf(r)) \qquad (2)$$

where PLf(r) is the loss rate at target distance r, Pm is the cell rate and G is the receiver gain. PLm(d) is the value of femtocell quality consumption d and Pmax. The signal-to-polarization-to-noise ratio (SINR) is considered to be a fairly acceptable performance and efficiency ratio.

Information protection and security

Unification of security standards for information security standards in the fifth generation, according to generally accepted standards similar to their predecessors, such as Elliptic Curve Coding Schemes (ECCs), IEEE 802.15.4, IPv6 over Area Networks (6LoWPAN), and Co Application Protocol (CoAP). Due to the use of self-intelligence programs, and advanced artificial intelligence, this cybersecurity is considered the most applied to artificial intelligence. Such as security, authentication, and proactive control of data access**.**

Antenna structure

The fifth generation antennas are better than their predecessors, and there is great progress in their use of capacitors, conductors and metal rods, and they are distinguished from other networks by speed, access time and security, but they are more complex, and they operate in the 58.5-60.5 GHz spectrum, and can be applied to mobile stations, and their size is 5x5x0.1 mm3, and their radiation efficiency is more than 88%, and the loss range is less than -10 dB, and the gain value is 7.839 dB at 60 GHz. The dual-band antennas are designed with eight MIMO antennas consisting of four pairs of L-shaped slots and are based on SIRs, and the SIR impedance ratio is responsible for the dual resonance and antenna gain, and the impedance can be adjusted, and the isolation between the elements is more than 11 dB and the loss is more than 10 dB. In LTE 42 spectrum (34300 to 3500 MHz) and LTE 46 spectrum (5150 to 5925 MHz), the average antenna efficiency is 49%. For the multiple-input multiple-output MIMO system, it has the ability to transmit multiple data packets at the same time. It improves network capacity and multipath SU-MIMO can also be used in wireless transmission between the EU and AAS; by sending different layers to separate the transmission paths.

One of the most important applications of 6G is the use of new communication infrastructures, providing channels with very high data rates using sub-terahertz frequencies. Another requirement is the use of artificial intelligence engines, which include machine learning tools in the network end nodes. With the emergence of machine learning and artificial intelligence technologies, as well as the explosive rise of the Internet of Things,

6G is the best solution with high bandwidth and high-speed Internet. With the help of AI-based algorithms and models, AI applications will also be used in many gadgets and places like drones, cars, autonomous robots, and interaction mechanisms that include human-human-machine interaction through interactive communication with the five senses is also vital. 6G technology enables high-speed internet access, network packet switching, high security, data storage capabilities, smart batteries, etc.

The security issue with 5G to 6G has remained the need for low complexity and higher levels of protection. 6G can implement many security technologies like MIMO and Low-Density Parity Check Code (LDPC-code), thus the issue can be solved using distributed key management, which is a reliable method for high-frequency communication systems. 6G technology operates at frequencies from 100 GHz to 1 terahertz. It provides higher frequency than 5G bandwidth. 6G network provides peak download speeds of over 10 Gbps and peak upload speeds of over 10 Gbps. Once 6G is introduced, it will be able to reach over 100GHz, compared to the speed and capacity of 5G. addition, the prepared data and new models will be improved through the design of the internal wireless network, localization studies and the future Wi-Fi Gigabyte network with the Internet of Things.

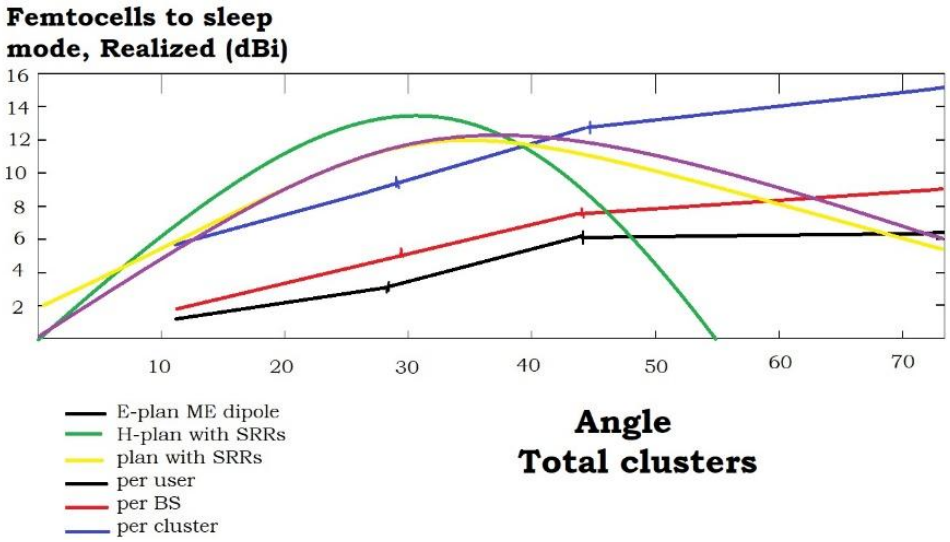

Figure 2 The graph of the femtocell density operating in idle mode and the results for a circularly polarized magnetic dipole antenna at 30 GHz.

Noise ratio dB

The spectral bandwidth loss ranges from 90 to 220 dB, so it is not easy to use the bandwidth continuously, so it must be distributed over distances to achieve better performance. Therefore, terahertz has the ability not to penetrate walls and other reflections, and eliminates the need for X-rays for military detection and does not harm people because it is non-ionizing. As shown in the graph in the following figure (3), which shows the absorption loss from 0.2 to 9 THz by water vapor and the time average for different beam sizes.

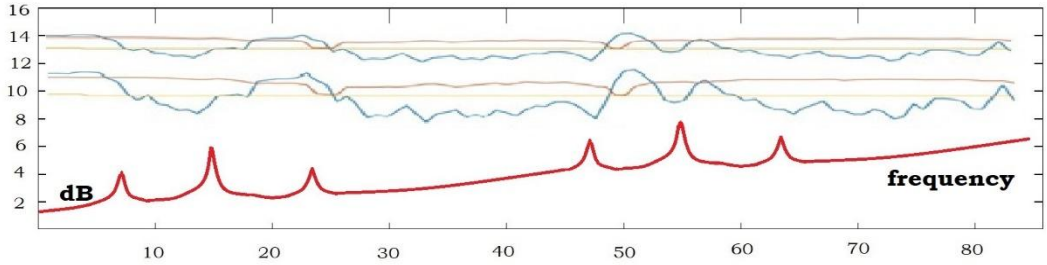

Figure 3 shows the absorption loss from 0.2 to 9 THz by water vapor and the time average for different radial sizes.

The general difference between 5G and 6G

After collecting the data for 5G and 6G to make a comparison, we can mention the year of use, service speed, use, standards and the basic network, which are shown below:

Generation	**5*G***	**6*G***
Year of start of implementation	2020	2030
Speed	From 2Mbps to 1Gbps network LMPS	10 Gb/s
Technologies	Integration of broadband LAN, WAN, PAN and WLAN	5G, satellite networks
Standards	Network access convergence, including OFDMA, MC CDMA, network LMPS	GPS, COMPASS, GLONASS, Galileo systems

Results and discussion

This research article contains 5G and 6G technologies and the comparison between them, as well as the infrastructure, basic supplies and concepts of each, the obstacles facing both the fifth generation network and the sixth generation networks, and the basic problems that may face 6 G We also have antenna engineering improvements to provide better gain response bands, especially at the resonant frequency in 6G networks. In contrast, 5G antennas give a more efficient gain in the mmWave spectrum. From 20 GHz to 80 GHz, it is better than in the 4G network, which is noticeable to the customer when downloading data much faster. We also note the establishment of multiple inputs and outputs (MIMO) in 6G networks to speed up the network program for the 6G network. Another common obstacle in the mmWave spectrum is the loss of signal and attenuation when it rains, especially in winter, so this should be taken into account in the future 6G network.

Conclusion

At the end of this article, we have provided extensive studies on current and future 5G networks, from several aspects to learn about the 6G network. Accordingly, 6G networks are more advanced and practical, especially in the field of frequency spectrum, international navigation, positioning, artificial intelligence, smart cities, drones, remote command and control, remote surgery, especially smart factories, automated transportation, and partnership between countries and cities. This advanced technology will be a major scientific revolution in the field of transportation, the speed of transferring large data, and many other uses, the most important of which we mentioned here in this article, and it will change the lives of many people, and preserve human lives by reducing aviation accidents and traffic accidents, especially in early notifications that will contribute to reducing disasters in our lives. As we have indicated, the complexities of 5G networks, especially maintenance, its difficulty and high cost, we recommend moving to 6G networks without going through 5G networks in Libya.

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