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# Evolving Mobile Communication Using Artificial Intelligence

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**Abstract:** *The importance of artificial intelligence (AI) in enhancing Mobile Communication (MC) is covered in this abstract, especially in light of the developing 5G and impending 6G networks. The study examines a number of AI methods, including fuzzy logic, reinforcement learning and neural networks, how they are used in MC. It draws attention to how AI might improve the efficiency of networks, solve problems, and meet the rising demand for mobile services that are quicker, more dependable, and more customized. While taking into account the ethical and technological requirements for AI integration, the paper also looks at how AI can affect future technologies, such as intelligent traffic management, maintenance prediction, and tracking the environment. In order to secure responsible AI development, the article highlights the necessity of cooperation between industry, academia, and government. In the end, it offers a thorough analysis of how AI can transform mobile communication, shedding light on the potential advantages and difficulties of implementing AI in networks of the future.*
**Keywords:** *Mobile Communication (MC), AI, 5G, 6G, Network*

## 1. Introduction

One method of adopting the human brain or way of thinking is artificial intelligence [1], while other methods include animal behavior [2], [3], biological structures, and species [4]. AI in particular plays a crucial role and offers a viable means of improving the performance of MC systems. The dynamic adaptability of MC in circumstances is largely facilitated by AI approaches. In order to reduce inefficiencies and expandability, the complex network architecture must simultaneously switch from traditional administration and operation approaches to the intelligence strategy [5].

Due to the need to enhance service requirements with multiple devices, intricate networks, and various applications, the forthcoming generation of WiFi networks is more complicated and requires more resources [6]. In addition, the network developers must change their system to deliver the best and available assets to boost the service quality. Additionally, according to industry projections, IP traffic utilization will exceed 3.3 zetta bytes (1015 MB) in 2021, and within the subsequent two years, cellphone traffic will surpass PC traffic [7]. AI offers the ability to create adaptive systems that improve system and environmental performance. The advent of big data has led to the availability of ever-larger datasets from wireless or mobile technologies. Stated differently, the implementation of AI in MC would guarantee that communication systems are more effective, operate more effective, and raise Key Performance Indicators (KPIs) [6, 8]. The demand for mobile stations will rise in tandem with the booming volumes of mobile traffic and the requirement to handle massive amounts of data due to the growing network equipment and hardware adoptions of mobile devices and their applications. According to Zhang et al. [7], one of the key answers is to use cutting-edge AI methods, like ML and DL, in MC to handle massive amounts of data and efficiency from terminals and give complete mobile stations.

## 2. Literature Survey

Nguyen et al.'s article "When AI meets 6G" (2021)[9] examines how AI might affect how MC develops in the future. The writers go over the advantages, difficulties, and possibilities of integrating AI into 6G networks, such as better accessibility, effectiveness, and customization of communication. They also draw attention to the cooperation, ethical issues, and technical prerequisites required for the responsible development and application of AI in mobile communication. IEEE Network, a peer-reviewed publication in the networking and

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telecommunications domain, published the paper [12]. In order to enable upcoming technologies like AI, the Internet of Things (IoT), and autonomous vehicles, the research emphasizes the necessity for faster, more dependable, safe mobile connectivity [13]. The investigation also looks at the technical details and possible uses of 6G systems, such as intelligent network administration, ultra-low latency, and fast data transfer. To guarantee the efficient creation and deployment of 6G networks, the authors stress the necessity of cooperation between business, academia, and the government [14]. S. Li et al.'s paper [11] examines the current and potential future paths of ML in 6G wireless networks. The study addresses the possible uses of ML in 6G networks, such as proactively network administration, smart security, and proactive distribution of resources. The researchers also draw attention to the difficulties in integrating ML into 6G networks, including the requirement for substantial data sets and powerful computers. In order to overcome these obstacles and realize ML's greatest potential in the subsequent development of wireless communication, the paper ends by urging more ML research for 6G networks [15]. The investigation investigates how 6G networks can allocate resources using ML. It talks about the latest developments in ML methods, like federated learning and deep reinforcement learning, for effective allocation of resources in cellular networks. The difficulties that must be overcome so as maximize promise in 6G connections are also highlighted in the article. In order to overcome these obstacles and realize ML's greatest potential in the subsequent development of wireless communication, the paper ends by urging more ML research for 6G networks [15]. The investigation investigates how 6G networks can allocate resources using ML. All things considered, the study sheds light on how ML might be used to allocate resources in upcoming wireless networks [16]. The possible application of AI in beyond-5G wireless networks is examined in the paper by Shakeri, Poor, and Cui [10], which also highlights the difficulties and opportunities involved in implementing AI technology. In order to address technological and ethical issues, the article highlights the necessity of industry, academic, and government cooperation while discussing a variety of AI applications, such as maximizing network efficiency, scheduling of resources, and encryption. In addition to advocating for the ethical growth and application of AI technology in the subsequent evolution of wireless systems, the authors offer insights into how AI can transform wireless networks beyond 5G [17]. The study examines how AI might affect how MC develops in 6G networks in the future, stressing both the advantages and difficulties of implementing AI. The paper talks about how AI could increase communication's effectiveness, convenience, and customization. To guarantee ethical utilization, technical specifications and moral issues must be taken into account. To create and execute rules and guidelines for the application of AI in MC, industry, educational institutions, and government institutions must work together [18]. The possible effects of AI on the development of MC in the future, particularly in 6G networks, are thoroughly examined in this research. It talks about the advantages and difficulties of using AI in MC as well as how it may increase accessibility, effectiveness, and customization.

## 3. Challenges of AI in MC

In the next generation of mobile or wireless networks, AI will play a crucial role in handling massive data as enhanced analysis of information and arranging different communication devices. However, the MC buildings must be productive, dependable, and flexible enough to accommodate a variety of offerings. For example, it must enhance broadband service performance, reduce peak-to-average power ratios (PAPRs) [20], enhance orthogonal frequency division multiple access (OFDM) [19], and enhance connection reliability [21]. The massive networks and mobile devices with rapid data exchange and connectivity will provide issues in the 5G MC system [5]. Kibria et al. [6], who have examined data analytics, ML and AI in network communication, provided an explanation. It was assumed that the new MC transmission network will have more complicated handling of networks. Based on the increasing amount and velocity of cell phone end-user data, Banupriya et al. [22] predict that traffic in 5G MC will increase by 1000 times. Therefore, the next generation MC does not allow existing network administration and methodologies [22]. Secondly, because the earlier researchers still concentrated on the fundamental network issue on the physical layer side, like the use of AI on the route selection problem, the traffic management difficulties remain open to topical study [23]. Yet, based on user-experienced suggestions on the program and cognitive levels, only a limited amount of AI approaches are deployed for traffic enforcement. Therefore, the next generation MC How to integrate AI into the upcoming MC messaging system presents another difficulty. The difficulties in 5G include, for instance, how to connect the number of mobile devices with actual time linking massive Machine-Type Communications (mMTC), how to provide internet access digital media that utilizes well as how to present tactile characteristics internet applications (Ultra-Reliable Low Latency Service, or URLLC) [22]. Therefore, the next generation MC Mobile knowledgeable communication has been described as a system that is proactive that is self-aware, adapts itself, forecasting, successful, and cost-effective to operate and optimize [6], [8]. Other AI challenges in the MC system include selecting solutions, controlling networks, and optimal utilization of resources [8]. Another essential in mobile communication is how AI can be applied to various wireless communication scenarios such as power control, radio resource management, mobile management, and interference management [22]. There have been reports on the development of MC networks from the first to the sixth generation [20].

## 4. AI Approach based on 6G Integration

The whole sector could undergo an evolution if AI is included into 6G networks. It has the power to drastically improve network dependability and efficiency, develop new business models, and change how we work and live. These are a few examples of how 6G wireless networks can incorporate AI. Management of Intelligent Networks: The complicated 6G network can be managed with AI. It has the ability to track network traffic and instantly spot trends and irregularities. In order to avoid interruptions to the network, it can also anticipate network traffic congestion and intelligently distribute services.

**Advanced Security:** AI has the potential to be extremely important in guaranteeing the security of 6G networks in particular given the increasing threat of cybercrime. It can keep an eye on network connections for any unusual behavior and instantly identify and stop hacking attempts.

**Smart Resource Allocation:** Intelligent networking allocation of assets is possible with AI. Depending on their needs and the state of the network, it might rank important users and apps. By doing this, latency may be decreased, and network efficiency can be enhanced.

**Intelligent Edge Computing:** In 6G networks, computer performance at the edge can be improved with AI. In order to improve speed and lower latency, edge computing algorithms process data closer to the source. Through real-time data processing, AI can facilitate smart choices at the edge.

**Autonomous Devices:** In 6G networks, AI can make autonomous equipment possible. This implies that absent human assistance, machines are capable of learning and adapting to the environment, making judgments, and acting. The overall user experience can be greatly improved, and fresh opportunities for creativity can be opened up.

**Decision making in MC:** A number of investigators, including Banupriya et al. [22], have reported AI for making choices in MC. They estimate QoE (Quality of Experience) for different kinds of service using an AI approach. They also use NN for KPI classification, that bridges a KPI with QoE in mobile broadband services. AI-assisted QoE content retrieval. [23] Fu et al. suggest the quality of experience (QoE) of a two-part tailored content retrieval service: 1) Efficient enough to capture customer interests and events, and 2) Easy to use and appropriate suggestion procedure [23]. In analog, digital, and hybrid beam forming, data analytics, ML and AI approaches can be applied to create the best beam patterns, interactively choose the best beam, and carry out the laser-steering operation [6]. Out of the 625 phrases, 82 have at least two incidents, which is the maximum. The examination of the association between variable variables is shown in Figure 1, where the circle represents the quantity of compounds.

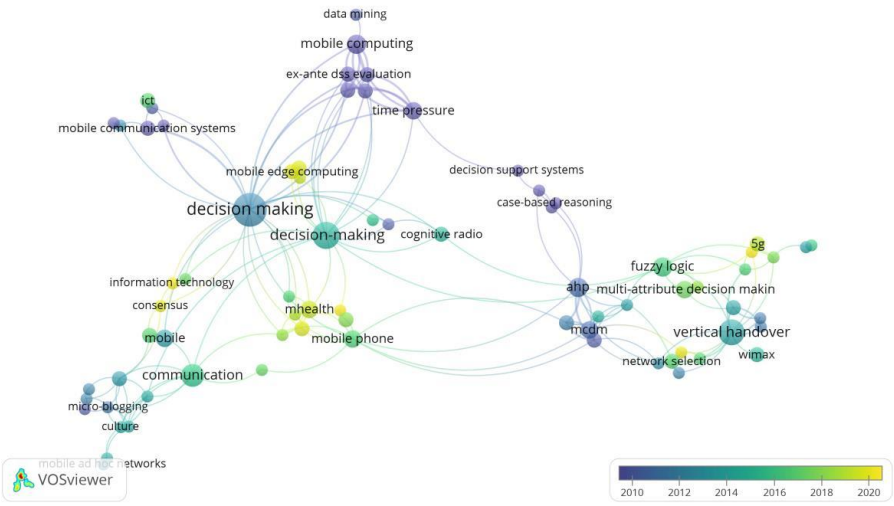


**Figure 1.** Phrase overlaying representation for MC making choices

The term "choice making" turns into an animating theme with connections to other phrases. Future studies should focus on the association between the red-circled words and the yellow-colored keyword dots and the term "choice making" in MC. According to the article year, the search engine optimization trend is renewed when the dashed color on the keywords is better.

**Resource optimization in MC:** Broadcasting tree mobile adhoc network architecture has been optimized through the application of genetic algorithms in resource optimization. This process of optimization is supplemented with additional goals like energy savings and constrained end-to-end delay [19], [24]. Neural networks and the decrease in the PAPR problem, which is exploited in learning via the internet, are the subject of additional research. AI methods can also address a crucial component in improving the effectiveness of OFDM measurement of channels [24]. Examines an intelligent radio system that uses shared spectrum sensing, in which a number of secondary users work together to produce reliable spectrum sensing data. to facilitate spontaneous spectrum access that is dependable and efficient. In order to address the issue of inter-cell disruption, which could negatively affect mobile users' performance in mobile networks, AI has also been suggested [24]. Current AI techniques combine central processing units (CPU) and graphics processing units (GPU) to enhance edge performance in computing [23]. Applying AI to MC involves sophisticated statistical techniques and should consider end users, infrastructure, equipment, gadgets, and other factors [23]. Figure 2 shows that the most used keywords in this trend are resource allocation (n=18), mobile edge computing (n=14), optimization (n=9), network optimization (n=6), quality of service (n= 6), wireless networks (n=5), Mobile communication (n=4), and QoS (n=4).


**Figure 2.** Word Cloud analysis Resource optimization in Mobile Communication

**AI-powered defect identification and proactive upkeep:** With so many devices and network components, 6G connections will be extremely complicated. Rapid and effective defect detection and diagnosis will be essential. Predictive upkeep and network issue prediction are two tasks that AI systems can assist with. AI will make it feasible to keep an eye on network sections in real time, examine data to spot irregularities, and take preventative action to avoid errors and guarantee availability of networks.

**AI-driven conservation of energy and network optimization:** It will be crucial to optimize electrical consumption while preserving network reliability because 6G networks would use a lot of electricity. Through network data analysis, traffic prediction, and installation optimization, AI algorithms can aid in maximizing the efficiency of network activities and the use of energy. AI will make it feasible to minimize electrical consumption and maximize the effectiveness of networks. In conclusion, by facilitating intelligent network administration and optimization, AI will be essential to the development of 6G networks. 6G networks will be able to provide the performance and dependability needed to accommodate the next phase of MC by utilizing AI algorithms to accomplish effective resource allocation, scheduled upkeep, and optimized networks in Figure 3.

**AI-supported privacy and security for networks:** In 6G networks, AI has the ability to completely transform privacy and network security. Standard safety precautions might not be enough to fend off sophisticated cyberattacks given the rise in data flow and the number of devices that are connected. Because AI can identify, stop, and react to cyberthreats instantly, it can significantly improve networking security and privacy.

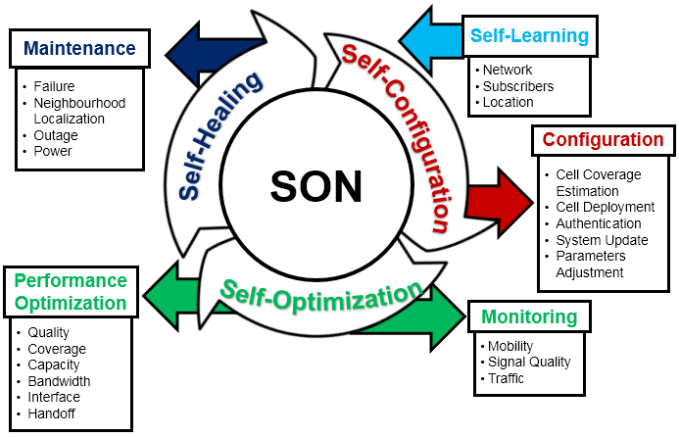


**Figure 3.** AI-enabled network management and optimization.

## 5. Other AI Application

Table 1 shows how AI affects MC.

**Table 1.** Applied AI on MC

| **MC Technology** | **Applied AI** |
|---|---|
| Autonomous autos and healthcare devices. | Robotics with intrinsic AI [25].<br>Overview of AI algorithms for driverless cars. These systems specialize High-level taking decisions requires the ability to observe and react to surroundings in order to achieve objectives [26]. |
| Internet of Intelligent Things | AI approaches and network solutions are used to build knowledge and capitalize on its advantages [27]. |
| Mobile Cloud Computing MCC | Expensive technologies including virtual reality, AI, vision, tracking of items, image processing, and the processing of natural languages are gaining popularity for managing MCC[28]. |
| 5G Networks | AI or its subdivisions, such as ML and DL, have developed to the level where 5G wireless networks can be anticipatory and proactive, enabling the 5G concept [29]. |
| Wireless Sensors Networks | AI is utilized to support smart radio stations. ML is a key tool for addressing the issue mentioned above [29]. Utilizing the Received Signal Strength Indicator, ML techniques can be used for geolocation in wireless sensor networks (30).<br>A wireless sensor network's cluster-head can be selected using an ANN, increasing the duration of the network [31]. |
| Mobile heterogeneous networks (HetNets) | AI techniques such as ML, bio-inspired algorithms, and fuzzy neural networks excel at solving complex problems on a big scale [32].<br><br>These potential designs use AI concepts like memory, logic, and decision-making to create a closely linked internet [33]. |
| Revealing mobile malware hidden communications | Two AI-based detection approaches, neural nets and decision forests, are used for identifying hidden virus data exchange [34]. |
| Mobile and Wireless Networking Vehicular mobile networks | DL [31]<br>AI based edge hiding [35] |

| | |
|---|---|
| Next-generation wireless networks | ML, ANNs [36]<br>Big data analytics can help analyze user activities and spot anomalies [37]. |
| Mobile Multimedia | Deep learning has grown into a crucial tool for audiovisual computing. [38] |
| Wi-Fi Based Indoor Location System | ANN [39] |
| Cognitive Radio Networks | Cognitive protocols for routing aim to integrate AI-based methods smoothly into their architecture [40]. |
| Data science and artificial intelligence (AI) for communications | Advancements in AI, ML, and network data analytics have the potential to transform interpersonal relationships and customer experiences [41]. |
| Cellular Network System | [42] explores the use of AI in mobile network planning, operations, and improvement. |

## 6. Conclusion

AI plays an important role in improving the efficiency of MC systems by enabling active, self-aware, self-adapting, forecasting, productive, and cost-effective operations and management. The paper discusses both ancient AI techniques and recent ML approaches to wireless communication. The techniques included fuzzy logic, neural networks, learning through reinforcement, and various AI techniques used in MC. Big data, data analytics, greater frequency delivery, device-to-device communication, accurate construction, ultra-dense system, Massive MIMO, 3D Beam shaping, V2X, Drone Base Location, Multi-Access Communication, mm-wave, Cloud-RAN, the Edge program Network, and micro Stations are some of the key terms or challenges among AI and subsequent years MC. The challenges include 5G generations problems and how the 6G of mobile connections will be driven to provide reliable networks and service kinds for large mobile phones and data.

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