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AI based approach for 6G wireless communication

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Abstract
With the advancement in science and technology, we need a reliable wireless communication system to meet our future demand to provide very fast data transfer between devices, to meet this demand we have to explore the fields of 6G wireless communication to secure our future needs. In this paper, we are going to analyse various ways by which 6G wireless communication is going to be possibility in near future.

Keywords: NOMA, SCMA, MIMO, AoD, AoA, NFV, SDN, SCMA,EAoA, AAoD, 2M2/l, WINNER II, WINNER+, IMT- A,TACS, NMT, JTACS, FM, FDMA, UEs, GSM, BW, GPRS, EDGE, FVLC, VLC, QoS, AP-CU, APs, V2V

1. Introduction

The installation of communication networks between transmitters and receivers, performance evaluation, and theoretical analysis all depend on channel models. Channel modelling and characteristics analysis. Mobility, non-stationary nature of frequency/time/space domains and unpredictability of motion trajectory should be considered for upcoming 6G wireless communication. This article give an overview regarding fundamentals in modelling of channels in 6G [1].

Following that, the creation of modelling in channel and analysis of characteristiocs of upcoming generation communication systems is explored. Third component in this paper discusses the research challenges connected with 6G wireless communications channel models and characteristics. The moment has come to investigate ways to update and extend 5G networks in preparation for 6G, which is predicted to achieve everything's interconnectedness and the construction of smart environment of mobile communication for day to day purposes. Many countries are presently deploying 5G networks in different countries. This article presents an overview and viewpoint on utilization of sparse code multiple access (SCMA) regarding 6G communication networks, which are currently in development for an emerging non-orthogonal multiple access (NOMA) scheme to enable connectivity on a large scale. SCMA is a disruptive (NOMA) scheme. We suggest using SCMA in a massively dispersed access system with an ultra-dense network, NOMA, and fiber-based visible light communication architecture.

2. Architecture of 6G networks

Wireless it is anticipated that 6G networks' design would change dramatically from that of earlier generations, combining a number of innovations to accommodate cutting- edge technologies, cutting-edge applications, and changing user needs. Here is an outline of several significant components and ideas that may be included in the 6G network architecture, while the precise design will still change and be improved:

Network Intelligentization: 6G seeks to incorporate network intelligentization rather than just network softwarization. In order to support intelligent decision- making, adaptability, and learning, the network must be integrated with AI-based approaches and techniques. Network entities will need to provide a variety of functions, including as enhanced IoT functionality, wireless power transmission, content caching, computation, and communications [2].

Building on the ideas offered in 5G, network softwarization will progress even more with 6G. To achieve this, software-based virtual networks must be built using technologies like Software-Defined Networking (SDN) and Network Functions Virtualization (NFV).

Network slicing, which permits establishment of many virtual networks on the same physical infrastructure, will remain critical in 6G [3]. Heterogeneous Hardware Capabilities: 6G networks will be able to handle a variety of novel radio accessed through various interfaces, including THz communications and intelligent surfaces. To meet the various hardware requirements and updates, the design has to be adaptable and versatile. It may be possible to use an algorithm-hardware separation technique to enable quick response to changing hardware capabilities.

Network of Subnetworks: A crucial aspect of 6G will be the idea of a "network of subnetworks." Local subnetworks will be able to develop independently and update themselves in response to regional conditions and user requests. The rapid adoption of cutting-edge innovations is made possible by this localised evolution, which may take place in a small number of nearby cells without the requirement for system-wide modifications.

AI-Driven Upgrades and Coordination: AI-based techniques will be essential for making 6G networks intelligent and adaptable. In order to use AI approaches to dynamically improve itself, each subnetwork will gather and analyse local data. Through game and learning-based methodologies, inter-subnetwork coordination may be accomplished, assuring convergence and compatibility across developing subnetworks [4].

AI-Driven Upgrades and Coordination: AI-based methods will be necessary to create intelligent, flexible 6G networks. Each subnetwork will collect and evaluate local data in order to apply AI techniques to dynamically enhance itself. Inter- subnetwork coordination may be achieved by game- and learning-based approaches, ensuring convergence and compatibility across evolving subnetworks.

3. Technologies for 6G with AI

The 6G will be significantly different from other generations due to the tremendous development of wireless networks, which will be characterised by a high level of variability in several factors, including application kinds, radio access methods, processing and storage resources, and network infrastructures because of the diverse variety of new applications, effective utilization of wireless communications, processing, storage resources and a controlled manner utilization of network from edge to the core will be required. Finally, wireless networks create an increasing volume and diversity of data [6]. This offers up new possibilities for data oriented network operation and design for 6G, allowing for real-time additivity to dynamic network settings [5].

Big Data Analytics for 6G

It is the first naturally occurring usage for AI. Four analytics categories that may be employed with 6G are diagnostic analytics, descriptive analytics and prescriptive analytics in addition to predictive analytics.

Descriptive analysis explore previously stored data to take the insights into the performance of the network, to check the profile of the traffic, channel the conditions, user perceptions, and other subjects. It involves the exploration and analysis of data to uncover meaningful information and gain a better understanding about the past events. Diagnostic analytics enables that goes beyond descriptive analytics and aim to understand the causes and reasons behind certain events. It involves a deeper analysis of data to identify patterns, relationships, and correlations that explained the reason of occurring the events [7]. Predictive analytics focuses on analyzing the historical data and used it to make predictions such as weather forecasting and many more events. It involves statistical algorithm, machine learning techniques to identify patters, trends that can be helped to tell their future behaviour. Prescriptive analytics provides decision-making possibilities for resource allocation based on projections. It goes without saying that storing and analysing massive amounts of data raises worries about data security [24]. Simultaneously, we can say that it is condemning to know about the law and constitution directs the conventions and possessions in the circumstances of 6G, also remembering the necessities for equivalence the hazards and benefits.

Features/Technologies	Description
Higher Frequencies	Using millimeter-wave and terahertz frequencies to achieve faster data speeds and lower latency.
Intelligent Connectivity	Integration of satellite networks, terrestrial networks, and aerial platforms for seamless connectivity across various environments.
Massive MIMO and Beamforming	Enhanced MIMO systems with a larger number of antennas and advanced beamforming techniques for improved signal quality and coverage.
Heterogeneous Network Integration	Integration of different wireless networks (cellular, Wi-Fi, satellite, etc.) to create a seamless and connected network environment.
Edge Computing and Network Slicing	Deployment of edge computing infrastructure and network slicing for reduced latency and customized network instances.
Quantum Communications	Exploration of quantum communication technologies for secure and reliable data transmission.

4. MIMO Demonstrating For 6G wireless Organization

Conventional RICIAN and RAYLEIGH channel replica can give insights on competency dispersions and Doppler movements of signs shipped from transmitter to recipient. Utilizing this conjectural information, spatial Channel models develop the ideas of proliferation delays and the design the send together with get radio wire exhibits. By taking into account various compromises, MIMO frameworks may effectively further develop correspondence execution regarding unwavering quality, range productivity, and energy efficiency [8].

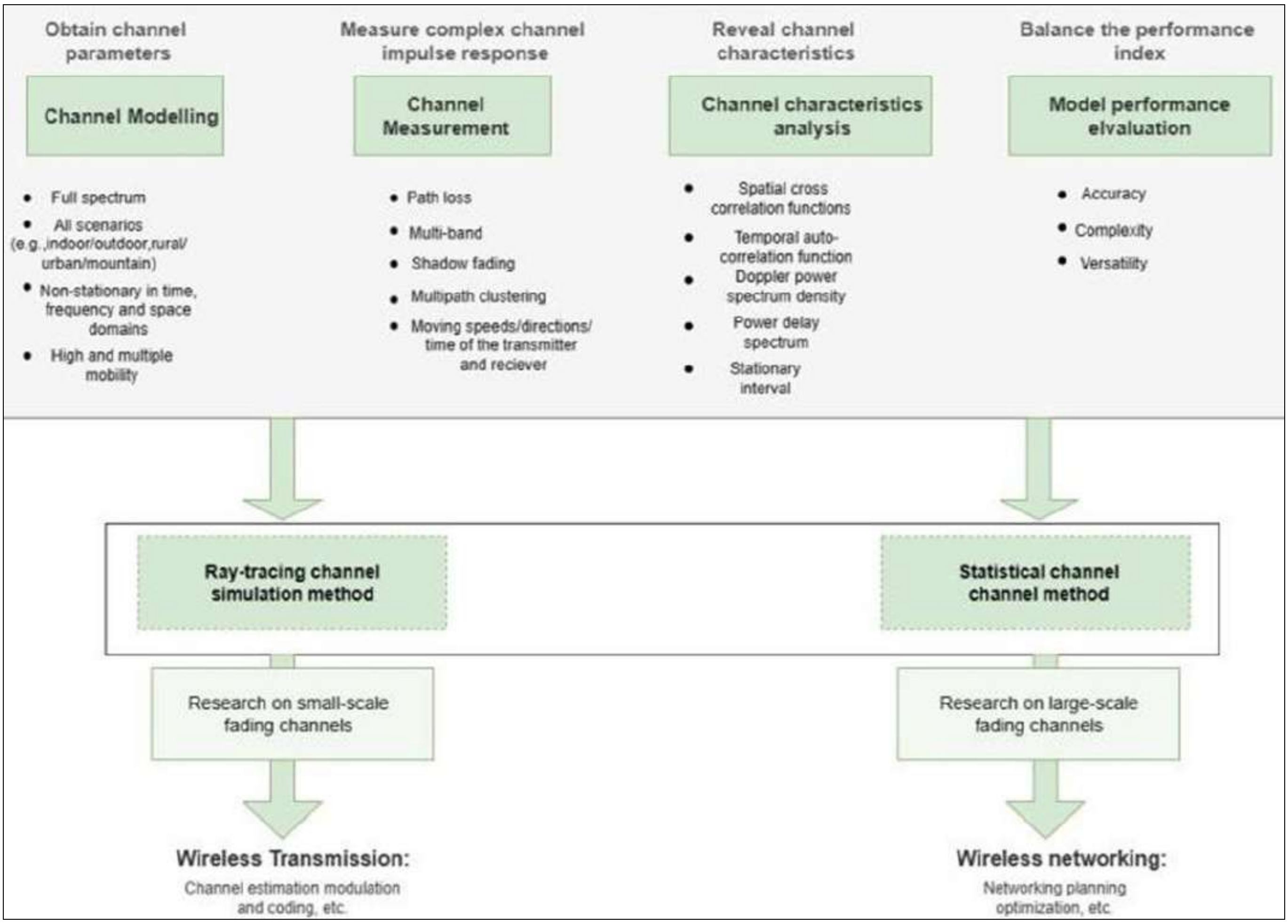
It is feasible for unmistakable communicate recieving wire and get radio wire matches to create separate sub-directs in MIMO channels because of changes in the positions of the components at the cluster's two closures, and this can cause the rakish boundaries as well as the recieving wire exhibits to have non-straight features [9].

Accordingly, the azimuth point of flight (AAoD) and height point of takeoff (EAoD), as well as latitude and longitude point of appearance and rise point of appearance (EAoA), are assessed for each wave in light of the mathematical areas of the waves and the course of action of the recieving wire cluster. Moreover, in 3D dispersing conditions, MIMO recieving wire exhibits with high spatial goal can find adjoining beneficiaries. For each dissipated multipath in 6G remote channels, the engendering pathways and precise boundaries in both the flat and vertical parts should be properly simulated [10].

Space and time Non-Stationarities

Due to the significant utilization of state of the art innovation in wireless organizations and the channel models will have novel elements together with explicit internal and external connections. Most of customary 5G channel models, including Victor II, WINNER+, and IMT-A, utilization the wide-sense fixed uncorrelated dissipating (WSSUS) speculation. To reproduce the non-fixed nature of channels at remarkably short spans, these models coordinated the time- development of the bunches to the fleeting variety of genuine correspondence settings. Thus, the above suspicion won't generally be right in 6G high-portability remote channels. Remember that 6G channel demonstrating expects to work on the precision of remote channel matching to genuine correspondence conditions, despite the non-stationarity of the channels ought to be considered from time/space or recurrence domains [12, 35].

In V2V channels of 6G, for instance, fast mobilities of the portable transmitter and recipient have non-fixed highlights in the space, time, and recurrence areas. In any case, in automated flying vehicle (UAV) conditions, multi-portability (UAV transmitter, ground collector, together with in motion bunches, for example), the vulnerability of a 3D in motion direction (huge rise point), non-stationarity in the time space, differentiations between ground to air or air to ground and aerial narrow or channels, and enormous shadow blurring all affect channel characteristics [31].



5. Huge MIMO Channel Displaying

The signal's flight and appearance ways make unobtrusive stage deviations in fixed-to-portable spread conditions. The distinctive qualities of the communicate and get receiving wire exhibits are similar in this situation, which might prompt the extremity source supposition in the transmitter together with beneficiary. Whenever we endeavor to put in MIMO innovation inside remote mechanism to increment framework execution, every radio wire has an unmistakable perspective in light of how the transmission and get radio wire exhibits are fabricated. The improvement multi-anteena innovation with the hundrerds of anteenas known as an enomourous scope receiving wire, has been extensively investigated in recent years to fulfil the significant traffic and connectivity required of 6G networks [23]. The far-field assumption, commonly known as the plane wave front assumption, is true only when propagation lengths exceed the 2M2/l Rayleigh distance where the l in the given equation is frequency and the M in the given equation is exibit size or the volume. The measurements in demonstrated this. The send get radio wire exhibit's transmission wave front is supposed to satisfy the round presumption, bringing about fluctuating precise boundaries and stage shifts for different radio wire parts inside a similar cluster. In view of the enormous scope radio wire exhibit elements of the gigantic MIMO channels, the groups are not generally fixed on the cluster pivot. As such, the sending or getting parts of a radio wire exhibit can recognize a cluster. Clusters should be utilized to delineate or mark out the non-fixed belongings and properties of the huge MIMO divert in both the spatial and transient domains [11, 34].

Generation	Technology	Characteristics
1G	Analogue	Basic analogue technology with FM and FDMA for voice communications. Low quality, limited capacity, no encryption.
2G	GS M	Digital technology using TDMA and GMSK modulation. Improved capacity, global standard, enhanced security.
2.5G	GPR S	Packet switching technology for better data rates (up to 50 kb/s) within GSM networks.
2.75G	EDG E	Increased data speeds for GSM Evolution (EDGE) technology, paving the way for 3G networks.
3G	UM TS	Introduction of CDMA-based technology, higher data rates, support for multimedia services.
4G	LTE	Long Term Evolution (LTE) technology with improved data rates, low latency, and all-IP based architecture.
5G	NR	New Radio (NR) technology with higher data rates, ultra-low latency, massive connectivity, and network slicing.
6G	Future	Speculative next-generation networks with advancements in AI, intelligent radio, IoT, and high-frequency bands.

1. 6G wireless network security

The 6G keen correspondence framework execution issue will bring about extraordinary defects in remote correspondence frameworks and frameworks [27]. Profound learning application attacks incorporate information contamination, control-stream capturing, order break, and disavowal of-administration assaults. It is essential in this occasion to analyze the fantastic security of 6G organizations. Endogenous organization security, which incorporates physical as well as organization layer security, is otherwise areas of strength for called security for 6G interchanges [36]. The production of a safe 6G remote channel plan that utilizes state of the art security innovation is presently in progress. The designing a safe 6G wireless channel architecture that makes use of cutting-edge security solutions is still a work in progress [29].

2. Evaluation of the performance of 6G communication networks: The accuracy, complexity, and adaptability of channel models may all be used to evaluate their performance. Comparing the statistical characteristics of channel models with actual data allows one to assess the accuracy. The quantity of model parameters, the amount of computation, and the length of the simulation may all be used to gauge complexity. The flexibility of the model framework is essentially measured by how well it tracks the propagation properties of communication channels over a variety of frequency groups and correspondence circumstances. An ordinary channel model ought to strike a split the difference between precision, intricacy, and adaptability [20].

3. 6G Wireless Communication Network Versions

This part portrays our 6G remote correspondence network thought. To that reason, we will initially introduce a speedy synopsis of portable innovation movement from 1G to 5G.

Mobile Networks 1G to 6G

Generation	Network Technology	Maximum Data Rate	Year Introduced
1G	Analog	Up to 2.4 Kbps	1980s
2G	GSM (Glob al System for Mobile Communications)	Upto to 384 Kbps	Early 1990s
3G	UMTS(Universal Mobile Telecommunications System)	Up to 2 Mbps	Early 2000s
4G	LTE (Long- Term Evolution)	Up to 100 Mbps(LTE- A:Up to 1 Gbps)	Late 2000s/Early 2010s
5G	5G NR (New Radio)	Up to 10 Gbps (Theretical)	Late 2010s
6G	Expected tom use advanced technologies like Terahertz (THz) frequencies, Artificial Intelligence (AI), and more	Expected to surpass5G speeds significantly	Anticipate d in the 2030s

6G wireless communication networks

It is possible that 5G networks would be insufficient to sustain the transformation of a ubiquitous mobile civilization into sentient life [30]. In terms of data rates and system capacity, spectrum efficiency, and access latency, for example, 6G networks are predicted to outperform 5G networks by a factor of ten to one. According to predictions, 6G will feature the following characteristics:

1. 6G should pervasive, interconnected network with the greater and strong coverage from land to sea to space. In other words, combined ground-water-air-space communication will be one of the most significant areas of 6G research. Visible Light Communication (VLC), NOMA, Unmanned Aerial Vehicles (UAVs), Subaquatic communication and other essential technologies are likely to be used in 6G networks [21, 22].
2. In order to achieve a 10 to 100-fold increase in data transmission, 6G is projected to operate at a higher frequency, such as millimetres-wave (mm Wave), THz, and visible light. However, significant signal attenuation and Signal degradation constitute a significant difficulty in high- frequency situations [23].
3. The network for 6G will be personalised and intelligent. 6G will achieve computerized mobile phone communications and develop into a centralized system with three distinct aspects. User-centric, data-centric, and content-centric, by help of artificial intelligence (AI) technology. Consider the conventional one-dimensional network-centric strategy [32, 33].
4. 6G network will be equipped internal security system. 6G will benefit from adaptive risk management, real-time dynamic analysis and self-awareness, by implementing trust and safety protocols [25].

The Internet of Everything (IoE) is predicted to generate massive volumes of data over 6G [26, 29]. In conjunction with other cutting-edge technologies such as cloud and edge computing, blockchain, and AI, 6G will allow intelligent things. In other words, 6G will finally allow for an omnipresent intelligent mobile ecosystem [37].

I. The Architecture of a Massively Distributed Access System

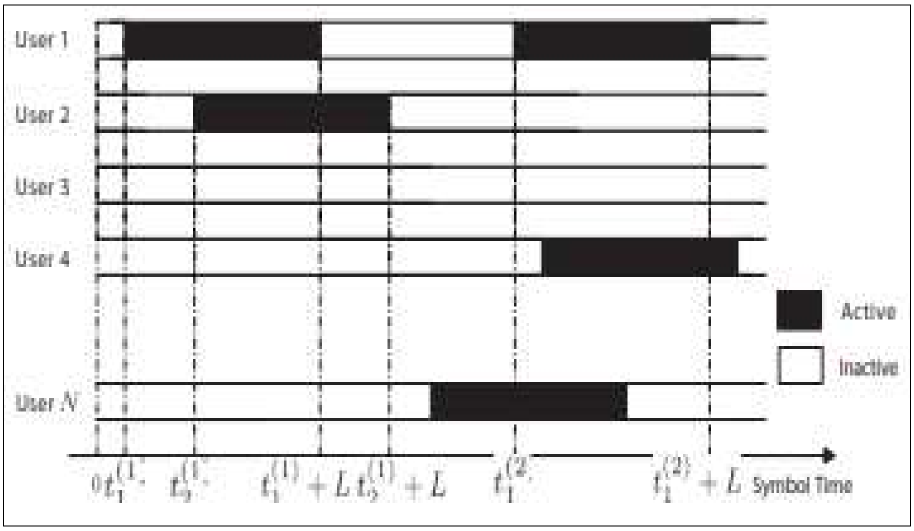


Fig 1: Time-domain structure of the grant-free NOMA scheme

Demonstrated, massively dispersed access systems often operate in crowded metropolitan areas like the downtowns of huge cities, sporting arenas like football stadiums, or industrial settings like enormous manufacturing factories [15, 16]. The use can let these situations accommodate enormous numbers of concurrently linked devices at ultra-high densities.

Remote or optical front hauls can interface geologically circulated APs or receiving wires to a focal unit (CU). Remote front hauls are defenseless against extreme remote engendering situations even in thickly populated metropolitan regions where generally dispersed radio wires are necessary [31]. Assuming that the size of the cell is essentially not exactly inclusion, the correspondence the bottleneck might move from remote access lines among APs and clients to remote fronthauls.

Besides, equal obstruction between remote access associations and remote fronthauls may debilitate the presentation of coordinated networks using in-band remote fronthauls [24].

The opposite hand, optical fronthauls are trustworthy, secure, and have a large bandwidth (resulting in fast data rates). To employ optical fronthauls, an optical infrastructure must be constructed, It very well may be costly and tedious. Be that as it may, when the foundation is set up, it might fill an expansive assortment of needs of applications for many years. Furthermore, optical fronthauls may be developed by exploiting existing pre-wired optical equipment in buildings and industrial sites. As a result, Long-term investment in optical fronthaul is prudent [14].

We may use Fiber Based Visible Light Communication (FVLC), which comprises of optical fibre fronthauls and VLC access lines, to relocate VLC access connections as near to customers as feasible. Each light-emitting diode (LED) in an FVLC system may be viewed as VLC access. VLC access lines can give improved QoS performance for a larger number of users because to the close proximity of LEDs to users. [17, 18].

It is critical to evaluate the overall network effect of optical fibre fronthauls by taking into consideration the complicated interactions between the wireless and optical domains caused by the combination of fibre fronthauls and VLC access links [19].

Conclusion and Future Scope

In this study, we offer an overview of channel modelling and characteristics research for upcoming 6G communication systems. The underlying trend in channel model development has been explored, which includes geometry- based stochastic models, highly dynamic channel characteristics, channel property optimisation, and bandwidth and spatial dimension expansion. The existing 6G channel models and characteristics were discussed. Because 6G channel modelling research is still in its early stages, future communication systems will necessitate extensive research.

This article is a modest attempt to provide a 6G research roadmap for the future. Following the discussion of enabling technologies, additional 6G evolution elements were identified. Despite the fact that only a partial image was supplied, we hope that our debate will pique your interest and lead to more study into how cellular networks will evolve in the future.

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