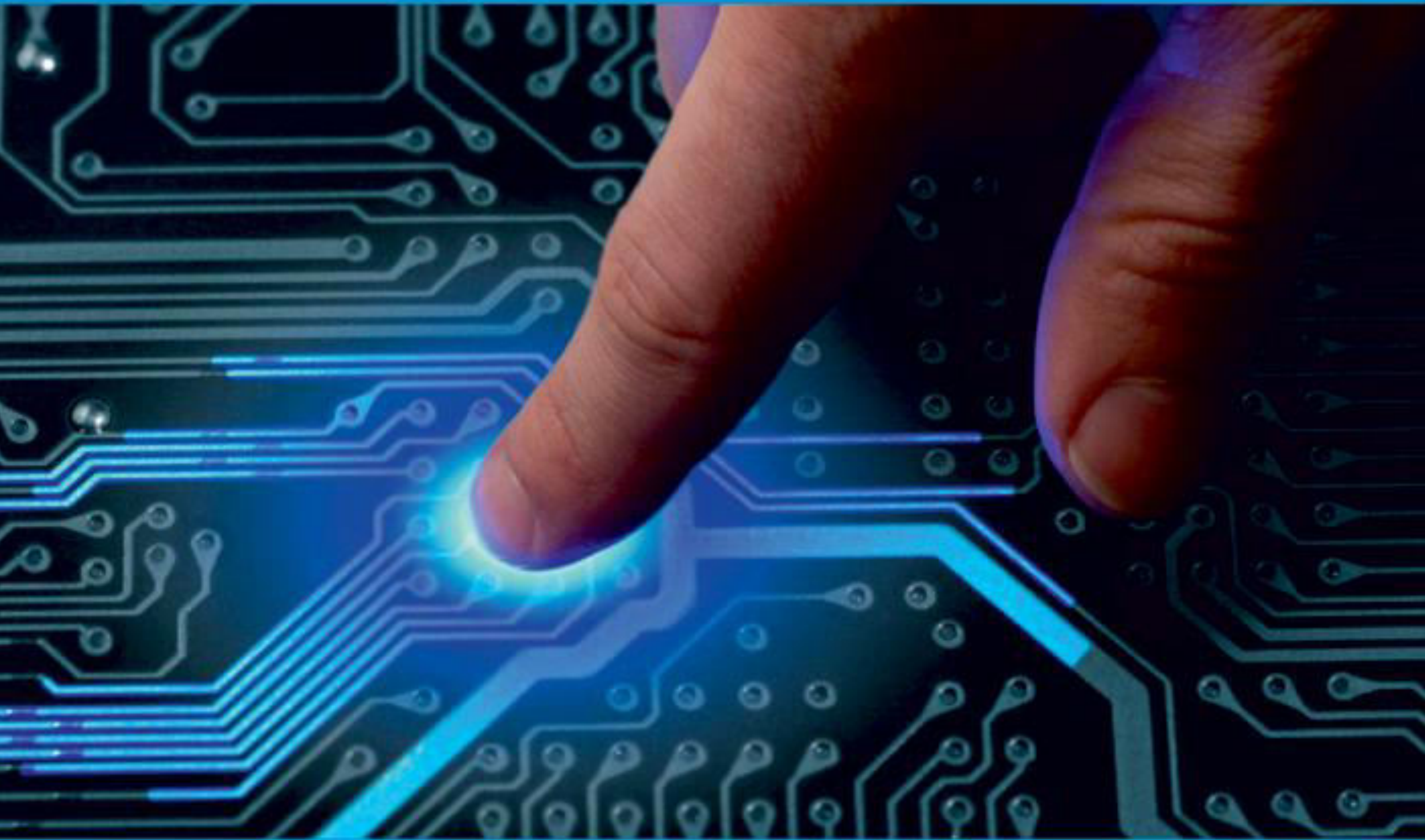
IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 12, Issue 3, March 2024

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.379

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 | Monthly Peer Reviewed & Referred Journal |

|| Volume 12, Issue 3, March 2024 ||

| DOI: 10.15680/IJIRCCE.2024.1203104 |

Developing an Innovative Hybrid Strategy for Network Selection and Rapid Delivery Handover Protocol in Wireless Networks

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ABSTRACT: In the realm of cognitive radios, network selection poses a significant challenge, particularly during the transition from 5G to 6G technologies aimed at addressing spectrum scarcity issues. The objective is to establish fast delivery handover routes capable of handling high-speed data access while upholding Quality of Service (QoS) standards. It's imperative to minimize interference caused by secondary users (SUs) within licensed networks. From the perspective of secondary networks, the task is to allocate networks to SUs in a manner that minimizes overall interference with licensed and unlicensed users, facilitating the accommodation of increasing SUs in the network. To address these challenges, we propose the NN-PSO technique for network selection and Fast Delivery Route mechanism. This approach aims to enhance system efficiency by considering two additional types of SUs in the network and accommodating their preferences while adhering to the priorities of major network operators. By doing so, we aim to mitigate interference and optimize network performance effectively.

KEYWORDS: Network selection, fast delivery route, 6G LTE networks, Particle swarm optimization Cognitive Radio, Neural Network

I. INTRODUCTION

The landscape of cellular networks is undergoing significant transformation as they are increasingly tasked with accommodating a vast array of mobile devices, applications, and services. Cisco's annual Visual Networking Index forecasts a surge in wireless data traffic, exceeding 190 exabytes in 2018 and surpassing 500 exabytes by 2020. Projections also indicate a proliferation of over 50 billion human and machine-type devices by 2020. Alongside this, there's a continuous expansion in the variety and availability of cloud-based applications and services for mobile users. In response, both incremental enhancements to existing 5G systems and revolutionary advancements envisioned for 6G systems, commonly referred to as Beyond 5G systems, are rapidly emerging.

Initiatives such as the METIS project have outlined key performance indicators for 6G systems expected to be operational by 2030, emphasizing the need for significant performance improvements over current 5G systems. These B4G systems are expected to support three major communication paradigms: enhanced mobile broadband, massive machine-type communication, and mission-critical machine communication. To effectively cater to these diverse applications, B4G systems must achieve user data rates of 10Gbps, a 1000x increase in system capacity compared to 5G systems, and provide support for ultra-high-speed mobile users. Additionally, they are expected to achieve 10x energy savings for both devices and network infrastructure. Furthermore, to facilitate data communication at ultra-high speeds, B4G systems should be capable of supporting ultra-low latency communication of approximately 1ms.

The rapid evolution of wireless communication technology has significantly impacted human lifestyles, evident in the exponential growth of mobile users. To meet escalating demand, communication standards are evolving swiftly, transitioning from one generation to another. The evolution of wireless communication technologies is delineated by their generational advancements. The mobile wireless industry commenced in the 1970s with the first generation (1G) of mobile communication technology, typified by analog systems like Nordic Mobile Telephony (NMT) and Total Access Communication Systems (TACS), primarily designed for voice services. However, limitations such as bulky devices, frequent call drops, and restricted mobility were prevalent in this era.

In the early 1990s, the introduction of the second generation (2G) of mobile communication, notably Global System for Mobile Communications (GSM), marked a significant leap forward with the advent of digital technology. 2G

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facilitated both voice and data mobility. Subsequently, General Packet Radio Service (GPRS) (2.5G) and Enhanced Data rates for GSM Evolution (EDGE) (2.75G) were introduced to enhance data support and mobility across networks. Responding to the growing demand for data services in wireless communication, the industry transitioned to third-generation (3G) technologies, exemplified by Universal Mobile Telecommunications System (UMTS) and Wideband Code Division Multiple Access (WCDMA), providing integrated packet audio, video, and data services with mobility support.

II. RELATED WORK

Since 2010, the Third Generation Partnership Project (3GPP) has been dedicated to defining Long-Term Evolution Advanced (LTE-Advanced or simply LTE-A) systems and their component technologies. The release 10 of 3GPP commenced in early 2010 and was nearly finalized by March 2011 after receiving approval from the ITU for meeting all the requirements for IMT-Advanced. Innovations introduced during this release included carrier aggregation for transmissions across multiple frequency bands, enhanced multiple-input multiple-output techniques, relays, and self-organizing networks.

Spatial frequency reuse, achieved through deploying more cell sites, yields a capacity gain of over three orders of magnitude. Additionally, studies indicate that over half of voice traffic and 70% of mobile data traffic originate from indoor and enterprise environments. Consequently, smaller low-power cell layers have been added over the existing macrocell layer. These low-powered small cells comprise picocells, femtocells, metrocells, and relays, among others. While picocells, relays, and metrocells are utilized for outdoor deployments, femtocells are intended for indoor settings such as residential or enterprise buildings. In enterprise deployments, multiple femtocells are typically deployed in a coordinated manner, enabling the small cell base stations to adaptively self-organize and optimize their transmission parameters.

A network that encompasses several overlapping cell layers, each with distinct characteristics such as transmission power, carrier frequency, and backhaul technology, is termed as a heterogeneous network (HetNet). HetNets, in general, significantly improve network performance and service availability by enabling dynamic traffic offloading from macrocells for various purposes including network load balancing, capacity enhancement, or coverage extension. Small cells are therefore expected to play a significant role in enhancing the coverage and capacity of 5G and 6G cellular systems. Additionally, small cells are anticipated to feature unique access control capabilities categorized as follows:

Open Access: Small cells are accessible to all users of the cellular network.

Closed Access: Access to small cells is reserved for users who receive closed subscriber group (CSG) access from the cellular network provider.

Hybrid Access: In addition to providing access to CSG-capable users, small cells can also offer limited access to users lacking CSG capabilities.

However, the heterogeneous nature of the different cell layers presents several significant challenges that impact the actual capacity achievable by the overall system as well as the quality of experience offered to mobile users. Specifically, the key challenges affecting this novel network architecture are inter-cell interference and mobility management. Although these two major issues have been extensively discussed in the literature, certain fundamental aspects of them remain unresolved challenges for the community.

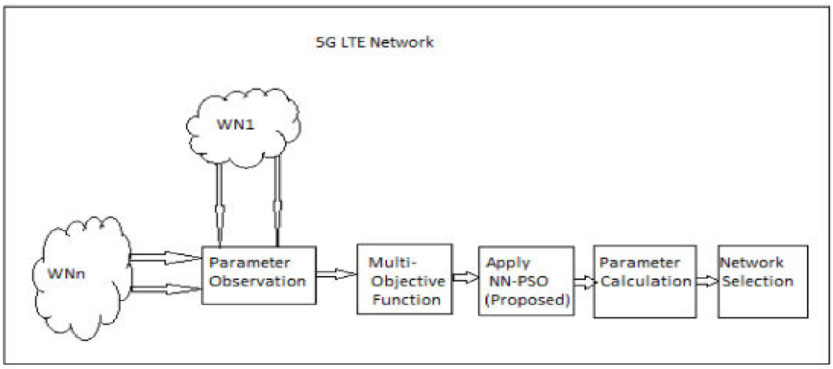

Fig.1. Basic working shape for Network Selection and speedy transport Route through the use of NN-PSO.

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III. PROPOSED WORK

Future 6G wireless networks will be required to support applications demanding high data rates. One solution to meet the data rate requirements is to enable network densification through the deployment of small cells. This densification leads to higher spectral efficiency and can also reduce the power consumption of mobile devices by facilitating communication with nearby pico-cells. Consequently, this solution significantly improves network coverage. However, it necessitates advancements in hardware miniaturization and cost reduction in the design of small cell base stations. These small cell base stations can be deployed as low-powered femtocells commonly used in enterprise/private setups or higher-powered pico-cells to enhance outdoor coverage of macro cells.

Hybrid Approach (PSO+NN)

The hybrid approach process is illustrated in the following figure. The main idea behind using the Particle Swarm Optimization (PSO) algorithm to enhance the Backpropagation (BP) neural network is to combine them. This involves utilizing the initial connection weights between BP neural network layers and the initial edges between neural nodes to improve the distribution, implement global steps within the solution space, and find the optimal initial weights and edges of the BP neural network at a rapid convergence rate. Consequently, the initial weights and thresholds obtained by the BP neural network can be utilized for training and testing the sample set. Figure 4.3 depicts a flowchart of this streamlined model.

From a communication system perspective, consider a network provider having a Base Station (BS) serving multiple users with a allocated bandwidth. In the cognitive system, we refer to this system as primary. Now, another network provider (secondary system with a BS and several users) needs to serve a different set of users but lacks the bandwidth, generally acquired through auction. The primary receivers only receive signals tuned to the frequency of their allocated bandwidth. The secondary transmitter requires bandwidth for its transmission. If the secondary system uses the same bandwidth, the primary receivers will receive signals from the secondary transmitter, acting as interference. So, the secondary system will wait until the primary system stops transmitting (spectrum sensing) and will serve its users using the bandwidth of the primary system. Alternatively, the secondary system will transmit simultaneously with the primary transmitter without increasing the interference at the primary receiver beyond a specified threshold.

Consider two individuals P1 and P2 occupying a room reserved for preservation and no others are allowed inside. These two individuals are part of the primary system. Now, two other individuals S1 and S2 who don't have their room enter the primary room. These two individuals are part of the secondary system. It is observed that P's do not want to interact with S's and vice versa. Now, what S1 and S2 need to start a conversation? Since the room is allocated to the P's, they won't speak until both P1 and P2 stop speaking or speak in such a low voice so that P's are not disturbed.

Now, in mathematical terms, if only primaries are active, the received signal at primary receiver is Ypr = Hp Xp+Wp where Hp is the direct link between primary Tx and primary Rx, and Xp is the symbol transmitted from primary Tx. Do you know why Xp is received at primary receiver? It is because the receiver is tuned to the frequency of transmitted symbol. Now, a secondary Tx wants its symbol Xs to be transmitted to its secondary Rx. But at what frequency it will transmit Xs Secondaries do not have their own bandwidth. Suppose it uses the same frequency of primary system. In this case, the primary will be Ypr = Hp Xp+HpsXs+Wp including the interference HpsXs which will affect the primary data rate. Similarly, Ysr = HsXs+HspXp+Ws will be received signal at secondary including the interference HspXp from primary. So simultaneous use of same bandwidth will add the interference. So one way is to detect whether primary is transmitting or not. Once this is detected, secondary starts and receives Ysr =HsXs+Ws and stops when primary become active.

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IV. IMPLEMENTATION DETAILS AND EXPERIMENTAL RESULT

TABLE I. IMPLEMENTION PARAMETER COMPAIRED WITH EXISTING WORK.

Sr. No.	Parameters	Exiting work	Proposed work	Remark (How much increase or decrease)
1	Number of Iteration	3k	64	2936 (decrease 0.01)
2	Population Size (proposed method)	12	30	18 (decrease 0.01)
3	Crossover Rate	0.5	0.4	0.1 (decrease 0.01)
4	Mutation Rate	0.03	0.02	decreased

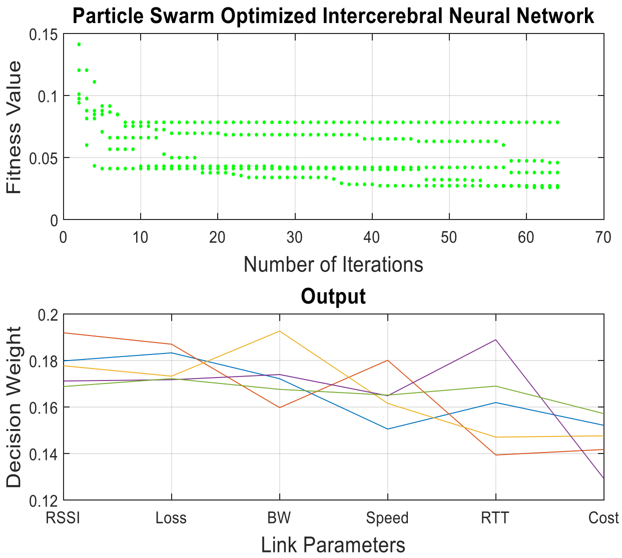

Fig.2. Particle Swarm Optimized Intercerebral Neural Network.
(a) Number of iteration v/s Fitness Value.
(b) Link parameter v/s Decision Weight.

TABLE II. LINK PARAMETERS V/S DECISION WEIGHT

Link Para meter	Weight Before	Weight After 1st loop iteration	Weight After 2nd loop iteration	Weight After 3rd loop iteration	Weight After 4th loop iteration	Weight After 5th loop iteration
RSSI	0.198	0.180	0.192	0.178	0.171	0.169
Loss	0.190	0.183	0.187	0.173	0.172	0.172
Band-width	0.166	0.172	0.160	0.193	0.174	0.168
Speed	0.160	0.151	0.180	0.162	0.165	0.165
RTT	0.151	0.162	0.139	0.147	0.189	0.169
Cost	0.134	0.152	0.142	0.148	0.129	0.157

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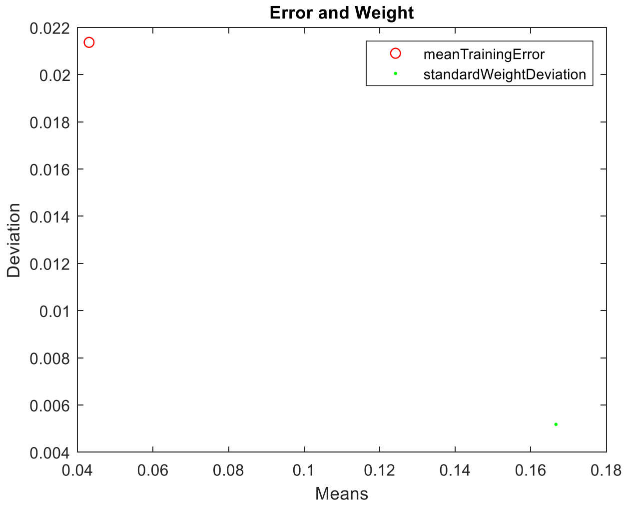

Fig.3. Error and Weight.

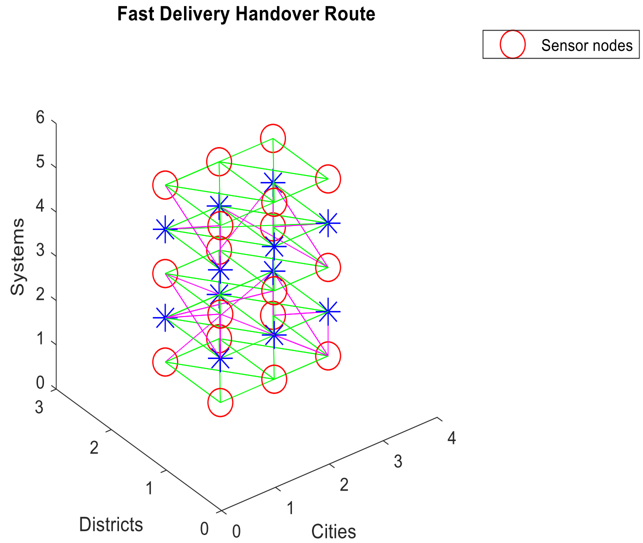

Fig.4. Fast Delivery Handover Route.

TABLE III. MEAN AND STANDARD VALUE OF EPOCH, ERROR AND WEIGHT.

Parameters	Epoch	Error	Weight
Mean	34.35	0.04	0.17
Standard	19.54	0.02	0.0052

The simulation output includes Mean Epoch, Mean Error, Mean Weight, Standard Epoch, Standard Error, and Standard Weight values as described in Table III. Here, Epoch denotes time. Mean Error represents the average error of standard simulation signal values, calculated by determining the variance of signals from the suggested value and then computing the mean values of Epoch, Error, and Weight, indicating the optimal value within one standard deviation of the mean. This method is employed to ascertain the mean and standard value of Epoch, Error, and Weight. Mean Error signifies the average of all errors in a vector or set, utilized for assessing system accuracy. Weight denotes the balance between exploration and exploitation, where the typical mean weight is 0.1667 and the desired weight is 0.0052.

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V. CONCLUSION AND FUTURE WORK

This study proposes the System Selection and Rapid Delivery Handover Route in PSO neural networks. By employing these methodologies within the neural network, the convergence speed is enhanced through the efficient updating of previous nodes, consequently optimizing the system and demonstrating improved energy efficiency. Simulation results also indicate superior performance with fewer cycles required to optimize fitness value and decision weight, considering factors such as RSSI, Loss, bandwidth, Speed, crossover rate, and cost for System Selection and Rapid Delivery Handover Route.

In future endeavors, the integration of two interleaved tasks (internal PSO and external PSO) into a single PSO for weight and structure exploration as a truly synchronous optimization process will be considered. Additionally, exploring the incorporation of a connectivity pattern optimization process into the PSO-PSO algorithm presents an intriguing possibility, given its promising performance observed in other studies.

Observations following the application of these methods include:

The performance of both NN and PSO surpasses that of previous methods. Enhanced fitness value and reduced crossover rate are achieved. Iterations for network selection are reduced, consequently improving speed.

A. Device-to-Device (D2D) Communication: Facilitates direct communication between shared or dedicated devices, bypassing IP-based or base station-centric networks.

B. Machine-to-Machine (M2M) Communication: Intelligent machines autonomously handle all data tasks, including data generation, processing, and transfer.

C. Internet of Things (IoT): Supports the IoT concept, which involves large-scale development of smart homes and interconnected smart products through the Internet. IoT enables connectivity "Anytime, Anywhere, Anyone, Anything."

D. Internet of Vehicles (IoV): Enables vehicle-to-vehicle communication via the Internet, aiding in traffic management and collision reduction. It provides low-latency and high-mobility connectivity.

E. Healthcare: Advanced sensor and communication technologies enable health monitoring, real-time communication, and data storage. Wearable technology offers healthcare solutions.

F. Smart Home and Smart City: Relevant for automation, appliances, embedded systems, and security in smart homes and cities.

In the future, hardware implementation of the proposed system can be pursued. Additionally, considering additional parameters can lead to a more practical and improved system.

REFERENCES

1. N. U. Hasan et al. “Network Selection and Channel Allocation for Spectrum Sharing in 5G Heterogeneous Networks” IEEE vol. 4, pp.2169-3536, march 2016 .
2. S. Chen and J. Zhao, ‘‘The requirements, challenges, and applied sciences for 5G of terrestrial cell telecommunication,’’ IEEE Commun. Mag., vol. 52, no. 5, pp. 36–43, May 2014.
3. Woon Hau Jaw, Zhong Fan, and Russell Haines, "Rising Advancements and Exploration Difficulties for 5G Remote Systems" Toshiba Exploration Europe Constrained, Bristol, BS1 4ND, Joined Kingdom.
4. Eduardo Casta˜neda, Ad˜ao Silva, At'ılio Gameiro, and Marios Kountouris, "An Outline on Asset Allotment Techniquesfor Multi-Client MIMO Frameworks", 1553-877X (c) 2016 IEEE
5. Mamta Agiwal1, Abhishek Roy2 and Navrati Saxena, "Cutting aspect 5G Remote Systems: An Extensive Study" 1553-877X (c) 2017 IEEE.
6. Jing WANG and Chih-Lin , "Late advances and future difficulties for massive MIMO station estimations and models", from technological know-how china February 2016, Vol. fifty nine Vol. 4, Issue 02, 2018 on the web): 2321-0613
7. Kwadwo, P., Agyapong, et al.: Plan contemplations for a 5G organize design. IEEE Commun. Mag. 52(11), 65 (2014).
8. G. Wunder et al., "5GNOW: Non-orthogonal, offbeat waveforms for destiny portable applications," IEEE Interchanges Magazine, vol. 52,pp. 97– 105, February 2019
9. K. Davaslioglu and E. Ayanoglu, "Measuring ability power effectiveness pick up in green cellular faraway systems," IEEE Interchanges Studies and Instructional exercises, vol. 16, pp. 2065– 2091, Final Quarter 2019
10. C.Rattaro, P.Belzarena, ‘‘Analysis and characterization of dynamic spectrum sharingin cognitive radio networks, ’’in Proc. IEEE Int. Wireless Commun. Mobile Comput. Conf. (IWCMC), Dubrovnik, Croatia, Aug. 2017, pp. 166–171.
11. W. Ejaz, N. ul Hasan, S. Lee, and H. S. Kim, ‘‘I3S: Intelligent spectrum sensing scheme for cognitive radio networks,’’ EURASIP J. Wireless Commun. Netw., vol. 2013, no. 1, pp. 1–10, Dec. 2018.

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12. W. Ejaz, H. S. Kim, ‘‘Distributed cooperative spectrum sensing in cognitive radio for advert hoc networks,’’ Comput. Commun., vol. 36, no. 12, pp. 1341–1349, Jul. 2019.
13. J. -i. Kani, S. Kaneko, K. Hara and T. Yoshida, "Optical Access Network Evolution for Future Super-Broadband Services and 6G Mobile Networks," 2021 European Conference on Optical Communication (ECOC), Bordeaux, France, 2021
14. D. A. Cordova M, T. -M. -T. Nguyen, P. B. Velloso and G. Pujolle, "A Preliminary Assessment of Blockgraph - a Mobility-Aware Solution to Secure 6G Mesh Networks," 2022 1st International Conference on 6G Networking (6GNet), Paris, France, 2022
15. L. Yue and T. Chen, "AI Large Model and 6G Network," 2023 IEEE Globecom Workshops (GC Wkshps), Kuala Lumpur, Malaysia, 2023, pp. 2049-2054
16. R. Bolla, C. Lombardo, P. Bono, N. S. Martinelli, R. Bruschi and B. Siccardi, "An Open-Source Prototype of Network Data Analytics Function for Next-Generation 5/6G Environments," 2023 IEEE Globecom Workshops (GC Wkshps), Kuala Lumpur, Malaysia, 2023, pp. 720-725
17. M. Bargavi, A. Dadhich and A. Sharma, "Exploring the Integration of Blockchain in 6G Networks for Improved Security and Efficiency," 2024 International Conference on Optimization Computing and Wireless Communication (ICOCWC), Debre Tabor, Ethiopia, 2024
18. S. Paul, "Investigating Federated Learning Implementation Challenges in 6G Network," 2024 Fourth International Conference on Advances in Electrical, Computing, Communication and Sustainable Technologies (ICAECT), Bhilai, India, 2024

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