International Journal of Future Generation Communication and Networking
Vol. 14, No. 1, (2021), pp. 730–749

A DETAILED SURVEY ON NON-ORTHOGONAL MULTIPLE ACCESS USING SCMA SCHEME FOR 5G MOBILE COMMUNICATION

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ABSTRACT

The development towards 5G mobile networks is considered by an exponential development in communication traffic. The use of very compact grids, low-power, with precise high spatial usage is a capable way to allow for managing, increasing data rate issues in 5G networks must be solved. Cloud Radio Access Network (C-RAN) will open the access for many new requests in 5G. C-RAN is an upcoming mobile network design which can report a number of experiments by the operators to face while demanding the support of increasing end user's requirements. It is permitting energy capable network process and budget savings on baseband resources. To achieve above goals, latest methods and network designs with outstanding spectrum and energy competence routine should be established. As one of the latest methods, Sparse Code Multiple Access (SCMA) is used in the novel frequency domain of Non-orthogonal Multiple Access (NOMA) technique, in 5G communication. An enhancement rate and energy problem is present during the transmission in the channel as well as in the uplink and downlink process of mobile networks by equally considering power allocation, codebook assignment, and bit-error rate (BER). There are numerous experiments during the designing of SCMA decoders for passing the messages to meet the principles estimated from 5G networks. For the above quality, coder can arrive from the Message Passing Algorithm (MPA) which needs numerous exponential computations to control conditional probabilities in case of Gaussian channels with noise. The Log-domain Message Passing Algorithm (Log-MPA) for multiple access signals with sparse code gives a complete reasonable study on the difficulty of Log-MPA and traditional MPA. In this paper the various methods and techniques related to 5G are discussed to enhancing the services and applications of mobile communication.

KEYWORDS: 5G MOBILE COMMUNICATION, NOMA, SCMA, MESSAGE PASSING ALGORITHM, C-RAN

INTRODUCTION

The consistent growing number of mobile customers, smart gadgets and application complexity builds the device densities which also include device traffic loads, and at the end it needs conventional cell networks taking care of such issues. In this context, analysts, specialists, scholarly community and industries are working for the next generation networks. In these networks-based Internet of Things [5] (IOT) will help the people and things together. The fifth era (5G) correspondence [4] frameworks should oblige greater levels of popularity including enormous associations, high range use, lower latency, and so on.

The baseband unit of 5th generation wireless networks with the centralized control provides the low-cost services for the numerous users with guaranteed solutions can be provided through the C-RAN [3]. For instance, 5G requires one million electronic devices associations for each square kilometer which can't be compromise by conventional symmetrical Orthogonal Multiple Access (OMA) conspires because of their symmetry of time or frequency resources. While comparing the OMA with CDMA or Orthogonal Frequency-

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Division Multiple Access (OFDMA) using current trend networks, gives the proficient usage of access, is more appealing in 5G Networks. The examination of NOMA innovation is going on by several researchers and rather than the regular methodology of actual or orthogonal distributing the signatures that removes the interferences and multiuser interference or the noise is permitted in the Low-Density Signature (LDS).

SCMA is the most encouraging method among the entire non-symmetrical multiple access techniques in 5G Communications. When contrasted with some other methods such as LDS, SCMA can accomplish better execution because of the gain by the SCMA code word [6]. Near Maximum Likelihood performance with minor complexity can be achieved while introducing sparsity codebooks [8] of the Belief Propagation (BP) or decoders algorithms such as MPA used. Significant exploration works can be directed in improving SCMA decoders [10] to fulfill the uplink necessities of 5G. MPA is occupied with several exponential calculations to compute the outward data and likelihoods of the received signal.

In this survey, discussion about the survey of up-to-date techniques in mobile communication for 5G networks by providing a historic view of the field and also describing in detail of the SCMA scheme. This paper is structured as follows: Section II begins by describing various system models for 5G mobile communications. Section III provides the survey of comparing the existing platform for mobile communication using the different techniques like NOMA, C-RAN, SCMA and Message passing algorithms during the uplink and downlink of information in the channel. Section IV describes the different challenges and future scopes for mobile communication in the 5G.

1. SYSTEM MODELS FOR 5G COMMUNICATION

2.1 NON-ORTHOGONAL MULTIPLE ACCESS (NOMA)

NOMA has become a significant strategy in 5G correspondence. In NOMA a more number of clients can be involved in the channel than the OMA which gives the efficient spectral densities. At the receiver the multiple interference of NOMA filtered effectively. The SCMA has compatibility with LDS while making the codebook design. The performance of MPA along with SCMA [14] displays preferred execution over LDS-CDMA and LDS-OFDM. So, in 5G Network communication, SCMA has as a superior outcome because of the presentation of NOMA strategy.

All the user signals are multiplexed orthogonally in multiple access schemes. The figure 1, gives the idea of various classifications of 5G networks and the different types of NOMA as well as the types of CDMA also shown. Demonstration of the interference reduced receiver will give good results to detection support of simple receivers. The permitted computational power of a small amount of noise can be removed at the receiver in these modern mobile communication systems. In NOMA [13] with existing resources can be used by more users along with increasing the channel capacity. Each signal has different power from one another that may be superimposed. It can be recovered through successive interference cancellation. So, in this way the network can recover the weaker and stronger response.

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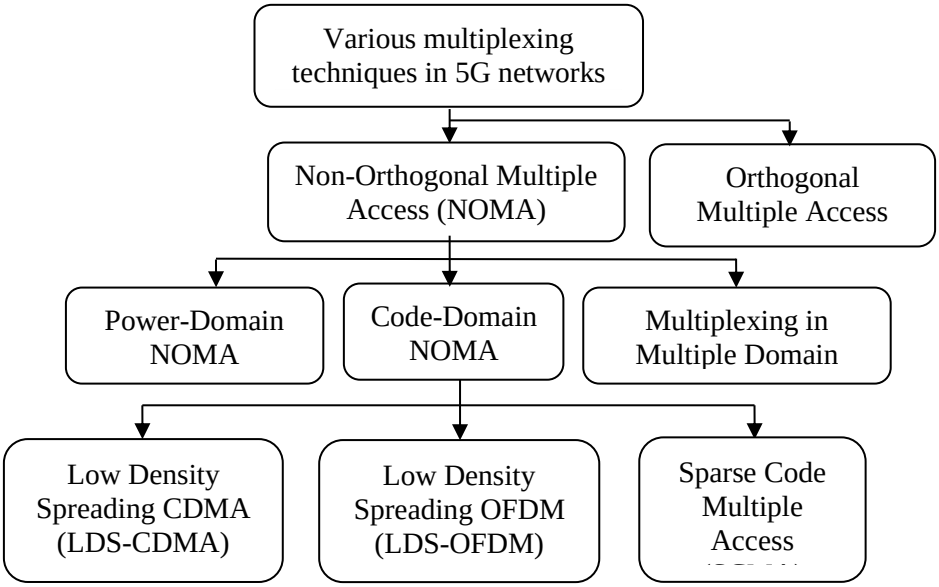

Figure 1. A classification of the Different multiplexing techniques under NOMA in 5G networks

Normally, NOMA agrees moderate interferences through non orthogonal resource allocation by means of allowable rise in complexity of the receiver. When comparing OMA with NOMA, NOMA allows more uses in non-orthogonal resource allocation. The dominant NOMA has divided into two categories as 1. Power-domain multiplexing 2. Code-domain multiplexing and this scheme also includes low-density multiple access (LDS CDMA, LDS OFDMA), SCMA, multi-user shared access, and pattern division multiple etc. Here the in sighted NOMA design is highlighted along with the opportunities, critics, challenges and future research, for taking new dimensions or further research in this area. The fundamental points of interest of NOMA incorporate the accompanying

1. Improved unearthly effectiveness
2. Low transmission idleness and flagging expense
3. Massive availability

2.2 CLOUD-RADIO ACCESS NETWORKS (C-RAN)

The C-RAN enables and supports visualization, coordinated multi-point access, cloud computing tools along with higher capacity and wider coverage. C-RAN is used as a centralized coordinated way and manages the mobility and interference in a formatted way. Due to vast connectivity, the massive qualities and spectrum scarcity, like many challenges facing C-RAN [12]. Hence, proper handling gives the better performance otherwise it may degrade those challenges. In 5th Generation Mobile network communication is able support more connecting devices while comparing with 4th Generation LTE systems say hundred times more per unit area. Though using OMA techniques in current LTE or LTE-A networks, the users can utilize the very limited orthogonal resources. In the same way the C-RAN networks also utilizes the very less orthogonal resources by the users. So, in both cases it can get better spectral efficiency through the orthogonal access to the above RAN networks.

Achieving small cells flexible control in a cloud computing, along with macro cells usage gives better total network volume in C-RAN is a hopeful solution for the cellular networks due to the spatial frequency reprocess. The recent trend is heterogeneous C-RAN architecture [16] plays an important role in NOMA. In C-RAN finding the power allocation and bandwidth are the technical challenges and still seeking the improvement in this context. In this consideration, this paper is investigating SCMA code book generation

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BER performance and power sharing for C-RAN carried out. The SCMA gives better performance when comparing total data rate performance of PD-NOMA to SCMA for the similar SNR, power allocations and number of users. The objective is to maximize the total sum rate of users by centralized radio resource allocation algorithm used in C-RAN through OFDMA based on coordinated multipoint network systems. Hence the Mobile to mobile communication is considered based on the architecture of information-centric networks (C-RAN) and also able to get the information about the users, bandwidth allocation based on the software visualization. Here, considering the evaluation based on an optimal power allocation, delay-QoS on power, effective capacity and the gain from caching content are accessed.

2.3 SPARSE CODE MULTIPLE ACCESS (SCMA)

SCMA could be a technology that is built up on the premise of LDS mechanism. This is essentially a non-orthogonal multiple access technique to accomplish enormous users that might connect large devices within forthcoming years [17]. Presently, the mobile communication technology is operating over wireless which is to pose consumer knowledge and orthogonal signals, so properly decipher the information at the end through the orthogonal characteristic.

In figure 2, the synchronous transmission SCMA system explained the transmission, which can associate SCMA encoder and communicate at least single layer through SCMA system. Every user should engage more than one SCMA layer. Here, it is assumed that every user had at least barely one SCMA layer. The communicated signal received from every layer which multiplexed to a few orthogonal resources. Due to the non-orthogonal characteristic of the SCMA system [18], the entire diversity of layers is also over the quantity as concerns orthogonal resources.

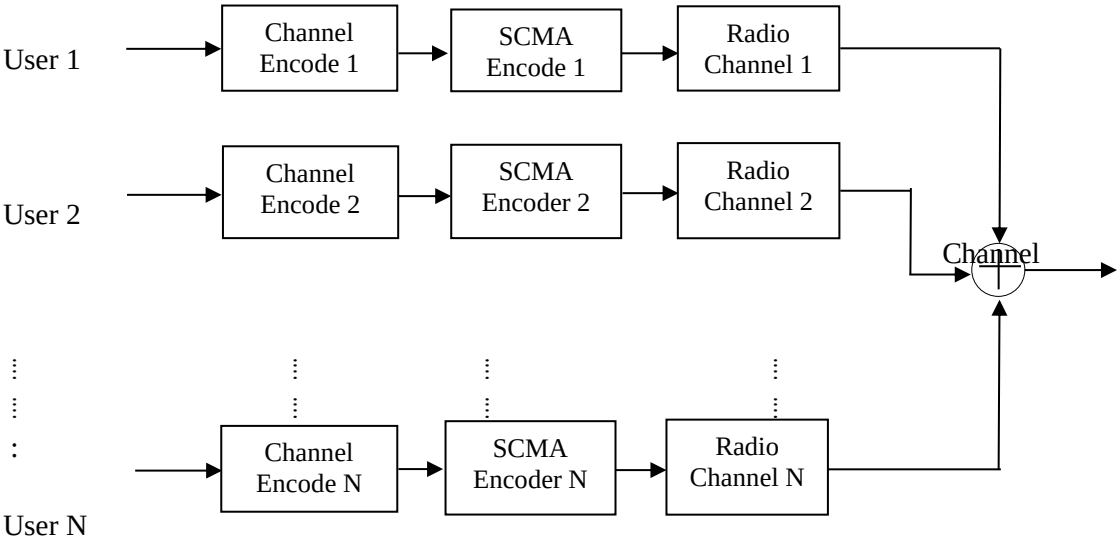

Figure 2. Block diagram of uplink SCMA system

The main functionality of SCMA decoder [21] which is processed fortuitous signal coming commencing every layer by using optimal MPA. The LLR of coded bits are calculated around the signals which send for decoding over the decoder, since the last interpreted bits are acquired.

2.3.1 BASIC PARADIGM OF SCMA

The biggest drawback of those orthogonal multiple accesses are the restricted variety of signals that area unit well-matched, but, the numbers of access users are limited. The SCMA overcomes this drawback. It connects the equivalent codebook of customer signals in step with the distributed medium to the equivalent code word, which can broadcast it. This methodology makes the system operation to an exact level to complete the surge

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within the variety of users. During this basic structure model of SCMA [24], the coded bits of an information torrent area unit straightforwardly map into code word from a codebook engineered supported a multi-dimensional constellation. The SCMA system performance chiefly is mainly depending on SCMA codebook and decoder. The MAP is an optimal multi-user joint detection, though the large storage capability and higher quality usually which can't be utilized Because of the structure of density unfold spectrum in SCMA, an inconsistent message passing methodology that estimated the most probability ratio detection which degrade the performance.

Generally, the SCMA has distinguishing uniqueness which can be evaluated with dissimilar multiple access techniques. The overloaded characteristic of SCMA which builds a non-orthogonal multiple access achievable in the sparsely of the code word renders by employing the suboptimal message passing algorithm [26]. Hence, the even though sparsely is in the code word in SCMA, which can detect the receiving signals area unit still time overwhelming. The blind algorithm looks at every probable signal lying on all OFDMA subcarriers which brought the expanding procedure quality during MPA.

2.3.2 SCMA SCHEME

The implementation fundamental structure of SCMA which it likes as a LTE transmission model, but the major design variance is in terms of spreading and modulation. The SCMA consumes very less density spreading; basically, custom in the LDS method above CDMA, hence it is denoted as sparse spreading [29]. The SCMA design is derived from the codebook of dual optimization in multidimensional modulation [30] and sparse spreading pattern. The primary objective of the codebook proposal is to offer best distance possessions which includes the facts of the entire multidimensional gathering for maximizing the gain of shaping or coding. In addition to that the feature of SCMA codebooks has an opportunity which contains a minor number of projected points for every resource. By nature, the multi-dimensional codebooks allow two constellation points which crash several non-zero mechanisms, as a result, divided non-zero mechanism [31]. The equation 1 described the receiving signal at base station as follows,

$$y = \sum_{k=1}^{K} diag\,(h_k) x_k + z \quad (1)$$

$\mathbf{x}_{k-}$ and h_k are vectors
k- SCMA fading channel
z- Additive complex Gaussian noise vector
K- Multiplexed to N orthogonal resources.

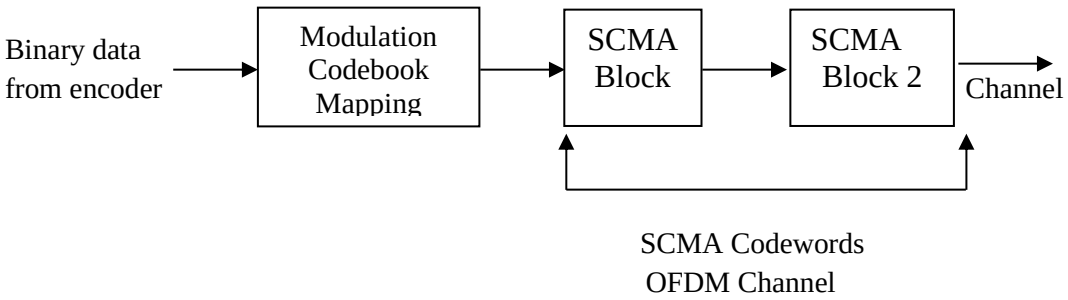

Figure 3. Block diagram of multiple access with SCMA

In figure 3 described about the instance of multiple access of a user through the SCMA layer-specific codebooks. As subsequent by using encoder for every user's coded bits which are related to SCMA codeword [34] consistent with its allocated codebook. Further the combined above OFDM symbols and tones are communicated over SCMA blocks.

2.3.3 MESSAGE PASSING ALGORITHMS (MPA)

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The fundamental rule of message passing formula breaks down a computationally troublesome drawback into several small problems that are simple to determine. The aim of the decoder is to determine the subsequent possibility of each bit, therefore the fundamental process of the message passing method throughout the emphasis for estimating the external chance and also the following probability supported by the earlier prospect and the graph model organization.

2.3.4 MAX-LOG-MPA DECODER

The MPA set of rules can decode in a technique which is near most advantageous in attainment to incorporate more exponential process, which has huge difficulty for implementation in hardware. It is significantly decrease its interpreting overall performance. Despite the fact that the interpreting method named Max-Log-MPA had a lack of accuracy due to complexity, resultant considerably reduced. Hence, it creates viable and easy for putting into effect the interpreting mechanism. By keeping over the simplified method, a basic SCMA gadget is used in Max-Log-MPA during the simulation process, and evaluated with an additional complex MPA understanding.

The deciphering difficulty of the contemporary message passing set of rules utilized by SCMA remains prohibitively excessive. In this paper [44], by way of inspecting the network shape of SCMA codeword, it suggests a less difficult deciphering set of rules depending on LSD. It avoids the comprehensive look for all feasible assignments and simplest deems signs inside a hyper sphere. The LSD may be regarded an intensity first tree search algorithm, it similarly advocate numerous techniques to dock the overabundance visitation nodes can able to diminish the size of the search tree.

2.3.5 MPA AND ITERATIVE DETECTION AND DECODING

Iterative detection and decoding is a manner to enhance the BER which attains the aid of changing the soft records between decoder iteratively and the detector. It has been employed in MIMO discovery notably and changed into primary planned to SCMA [48]. This algorithm affords a good act on SCMA decoding, but its difficulty is facing exponential growth with the amount of superposed operators on one physical source element.

2.3.6 WEIGHTED MESSAGE PASSING ALGORITHM

MPA is planned to be used for decoding SCMA [15] codewords, because the linking between consumers and resource fundamentals can be signified by dynamic graphs. When few codewords are superimposed on one source component and decode them, without rational about factor graph, then to translate codewords using other approaches that does not need duplication. To present a weight feature to extend the chance of the codewords that are overlying into the established signal. A decoded codeword is having additional quantities of SCMA codewords on one resource Component.

3 LITERATURE SURVEY

3.1 COMPARISON OF NOMA

The NOMA schemes will be classified to mainly 3 classes [50] named as power-domain NOMA, code-domain NOMA, and multiplexing of NOMA in multiple domains. Typically, the power-domain NOMA helps more number of users amongst the parameters like constant time (or) frequency (or) code resource block with various power stages. Code domain NOMA will care about multiple broadcasts amongst constant time and frequency resource blocks by different users. The third one, Multiplexing of NOMA in multiple domains is same as the multiple antenna based NOMA scheme. It is proposed to maximize performance by the way of

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improving the ergodic capacity while optimizing power. In 5G conjointly represent energy strength challenges attributable to the rise in variety of wireless devices. Therefore, its vital to analyze dynamic user grouping, power allocation and time allocation conjointly for NOMA with RF energy gathering.

Table. 1 Comparison of NOMA

Ref. No. & Author Name	Technique Used	Performance measure	Performance Value	Remarks
Z. Yang [79]	Dynamic NOMA power allocation scheme	Outage probability, Average rate	Achieve a better spectral efficiency	This novel D-NOMA power distribution pattern can be useful to both downlink and uplink NOMA circumstances.
R. Jiao [60]	NOMA-based cooperative relaying system	Achievable rate performance	NOMA constructed CRS reaches higher practicable sum rate than the regular CRS	NOMA method with CRS can communicate two signals in both slots, while regular CRS will transfer one signal through the parallel time.
J.B.Kim [32]	Cooperative Relaying System	Spectral Efficiency	Attain more spectral efficiency than the traditional	The sub-optimal power distribution scheme for NOMA that delivers almost the same routine as the optimal power distribution for high SNR.
M. Basharat [47]	Exhaustive Search Algorithm (ESA) and Mesh Adaptive Direct Search (MADS) algorithm using MATLAB	Performance of Complexity comparison of ESA vs MADS	Resource block index(K) versus user index(N) EX: K = 4 and N = 3 ESA -100,000 MADS -16,000	MADS algorithm is near to or different to the ESA in most of the circumstances where near to optimal solution with less complication.
Z.Q. Y. Cai [81]	Power domain NOMA, Code domain NOMA, NOMA multiplexing in multiple Domains	Spectral efficiency, out-of-band leakage, bit error rate	Improved spectral efficiency. Adopted to decrease out-of-band leak	The less difficulty near-optimal MPA detectors can attain better show than SIC detectors. LPMA can realize many levels in both the power and code domain
M. Moltafet [50]	Power Domain non-orthogonal multiple access (PD-NOMA)	Resource allocation problem	PD-NOMA-complexity – 360 SCMA-complexity -1536	The SCMA method reaches better sum rate in contrast to the PD-NOMA method, and the system complication of SCMA difficult than PD-NOMA
M. Salehi [52]	Poisson Point Process, Matern Cluster Process,	Accuracy probability, Joint PDF of N-ordered Random	Precision probability for PPP with $\alpha = 4$ is about 0.84	The consequences show that the precision chance is collective with respect to the path loss exponent because it

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	Thomas Cluster Process	Variables		is not depend on the base station power in the PPP model, band area in the MCP model, and scattering adjustment in the TCP model.
Md Fazlul Kader [54]	Full-duplex (FD) NOMA arrangement for a supportive relay distribution network termed as FD-NOMA-RS	Ergodic sum capability, outage likelihood, outage overall capacity	Significantly better outage performance	FD-NOMARS holds ability as a potential method for enlightening the 5G systems' performance than its equivalent.
S. M. R. Islam [64]	Power domain NOMA Super position coding (SC) Continuous interference cancellation (SIC)	Capacity analysis, power allocation strategies	Both the spectrum efficiency and the EE by the NOMA scheme are advanced values than the OMA scheme.	A broad view of some operation issues, including computational effort, error broadcast, arrangement backgrounds, and calibration status.
S. Sharma [65]	Message-passing and successive-interference-cancellation algorithms	Spectral efficiency	Better symbol-error-rate (SER) than existing system	The sum rate analysis substantiates the efficiency of the NOMA system

3.2 COMPARISON OF C-RAN

C-RAN is a complex design where baseband resources are combined, so that they can be united between base locations. The idea of C-RAN was initially presented by the name Wireless Network Cloud (WNC) and formed with the idea of Distributed Wireless Communication System (DWCS). The parameter metrics as high bandwidth, strict inactivity and jitter as well as less cost transport network. C-RAN must provide a consistency that is improved or comparable to regular optical networks in the name of Synchronous Digital Hierarchy (SDH), which achieved high reliability [12]. Some of the authors discussed the various techniques incorporated in C-RAN to perform better results are tabulated.

Table. 2 Comparison of C-RAN

Ref. No. & Author Name	Technique Used	Performance measure	Performance Value	Remarks
A.Sultana[7]	SDN enabled C-RAN, SDN-enabled Spectrum Auction Mechanism (SDN-SAM)	Total no. of bands, System bandwidth, Transmission power, Noise power	5-50 10 MHz 20 dBm -144 dBm	It is confirmed that the scheduled band mechanism for SDN-SAM mollifies the properties of reliability, individual rationality and economical stability.

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Checko[12]	C-RAN for Capacity Boosting	Multiplexing gain Increasing throughput	Reduction in signal sampling rate subcarrier compression	C-RAN enables energy effective network task and possible cost investments on base-band properties and expands network capacity by accomplishment load matching.
L. Ferdouse [38]	Probability established user association and power allocation (P2UPA)	The nearest distance method, The determined SINR based user association method	Obtained least data rate with maximum received information	Energy productivity in C-RAN represents the ratio of the complete throughput to the entire energy consumption
L. Ferdouse [39]	Double sided auction based spread resource allocation (DSADRA) method	Bandwidth consumption percentage, signal-to-interference proportion threshold value	System bandwidth 10 MHz, Minimum data rate 50-140 kbps, Transmission power of RRH 30 dBm, Noise power spectrum density -144 dBm/Hz.	The proposed algorithms confirm to unite to a stable provision despite different appearance rates of users and SINR values of the C-RAN systems.
L. Ferdouse [45]	Throughput aware SCMA-CB selection (TASCBS) method, iterative level-based power allocation (ILPA) method	Sum data rate, Energy efficiency performances	The TASCBS method results in a stable data rate and better energy saving.	The future methodologies TASCBS and ILPA are significant for practical operation of SCMA sustained downlink C-RANs
Mohammad [57]	Minorization-maximization algorithm (MMA)	Convergence, Computational complexity	The performance of the recommended explanation algorithm is adequately close to the optimal explanation	SCMA based C-RAN improves the performance of the scheme significantly even for the indefinite CSI.
R. Wang[62]	Multiple Radio Access Technologies (Multi-RATs)	Joint Resource Allocation, Mobility Management, Traffic Steering, Service Mapping	Better resource allocation, functional modules to the computing properties	C-RAN to achieve innovative traffic navigation and mobility organization based on customer awareness and flexibility forecast in Multi-RAT existed networks.

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3.3 COMPARISON OF SCMA

SCMA is a substitute for QAM variation and LDS distribution in a multi-dimensional codebook. This allows SCMA to learn from shaping or secret writing gains of multi-dimensional constellations as hostile easy duplication code of LDS. SCMA will get higher BER performance than LDS [53] with similar coding quality because of its shaping gain, by planning the issue graph and mapping functions. Many researchers have done analysis and obtained various performance metrics from the techniques for the 5G communication which are tabulated here.

Table 3. Comparison of SCMA

Ref. No. & Author Name	Technique Used	Performance measure	Performance Value	Remarks
A. Bayesteh [6]	Low-Complexity SCMA Detection	Enable low-complexity detection, Reducing the number of calculations	60% complexity reduction	The reduction of the complexity calculates on the capacity of the quantization regions to mitigate the transaction between complexity and attainment
C. Yan [10]	Turbo Trellis Coded Modulation (Turbo TCM) technology	Bit Error Rate	Better BER performance	Recommended codebook method with incorporate SCMA achieved improvised attainment in BER when compare with SCMA and conventional codebooks through AWGN channel.
Chao Dong [11]	Iterative codebook optimization algorithm	Arbitrary channel coefficients	The proposed optimization algorithm still has better performance	Improvised codebook and MPA demonstrates excellent results at receiver end.
Cheng Yan [13]	Downlink multiple input multiple output-mixed sparse code multiple access (MIMO-MSCMA) system	Bit error rate	Improvised the confluence consistency of the noticed codeword	MIMO-MSCMA improvised the confluence of acceptability which noticed codeword in each describe technique evaluate through MIMO-SCMA at receiver MPA
C.Cai [14]	Multi-dimensional SCMA (MD-SCMA) codebook design	Power efficiency or Spectral efficiency	Improved performance of BER on top of LDS	The average energy, the minimum sq. Euclidian distance and therefore the PAPR of mother codebook are

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				analyzed.
D. Zhai [17]	Cost-efficient algorithm	Energy efficiency performance	Total power consumption decreases	Cost economical algorithmic program to optimize the codebook style and assignment to reduce the machine quality of the MPA used for SCMA detection.
D. Zhai [18]	Iterative algorithm	Optimal power splitting ratio	Provide more energy to mobile devices	The power splitting ratio should be optimized to achieve a tradeoff between data rate and energy harvesting rate.
Heo, N [21]	Channel Estimation Schemes in the SCMA Codebook Reuse Channel	Sparse Pilot Based Channel Estimator (SPCE) Weight Regularization (WR) method using Overhead Reducing Channel Estimator (ORCE)	SPCE achieved in terms of gain of around 0.5 dB on top of UCE method at FER of 10^{-2}	Analytical sophistication of the ORCE is little for multiplying of 33 and adding of 41 by comparison with SPCE.
F.Wei [23]	Low complexity decoding algorithm (LSD-MPA)	Computational complexity	Well tradeoff between the BER performance and computational complexity	The advanced LSD-MPA's the facts of multiplication and summation have been decreased which concerning of first order scale evaluate with the traditional MPA
Nikopour [29]	Low Complexity Repetition Technique, Sub-optimal approach	Shaping Gain	Overall spectral efficiency is 2.25 bits /tone	Advantages of the proposed method provide potential gain of multi-dimensional constellation shaping gain.
Nikopour, E [30]	Multi-user SCMA (MU-SCMA)	Power sharing, Rate adjustment,	Low Complexity Approximation	MU-MIMO methods described area unit sustentation of spatial field pre-coding. It included multiplexing for substantiate benefit for improvising transmit feature procedure sophistication

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J. Peng [34]	Gaussian Randomization Algorithm, mapping matrix design algorithm	Bit Error Rate (BER)	Better BER performance, complexity reduction	Demonstrated that the recently designed codebooks will enhance the BER performance, significantly once the SNR is high.
Linsheng Zhang [46]	High-performance blind detection algorithm, SI-SD Blind detection algorithm	BER performance	Significant gains in performance and complexity	The simulation result exhibited the attainment conventional detection regulation include SI-SD proposed and compare with MAP detection. As a result, it exhibits best for gaining and complexness
M. Moltafet [51]	Message passing algorithm-based successive interference cancellation detector	Sum rate of the network	Improved the spectral efficiency.	Novel MA method with power and code applied in 5G for sending multiple signals over sub-carrier.
M. Taherzadeh [53]	Low complexity reception techniques	Sum of receive signal power with respect to noise ratio	Overall performance in terms of efficiency, spectral put to 1.5 bits/tone.	The SCMA is used possibly at destination system which utilized for performing in every multiple communication such as up and down link transmission consequence of forthcoming wireless communication
M. Taherzadeh [54]	SCMA Codebook design	Constellation Shaping Gain	Gain is over 2 dB	Advantage of SCMA over LDS is its inherent shaping achieve due to the fact of multi-dimensional constellations style.
Roya Alizadeh [63]	VIVADO HLS Synthesis	Latency, Complexity	By analyzing co-simulation, the SCMA decoder be able to perform clock rate of 9.54ns	To find the most effective resolution, a neighborhood × time complexness analysis was performed with supported style house measurements.
Roya Alizadeh [64]	SCMA Decoding Area × Time Analysis	Area × time performance	Area × time performance values for 10ns - 110 for 20 ns -123	Solution a pair of which has orders demanding channeling, unfolding and maltreatment BRAM which considered taken into

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				explanation the finest in terms of latency, resource operation and power strength
S. Zhang [66]	Low complexity decoding algorithm, Energy Efficiency Analysis	Reasonable complexity, energy consumption	The Log-MPA method reduced additional incurred time of 20% and combined 50% extra users	SCMA theme gives in addition a couple of get admission to functionality with inexpensive satisfactory and electricity consumption, and hence, is concept to be associate in nursing strength reasonably priced strategy for 5G Wi-Fi conversation structures.
W. Zhu [71]	Random subcarrier assignment (RA-SCMA) scheme	user power pnk user rate rnk	By calculating average improvisation around 22.5% when compared with RA-SCMA and 32.4% OFDM	The proposed OFDM and RA-SCMA which designate enhanced SCMA above OFDM in spectrum strength.
Y. Li [74]	Codebook Assignment Algorithm	Uplink sum-rate optimization, shaping gain, power allocation	Overloading factor is 150%, Best power allocation performance	A joint codebook assignment and power allocation algorithmic rule is established
Z Yang [77]	Uplink SCMA	Average sum rate	SCMA = 25bits /s OFDMA 20 bits / s	The average add rate of SCMA is superior there to OFDMA, particularly within the high SNR systems
Z. Li [79]	Joint Codebook assignment and power allocation	System sum-rate	Power allocation is equal to optimal	Optimal power allocation technique is established victimization gibbons optimization

3.4 COMPARISON OF MESSAGE PASSING ALGORITHMS

The encoding and decoding process of 5G communication is performed along with SCMA scheme is proposed using MPA. Generally, the BER [53] presentation of the actual MPA and future approximations will be calculated with the value of Log-likelihood ratios. The author defined a basic MPA algorithm based on operating the exponential functions supports the novel algorithm that initiates sub-optimal modelling of the Gaussian noise combined with the polynomial allocations to decrease computational difficulties initiated by exponential functions.

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Table 4. Comparison of Message Passing Algorithms

Ref. No. & Author Name	Technique Used	Performance measure	Performance Value	Remarks
C.Wei [15]	Weighted message passing algorithm	Probability values, Complexity Analysis	Codewords' probability values bigger weight	The more the superposed codewords probability value is the higher weight factor when it obtains.
Ghaffari, M [26]	First estimation (ψ1′(d)) due to fat-tailed Cauchy-like distribution The further two density functions are ψ2′(d) and ψ3′(d)	The novel MPA algorithm BER performance is compared to the three other estimated MPA performance	ψ1′(d) of Block-Error Rate (BLER) performance loss is close to 1-dB like the two Block-Error Rate (BLER) performance loss ψ2′(d)= ~0.4 dB ψ3′(d), = ~0.25 dB	Improving the BLER difference of ψ3′(d) to 0.15 dB. It's amount mentioning that BLER loss of ψ1′(d) is almost to 1-dB after Turbo decoding.
H. Zhang [31]	Multi-stage MPA	Signal to noise ratio (SNR), Power allocation	High SNR, Computational complexity is reduced	The flexibility of Multi-stage MPA algorithm is giving better results of the difficulty and performance of an adjustable iterations task to each stage permitting to the user's SNR level.
J. Liu [33]	Log-MPA decoding process	Log-Like hood ratio	BER & BLER performance	Log-MPA outperforms MPA in fixed point recognition, especially with few countable bits
L. Tian [42]	Proposed Construction Algorithm, RR-MPA detector	BER performance Analysis	Performance improvement is high, better tradeoff between performance and spectrum-efficiency	While increasing the minimum Euclidean distance of the constellation then the error probability can be dominantly decreased when its theoretically studied

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L. Yang [44]	Sphere decoding (SD-MPA)	BER performance Analysis	BER performance and complexity reduction	Performance and complexity can be found dynamically
M. Jia [48]	Improved Partial Marginalization Message Passing Algorithm (IPM-MPA)	Energy efficiency of SCMA scheme	Decreasing the number of computations in MPA algorithm while keeping the BER at a workable level	The computation of IPM-MPA is same as PM-MPA, but it is lower than that of MPA 2) The better BER performance in IPM-MPA acceptable level when associated with PM-MPA. 3) When obtaining the code words in IPM-MPA updating the communication more efficient than PM-MPA.
M. Kulhandjian [49]	Exponential Message Passing Algorithm (MPA)	BER	The permutation based error rate is Eb / N0 = 18dB and conventional SCMA schemes about 10-3 and 10-1	When Comparing BER performance of SCMA with the permutation-based SCMA it gives better results
S Zhang [67]	Proposed Log-MPA algorithms	Complexity, Efficiency	More than 50% complexity reduction and energy efficiency	SCMA offers more multiple access with reasonable barrier and also energy efficient approaches is surveys.
Y. Han [72]	Detection complexity, Log-MPA iteration	Higher average aggregate energy efficiency	The performance of decoding complexity and overloading factors are moderate and better respectively.	The single SCMA can balance and achieves better between overloading factor and the decoding complexity.

4. RESEARCH CHALLENGES AND FUTURE DIRECTIONS

In the fourth generation (4G) of cellular networks, OFDMA is planned as an associated economical multiple access technique to handle the coming challenges [76]. Succeeding generations of cellular networks ought to be designed to handle existing challenges like spectral potency and energy potency. NOMA s is a vital

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authorizing technology for realizing the 5G key routine requests, as well as high system throughput, minimum latency, and enormous connectivity. The NOMA standard is kind of general and its presentation isn't restricted to mobile networks. C-RAN could be a novel mobile specification that has the probable answer to the encounters. C-RAN as well as inexperienced field deployments, that establish the system from scratch, also as preparation of extra cells for enhancing the capability of associate existing networks. Moreover, the network has a tendency to list totally different phases of C-RAN preparing to control its complete potential. A serious challenge facing future networks is economical utilization of resources. Several articles survey the progressive literature printed on C-RAN helps the mobile network operators to form associate optimum selection on reading methods.

The SCMA code-book style is even more difficult as multiple layers are multiplexed with totally various code-books. Present necessary study problems in SCMA space represent reasonable codebook style, fast secret writing computation so on. The shaping gain of code-book is the main source of the performance progress compared to the direct replication of QAM symbols. The most challenge of SCMA is its high detection and decoding complexity even sparse signature sequence is applied. The detection and secret writing complexity is even higher once a massive size constellation and a massive variety of users are employed. The challenges of the MPA technique [81] over the traditional encoding method trend the researchers to attain strategies that decrease the complexities of the SCMA receiver systems.

5. CONCLUSION

Mobile networks within the coverage of macro cells can be implemented to enhance the network capability and quality in homes, offices and public areas. As a promising mobile network, NOMA has been presented to be compatible with different key varying techniques for 5G communication. Because of the demand for leading level services and also the limitations of the accessible information measure for cellular networks, applying new techniques and ways to boost spectral strength in the fifth generation of cellular networks is incredibly vital. SCMA was recently projected as a communication technique for 5G wireless communication. The SCMA decoder rule supported the MPA which supports more during the signal received.

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