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Social and Economic Contribution of 5G and Blockchain With Green Computing: Taxonomy, Challenges, and Opportunities

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ABSTRACT In recent years Fifth Generation (5G) technology is the most recent advancement in a wireless communication network. There is the advent of using the 5G with diverse data structures. The Blockchain (BC) has become an approving adoption for decentralized, peer-to-peer, distributed transparent ledger systems with a diverse data structure. The use of 5G with BC is an emerging trend in communication technology. The elasticity of 5G with BC enables many applications to reciprocity information molds it a fast, transparent, consequential, and safe for transportation of data in this smart era. Green computing (GC) is presently the intense optimistic tactic for the integration of smart technology in a diverse and distributed world of power consumption. This Systematic Mapping Study (SMS) has been analyzed by cautiously elected publications between 2016 and 2020 in well-putative venus. This study analyzed the advanced research on power consumption solutions for BC-based 5G communication, Moreover, a taxonomy of 5G based on green BC and GC in various areas is presented. Furthermore, Green energy renewable communication (GERC) problems are being observed in this research by integrating three discrete technologies such as 5G with green BC and GC also along with smart systems. Lastly, the research gaps had been bestowed to render future directions for the researchers in 5G with green BC and GC as the solution for rechargeable data packets.

INDEX TERMS Fifth generation (5G), blockchain, green computing, green blockchain, renewable energy, SDN, WPT, systematic mapping study (SMS), criteria.

I. INTRODUCTION

Fifth Generation (5G) is the most trendy technology in this smart era. For smart homes, transportation, TVs, health-care, farming, agriculture, banking system, industries, furniture items, and cities smart technology is smartly contributing with 5G as shown in figure 1. 5G applications had varying requirements in terms of bandwidth, speed, and latency of auto rechargeable devices with many different factors and energy. High band frequency is having great bandwidth, that is obtainable to transfer large data. Wavelength spectrum with multiple bands like the high band, mid-band, and low band can build 5G networks in various ways. The best transmission rate in 5G is nearly 20GB/sec which offers great interconnection with low latency [1]. Autonomous vehicles and many other smart devices are being used in augmented reality with 5G for fast and reliable communication [2]. This smart era of contemporary technology with smart devices might be reached up to five hundred (500) billion in number by 2030 [3]. This nimble network bandwidth named 5G with the smart system is going to rule on this world and ornament more crucial to its security which is a major agitation [4]. The consolidation of radio ideas in [5] such as ultra-dense networks, massive machine (MM) communications, massive Multiple-Input Multiple-Output (mMIMO), device-to-device (D2D) moving networks and ultra-reliable can allow 5G as in figure 2 to assist the anticipated growth in mobile data volume while developing the limit of application zone that

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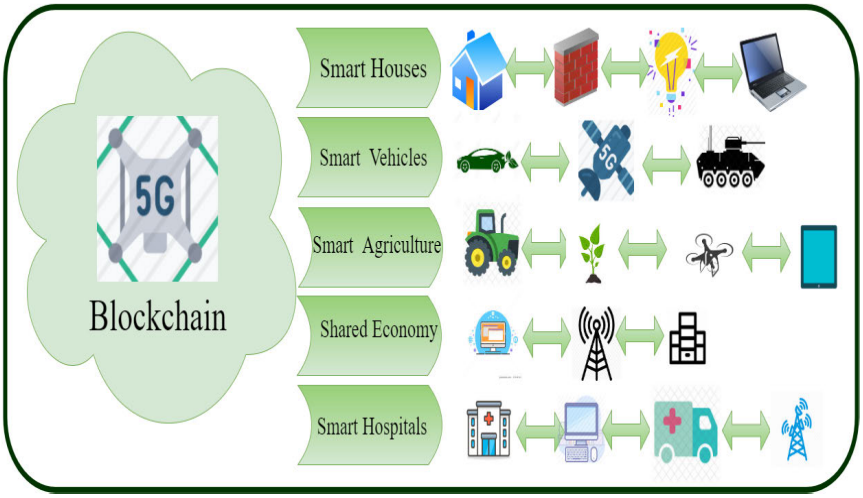


FIGURE 1. Smart system.

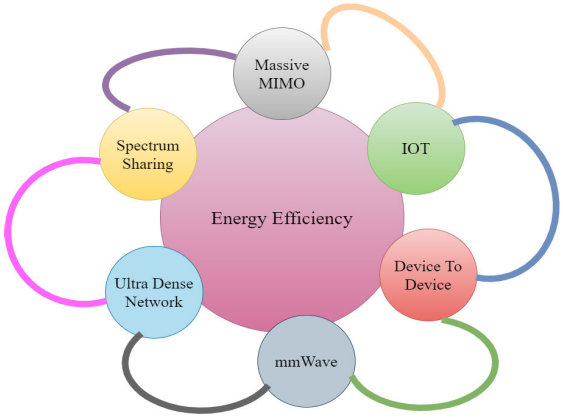


FIGURE 2. Energy consumption.

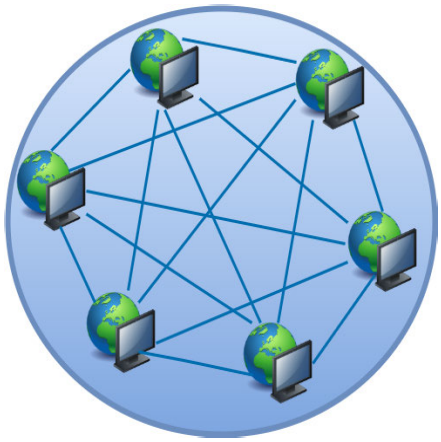


FIGURE 3. Peer to peer network.

mobile communications can assist on the far side 2021 [6]. Challenges are increased for 5G networks by merging Artificial Intelligence (AI) and network operator which can be one of the impressive results to address these complexities. To justify these dilemmas, BC must be integrated. BC, as a decentralized methodology furnished a secure sharing of data, information, and resources among respective nodes of 5G areas [7]. 5G, BC, and smart systems are opposite domains but by their integration future can be better [8]. 5G requires BC for the vast deployment of 5G services. BC is contemplated one of the nascent technology that will be having a great effect in the future. BC concede its security attributes such as credibility and integrity to respective applications such as smart contracts and bitcoins [9]. For economic transactions, BC is also a distributed ledger that is recently used to present cryptocurrency Bitcoins for the first time [10], [11]. Transaction data can be easily managed in peer to peer network as in figure 3. For financial and industrial services rapid development of BC extends for the next generation. But a lot of issues are being observed during the deployment like privacy, security, transparency, cost, decentralization, power consumption, and trust. BC manipulate efficient and fast over uncertain networks then 5G. BC is not only introduced to overcome the security issues but also helps in the faster distribution of real-time data [12].

BC technology is non-repudiation, immutable, integrity, proof of provenance, and trustful with privacy. BC's combination with 5G and smart systems still needs essential modalities about abstract application domains, privacy issues, scalability, performance, and potential financial acquires but the energy problem was constant [13]. For cellular network operators upcoming mobile generations are becoming increasingly evidential for energy efficiency. Green energy represents diverse modules of wireless communication. To cognize upcoming green networks founded on energy-efficient discipline that meets the atomistic demands in terms of content, elements triggered by the upcoming mobile generation, 5G can be helpful to fulfill the required necessities [14]. Green Computing (GC) must take the effective circulation impression, to operate and recycle, this smart

system can save up-to 15-20% energy [15]. For uncovering the security issues, costs and to reduce power consumption 5G is usually used in smart devices to making smart systems more worthy and trustful [16]. GC can be another important attribute for 5G systems, as power consumption from ICT (Information and communication technology) parts are predicted to grow insignificantly by 2030. The instant best time is when coming traffic backhauling the optimum instant time when traffic backhauling should switch with different technologies to minimize the whole power consumption [17]. At successor and transmitter interference cancellation (SIC) at the receiver is Power-domain superposition coding (SC) multiplexer. NOMA assigns one frequency channel to many users at a time in a corresponding cell [18].

LTE-Advanced systems is also having the purpose to support the deployment of cheap devices, tuning and network control power devices by having growing radio access network coverage. LTE susceptibility execution based on devices per physical resource block indicates insignificantly more number of devices are supported in an LTE system [19]. 5G promises quality of service (QoS) and high rates to the end-users and BC assures a high level of security and trust among the peers. Because LTE was the only step toward the 4th generation (4G) of radio technologies designed to increase the capacity. Social influence, trust, effort expectancy, and facilitating conditions are very critical constructs that affect BCT adoption directly. BC with the improvement of a security system with 5G, as the enforcement of and scaling up the miner security to deduct 50% attacks without damaging to PKI management system can be enacted [20].

In this article state of the art, is presented concerning 5G for BC. 5G with green BC is presently an intense propitious tactic for the amalgamation of smart technology in a divergent and distributed world. The idea of 5G and BC turned up from the obviate to stir out from conventional amalgamation structures, that flatter hard to come via the transition of time. Energy consumption, trust problems are being observed in this research by integrating two discrete technologies such as 5G with green BC and GC in IoE to some extend. This article is analyzed by giving a review on cautiously elected study published between 2016 and 2021 in known channels. Similarly analyzing the advanced research on power consumption solutions for BC-based 5G communication, a taxonomy of 5G based green BC and GC in various areas has been proposed. Apart from the study, 5G along with green BC and GC has also been presented for power consumption issues and rechargeable data packets. Rechargeable data packets are very necessary as this smart era of Internet of Everything (IOE) needs to proffer battery life. Moreover, it is also being observed there is very little adoption of any latest technology just because of trust issues. Mostly it took more than 10 years to adopt any latest technology which is a wastage of money and time. Lastly, the study gaps have been bestowed to render future directions for the study in 5G with green BC and GC as the solution for rechargeable packets and power consumption.

This paper is maintained as in figure 4. Sector 2 will be of background where the use of BC and 5G has been discussed in detail according to different work industries. Sector 3 about methodology adopted for this SMS by explaining some questions, exclusion/inclusion criteria, search techniques, quality assessment(QA), sector 4 is about results where answers to the defined questions have been given. Sector 5 is about the discussion where the proposed taxonomy is presented including main findings and open challenges. In the last sector, 6 conclusions and future directions have been discussed.

II. BACKGROUND

For the growth of the local economy, 5G is playing an important role. So, for the growth of the economy, 5G has become a brand new operating tool. 4G trade life but the world is changed by 5G. 5G has reduced the problems like privacy, security, low latency rate and speed, transparency problems. 5G has not only increased the speed of the internet, but it has also brought moderation in man's life making, economic and social life, enjoyment and work is remodeled and has become more advantageous. In simultaneous economic growth and social development, 5G has become a vital technology [21]. In financial transactions, BC provides an extraordinary chance for revolution. A completely new world of probability for banking, insurance, money transfer, investment, stock market, and lending is waiting. Cybersecurity and privacy problems however inhibit the more likely acquiring of BC [22]. BC can realign the modern legal, economic, political, and cultural topography claimed by stakeholders such as entrepreneurs, developers, and technology supporters. To improve transparency, effectiveness, and security over a vast range of transactions BCT is at the Centre of modern attempts [23]. As by [24] to make localized and shared economy applications that empower people to securely monetize their gadgets to create more revenue BC can be utilized. But paired with distributed file system framework it is desegregated as an unworthy public ledger. Interplanetary file system (IPFS) direct clearness, security, and challenges of scaling. In forecasting BCT assumption aim Facilitating process is recognized, belief, social influence, and attempt expectancy as analytical constructs [25]. BC only authorize the transferring of the digital tokens, for otherworldly transactions cryptocurrency BC was not used. Ethereum launch illustrates was feasible to program BC to keep up many types of transnational logic by smart agreements that accomplish precoded segments of software on the BC when particular conditions are connected. with no intervention from representative or requiring approval from third party's Smart agreements can perform transactions independently, [26]. In [27] author explain how these dispute notions can be sorted out and investigate the potential of BCT for sorting out the issues of safekeeping in the sharing economy. In [28] Three ordinary misapprehensions on the application of BCT to the sharing economy as well the wide forum economy had been shared:

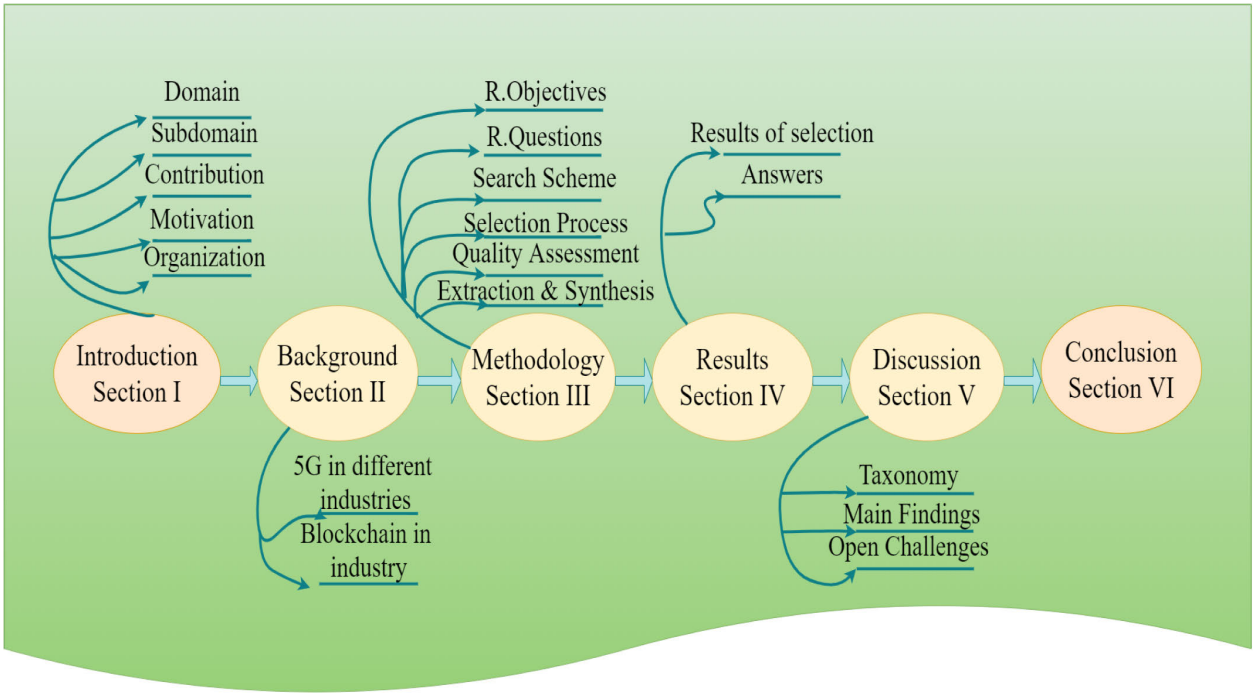


FIGURE 4. Paper organization.

- BCT not only solves all safe keeping problems when they come to the physical word interlinked with humans, trust-free misconceptions.
- Significance and part of forms as the agent and custodian should not be abandoned but frequently is the disintermediation misconception.

Information asymmetry and costs of transactions intricate with matching entrepreneurs with an investor [29]. IoT, 5G, and blockchain can give an advantage to shared economy practices. These advantages can be highlighted by a higher level of productivity, operating efficiency, and atomization, and smart factories in terms of resources should be renewable and sustainable [30]. The security, confidence, and accountability issues have been solved by introducing BC along with 5G but energy efficacy is a major concern. In new mobile cellular wireless networks (MCWN) with high energy and auto recharging green communication from the network providers, giant networking is expected [31].

Involving areas of 5G and BC like smart vehicles, smart agriculture, smart hospitals, and smart cities have been discussed below.

A. SMART VEHICLES

The definition has become one of the popular trends currently with the growing need for data generation and programming tasks. IoV is a distributed network that uses vehicle-generated data to enhance road safety for smart cities [32]. Mobile Edge Computing (MEC) is typically installed in a smart city in static mode in base stations (BSs). IoV could assist the smart city, Via paying share of idle vehicle computing services, to achieve scalable computing resource demand response (DR). Peer-to-Peer (P2P) computing resource trading system to balance IoV-assisted smart city spatio-temporal complex computing resource requirements and ensure transaction security and privacy preservation in our [33] system. A large amount of complex real-time sensor data is used in the Intelligent Transport System (ITS), so its stability is also a big concern. Security specifications, security threats, and security attacks are addressed in [34] in various security elements of IoV. To prevent traffic delays and collisions, drivers can be aware of the mobile location, direction, speed, and other real-time data of surrounding vehicles. In the absence of safety protections, though, IoV conditions may be unsafe. Due to the Internet's transparency and self-organization, there are tremendous malicious attackers in cars, [35]. Through the enhancement of automation and networking, autonomous vehicles are progressing at a rapid pace, opening up new possibilities for numerous cyber-attacks, including in-vehicle attacks and vehicle-to-everything contact attacks. A huge amount of data can be transmitted by 5G. It is especially helpful for the IoV, ensuring fast communications and protection [36]. As two rapidly emerging areas, the growth of IoT and BCT could strengthen the condition of the food chain today. The state-of-the-art creation of systems that use BCT to provide information security. Yet, researchers evaluate, the speed problem remained the same, if 5G is combined then [37] can also solve this problem. BC-based Stable message and revocation transparency scheme for safe vehicular communication.

Smart Energy (SE) has contributed to the introduction of innovative energy initiatives, infrastructure ventures, and business models as a transformative idea. The goal is to make the electric power grid more effective by generating/storing distributed electricity, adding smart meters, or reducing consumption/implementation costs. A major problem is the successful integration of solutions within SE structures [38]. In the 5G age, energy usage is a challenging concern to combat many challenges such as reactive mode of operation, high latency wakes up times, incorrect cell user association, multiple Self-Organizing Networks (SON) cross-functional operation [39].

B. SMART AGRICULTURE

The global demand for smart agriculture is projected to hit $ 15.3 billion by the end of 2025, relative to $ 5 billion in 2016. IOT [40] has been implemented in smart agriculture using wireless sensor networks (WSNs) such as irrigation sensor networks, prediction of frost events, precision soil farming, blind object recognition, smart farming, and precision agriculture [41]. 5G is likely to drive smart agriculture to the next level when it is possible to gather vast and real-time data to track crop and livestock status, logistics management, and other significant information. More human interest has been drawn by COVID-19 to food protection, which also has a positive effect on the market share of smart agriculture [42]. The privacy and security of smart farming, however, have become more common. Emerging finance, operations, and administration (FOM) problems in the Green Implementation in agriculture, IoT projects, such as IoT finance, funding for the supply chain and big data, recharging and upgrading network nodes, and Green IOT system [43] can overcome IoT data management. Through switching the resources on/off when they are inefficient, and building virtualized network resources such as proxies to minimize network traffic, the network solution would be able to reduce energy usage. It is possible to reduce energy consumption through SDN [44].

C. SMART HOSPITALS

Are now in several domains of medicine to furnish more reliable treatment services to patients. There is a non-unified architecture restricted to the connectivity protocol that can connect all intelligent things in smart hospitals [45]. There are also some challenges to the big data research tool using AI, such as centralized infrastructure, protection, and privacy, budget limitations, inadequate training data. BC-enabled AI Intelligent IoT Architecture that offers an effective way to merge BC and AI for IoT with existing state-of-the-art [46] techniques, algorithms, and applications. To reduce the optimization time for those algorithms several hybrid techniques can be used [47], [48]. Hospital records are also a significant contribution without breaching confidentiality. To fix anonymity, accountability, low latency problems, BC with 5G will play a critical role [49]. There is still a challenge to create sharing trust between healthcare providers, suitability, anonymity, and give patients access to health data management and high energy usage because BC may rethink the way the electronic health records of patients are exchanged and processed [50]. The convergence of 5G and Renewable rechargeable packets has resolved the need for reliable energy, delivery, and utilization models, the lack of accurate data flow profiles, the use of power conversion, energy cooperation, energy exchange strategies, and rechargeable packets. But there are still security, latency, confidence, and transparency problems. But there are still security, latency, confidence, and transparency problems. To achieve sustainable 5G and Green Connectivity with the BC framework [51], these issues are discussed along with some research directions to pursue.

D. SMART CITIES

Industry adaptation is effectuated in cities, the digital economic system is enforced sequent in smart companies, plants, and organizations which correspond nigh entirely a computer-aided fabrication. The parametric quantity imaginary being a smart city are explicit: the high caliber of life; accessibility of advanced modern technologies; city Substructure with the digital economic system elements; flexible living state of affairs. The groomed staff that will be needful to makeover smart cities and come through efficaciously observation [52]. The modern city infrastructure, immersion on many scourge associate to security, privacy, low latency, transparency, smart energy consumption, and auto recharging. Gainsay for smart city cue and architectural plan as BC-based systems and substantial usage of AI turn integral to scheme discipline, is to hold over man in the cringle to spawn the obligatory plane of reliance in security and privacy from the public. Meanwhile highlighting gainsay is auto rechargeable tendency [53].

mMIMO systems, an extremely parallel continual neural network (NN) for energy-efficient precoding. Simulation consequences for emblematical 5G readying premise exhibit an energy efficiency transmutation of one command order of magnitude or high with esteem to the actual state-of-the-art method can be formulated [54]. Green Cell-free mMIMO networks intelligibly amend the doable energy efficiency. Furthermore, they also unveil the existent exchange among the accomplishable energy efficiency, the accessible network-state substance, and hardware constellation [55]. 5G with BC will be the mainstay of the smart system and mount the effectuation for the evolution of smart cities but it is not reliable to preserve the energy by devising auto recharging smart devices [56].

Many issues are determined which have been resolved by using 5G and BC. In this 5G smart era, GC is an eminent gainsay for the sustainable evolution of networks. The energy harvesting subject is an auspicious strategy to uphold network lifetime [57]. Energy harvesting networks, knobs may replenish energy to subdue a variant of renewable energy from a mobile charger. Ascension in energy phthisis in cellular networks consequence in a growth in the carbon dioxide expelled into the surroundings, and revelation to the huge

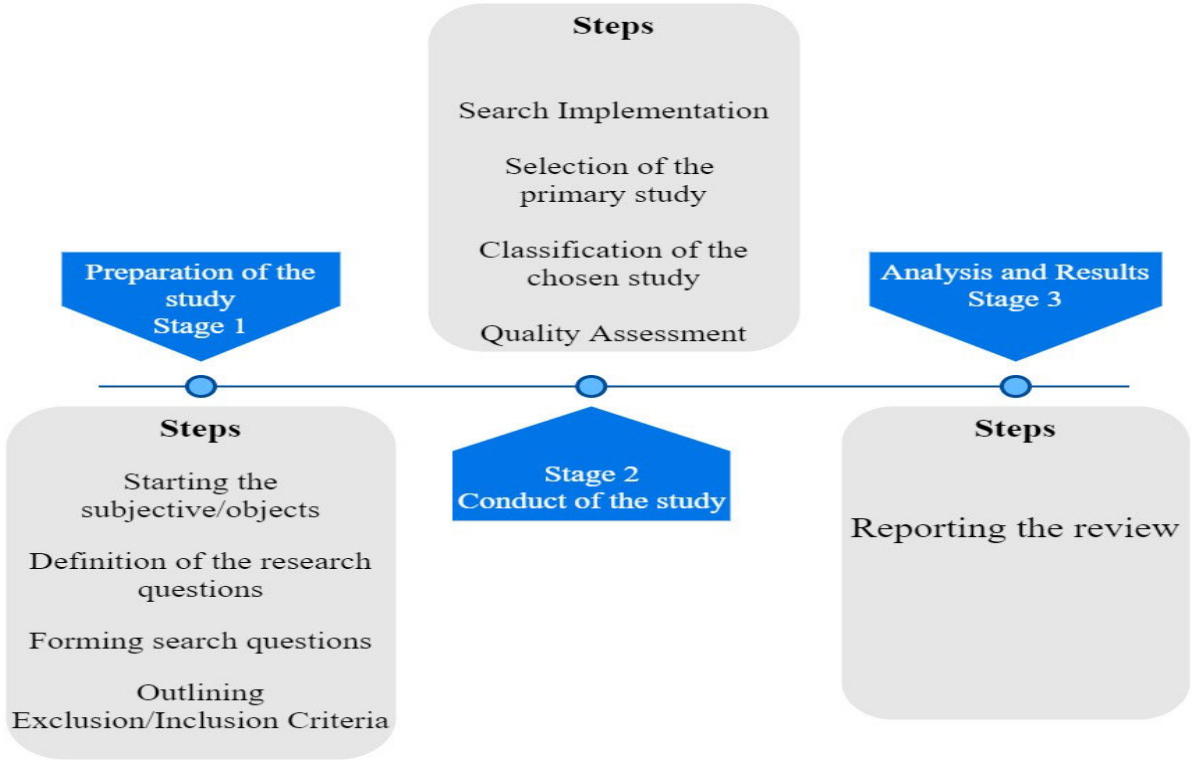


FIGURE 5. Systematic mapping study.

abstraction of noxious radiations [58]. Simultaneous Wireless Information and Power Transfer (SWIPT) for wireless communication systems presents a new paradigm, allowing wireless nodes to recharge their rechargeable batteries from RF signals while decoding information. Successful realization of SWIPT, 5G communications, and IoT technology assisted technical issues must be overcome at various layers to achieve an impelling green communication [59]. Green communication is an urgent need for power optimization of the upcoming 5G networks [60]. The advancement in communication researchers has the main focus of making this communication as green as possible by emerging it with 5G [61]. But energy affliction from spiteful smart devices can affect momentous energy failure to energy transmitters. Bonded wireless power transfer framework is requisite by commuting BC with it [62].

To protect the information in the network efficiently and securely for the upcoming 5G era has become a problem. A scheme based on a BC to solve the privacy issues in content-centric mobile networks for 5G is being proposed. The author [63] implement the mutual trust between content providers and users. Besides, the openness and tamper-resistant of the BC ledger ensure the access control and privacy of the provider. Trust-enhanced BC-based tracing mechanism for the whole content delivery process is in information-centric networking (ICN). It analyzes the records of behaviors on ICN nodes and locates the malicious ones. Secure energy data delivery in a BICN based smart grid, where we perform security analysis and conduct experiments [64].

Green IoT is a rising track that has appeal a huge number of basic cognitive processes on energy-efficient and modifies the product and usage of renewable energy [65]. Threat models against green IoT-based systems including, attacks against privacy, authentication, confidentiality, availability, and integrity properties are also analyzed by privacy-oriented BC-based solutions as well as consensus algorithms for green IoT-based systems [40]. A security model which is a decentralized system based on the smart contract and lightning network in the BC ecosystem; known as lightning network and smart contract (LNSC)has been proposed. But model entails scheduling, registration, charging phases, and authentication. It meshed with the latest scheduling criteria to intensify the security of trading among charging piles and EVs [66].

III. RESEARCH METHODOLOGY

For this study, SMS has been chosen as an analysis methodology. Figure 5 elaborate the mapping steps precede to accomplish this article, which is owning three divergent steps as 1. Planning, 2. conducting the mapping study, and 3. conclusions and reviews. An SMS is different from the systematic literature review (SLR) [67], Which content regarding the evolution of the confederation of the manifest, straining the recognition of the most similar pattern, and

TABLE 1. Research questions.

No	Research Questions	Main Motivation
Q1	How has the prevalence of technologies related to 5G technology with BC and GC evolved over years?	To categorize the publication inclination of 5G communication with BC and GC research over time.
Q2	Which publication Venus is the prime quarry for 5G with BC and GC study?	To categorize where 5G communication with BC and GC study can be originated as premier publication Venus for future research.
Q3	What are the research type of 5G with BC and GC strategies?	To search about the various types of research delineated in the SMS concerning 5G.
Q4	Which strategies have been proposed to overcome the energy efficiency issues?	To identify the effective strategy used to overcome the energy efficiency issues.
Q5	What are the contemporary challenges and gaps in the smart era of 5G technology by having BC with GC?	To recognize and ascertain unanswered RQs in current 5G communication technology.
Q6	What approaches have been reported in the 5G and BC study to address power problems?	To dictate the present 5G strategies reported in the current 5G with BC and GC mapping research.

wherever particular indication truant or adequately explicit in organic literature. Meanwhile, it is not the grail of the study, as the elaborated study of articles/papers is not here. The main objective is having classification, content analysis and recognition of publishing forums [68], [69].

A. RESEARCH OBJECTIVES

The main key intents are discussed here:

- To represent a comparison of proceeding study on 5G and BC to analyze real-world wield and to know mutual exclusiveness for future.
- Present and clear the present study topics, challenges, and future directions concerning secured 5G applications.
- A taxonomy has been proposed for saving energy of IOE.
- To integrate GC with 5G communication and BC.
- To overcome the energy consumption with strong and secure devices SDN approach with WPT protocol can be proposed along with green BC in 5G communication.
- To summarize research direction as well as to find if there is manifest for research and possible evidence.
- Another goal is to determine the publication fields of the study.

TABLE 2. Search strings used in scientific libraries.

Database	Search String
Google Scholar.	1,2,3,4,5
IEEE	**3**,4
Springer	2,5
Elsevier	2
MDPI	1

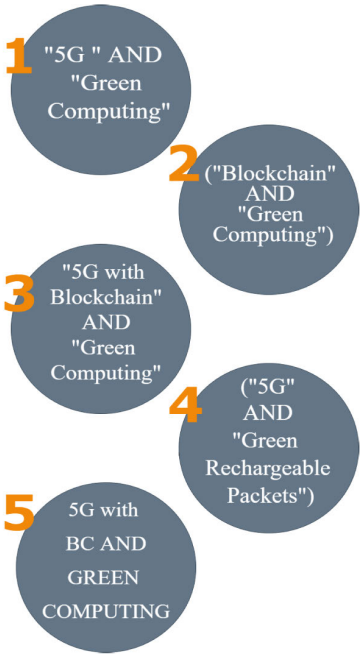


FIGURE 6. Search strings.

B. RESEARCH QUESTIONS

To conclude the selected research, Six (06) questions are being designed in Table 1. Entirely 06 RQs delegated for chosen criteria with pertinent causation. The given solution will assist to categorize extant studies, challenges, and further commandments referring to Secure 5G communication network and BC with GC.

C. SEARCH SCHEME

Following scientific databases/sources have been used to get the nearly germane articles for the chosen acquisition: IEEE Digital Library, Springer, ACM, Google Scholar, Elsevier, and MDPI also used for applied studies. For the development of bibliometric studies, Google scholar has been used functionally. Five different strings worn to demeanor the instinctive research for a chosen scientific depository is in Fig. 6. Incontestable the investigation strategy appealed in various databases to find relevant articles is in table 2. Some strings are commonly used in different databases to find the expected outcome.

TABLE 3. Including and excluding standards for the chosen study.

Inclusion criteria	Exclusion criteria
IC1- Papers published in journals and conferences.	**EC1-** Duplicated articles.
IC2- Studies published between 2016 to 2020.	**EC2-** Articles does not address BC and 5G green computing.
IC3- Articles presenting blockchain and 5G green computing	**EC3-** Books, thesis and published abstracts.
IC4- Studies from any geographical location.	**EC4-** Articles that are published pre 2016.

D. SELECTION PROCESS

Selected criteria are designed at distinguishing the research studies that are most relevant to the content of this study. Repetition of the same articles from different sources is also excluded. Selection of all articles is keenly observed by its keywords, abstract, and title, for the making the decision whether it will be included or rejected. After the first process of observation of the articles was to exclude the similar titles, obviously the titles are not for the review. The next step was to insert and exclude the articles based on chosen criteria as discussed in Table 3. Figure 7 demonstrate ramification of a selection process. 23 articles are being selected out of 214 identified studies.

E. QUALITY ASSESSMENT

One more important step in the assessment process was to ascertain the enclosed article's nature. Quality assessment (QA) is mostly performed in discussed mapping studies. Even, a questionnaire is designed [67], [70] to assess the selection of articles in it.

(1) Solution is in the articles. Likely consequences are No(+0), Moderate (+0.5), and No (+1).

(2) The contribution of the articles toward how 5G and BC linked with GC conducted is mentioned. No (+0), Moderate (+0.5), and Yes(+1).

(3) Future directions and gaps of the research distinctly defined. No (+0); Modest (+0.5), and Yes (+1).

(4) Articles are from known and trustworthy databases. Following is the ranking of the conference and journal (CORE). (Q.1, Q.2, Q.3, and Q.4), and JCR reports, this query was ranked. Realizable answers to this queries: Conference ranking for different core (C) :

- C (A) ranking (1.5),
- C (B) ranking (1),
- C (C) ranking (0.5),
- If there's no ranking in C (0)

Ranking in Journals:

- If Q.1 is rated (2)
- If Q.2 is rated (1.5)
- If Q.3 and Q.4 is rated (1)
- When it is not rated in JCR list (0)

We furnished an ultimate score of every article (rated 0 to 5) by adding evaluation for each query.

F. DATA EXTRACTION AND SYNTHESIS TECHNIQUE

Approached is pivoted to collect auspicious answers to the given questions.

Q1. Articles must be classified according to a published year for the sake of getting publication drift.

Q2. For these queries (RQ), to determine the publishing medium and source is compulsory. **Q3**. Research type can be outlined in the pursuing aggregation [71]:

- Solution proposal: Solution for energy problem in 5G is proposed. Can be proved a fresh resolution or essential elaboration of a grooved strategy. Some arguments with instances, the potential performance, and the connection of the resolution are shown.
- Conceptual Proposals: These researches processed conception by keenly observing and analyze accumulation already exist on the 5G with BC, GC With 5G communication technology, and GC with BC. Practical inquiries are not enclosed in this.
- Evaluation Research: Assessment and analysis of the 5G with BC and GC is performed. It refers to recognize troubles in 5G with BC and GC communication applications.
- Others: As Experimental, Investigation, analytical surveys, development, performance analysis, reviews comparative analysis, and case study.

Q4. Apprehension incumbent study in direction of 5G with BC and GC is the essential RQ of study. Piling up all the suitable researches from scientific databases, we are confident to propose a generic apprehension on 5G communication which is also tract the present energy-efficient study trends. This study will modify the latest studies and gross practician to the latest knowledge on extant study problems that will assist in the procedure to boost 5G communication technology with BC and GC to make the efficient devices. Different strategies are given in the classification table by which we can make the renewable devices in IOE system more efficient and secure by using the green BC and SDN approach along with WPT protocols. **Q5**. This SMS assists to recognize the present research gaps about those study challenges will consent advance questers and epitome on the field where the foster probe was required. By existing GC implementations with 5G and BC, will assist to realise unanswered research queries. **Q6**. Given approach can be classified as recommendation [71], in the following aggregation:

- Method: A procedure indirect the steps are adopted to gain GC and BC with 5G.
- Model: The scheme content that modifies the reasoning of the 5G communication technology with BC and GC.
- Infrastructure: Administrative structures requisite for a paunch or business to purpose utilitarian in 5G with BC and GC.
- Architecture: A planning, process, and designing structures for 5G with BC and GC.

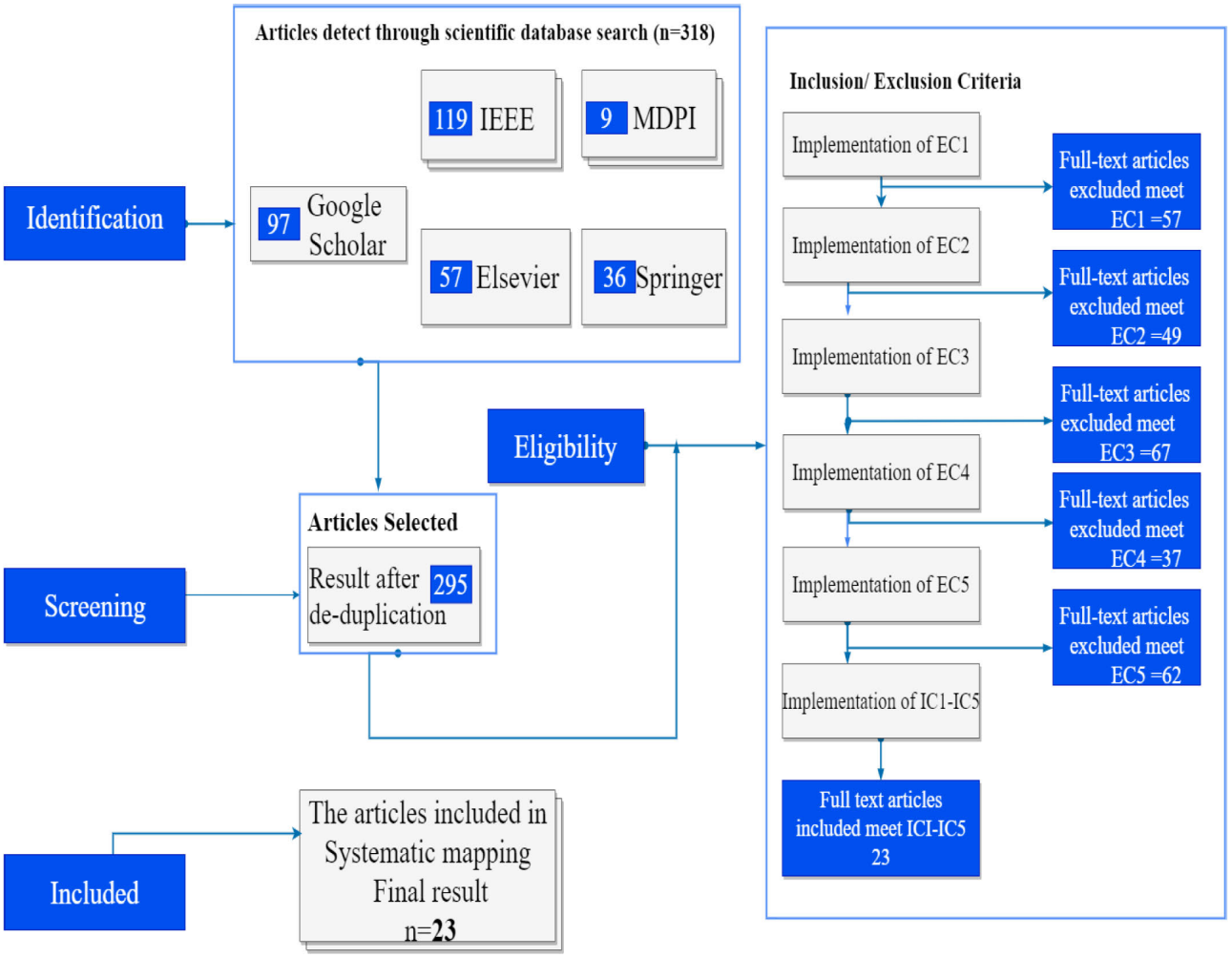


FIGURE 7. Study selection criteria.

- Framework: A theoretical framework planned to influence or straight the artifact of something that expands the artifact into something utilitarian in integrating GC and BC with 5G.
- Guideline: An instance of a pattern or pattern that can be utilized to constitute a course of state in 5G with BC and GC.
- Tool: Anything utilized to execute 5G.
- Other: framework, platform.

Synthesis cognition was adjusted for considering the research keys that are classified in consequence to all RQ, existing studies standing on the fundament of QA, and oblation graphical presentation for the intention of categorized consequences.

IV. RESULTS

This segment precise the results that are related to RQs delineated in given Table 1. Many papers are chosen to pretense the model for every RQ's results. We anticipated they are essential and form a momentous endeavor to 5G with BC.

A. RESULTS OF SELECTION

318 research studies are keenly observed by their keywords, abstract, and titles, 295 papers were spurned and 23 articles were cautiously selected. The recognition of 23 papers was observed to state the RQs delineated over. The itemization of chosen papers is bestowed in the given tab 6 with a given statement of categorization results and their given QA.

B. Q1. HOW HAS THE PREVALENCE OF TECHNOLOGIES RELATED TO 5G TECHNOLOGY WITH BC AND GC EVOLVED OVER YEARS?

Figure 11 (a) pretense general dispersion over the time of elected primary research, figure 11 (b) shows the drift of 5G with BC, BC with GC, and 5G with GC by years, meanwhile figure 11 (c) render the over years distribution of publication Venus. The abstraction of research publicized per year from 2016 to 2020 is shown in figure 11 (a). Most research papers were publicized in 2020 as it was a Fifth Generation with BC and GC is the year of evolution and modification. That could be described as, the 5G vantages adherent detrition with

BC architects focusing on Green Computing. The emergence in 2020 might be processed by the time this mapping research was a conduit and is improbable to bring out the distinct number of studies in 2020. 2016 to 2018 was the time in which 5G with BC and GC found less, as portrayed in figure 11 (b). Figure 11 (b) pretended that a large number of 5G articles were published in journals. Yearly three to four researches were published in journals as in figure 11 (a).

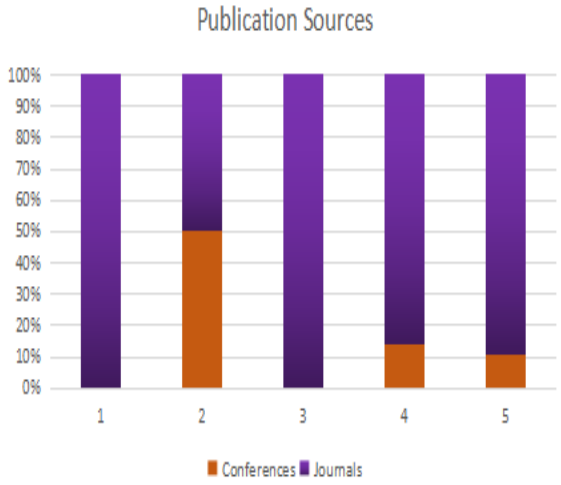


FIGURE 8. Publication channel.

C. Q2. WHICH PUBLICATION VENUS IS THE PRIME QUARRY FOR 5G WITH BC AND GC STUDY?

Publication databases of the chosen papers are shown in figure 8. The journal and conferences were the publication sources entangled in this mapping study. As in fig 8, most articles were published in the journal (19) (82%) and conference (4) (18%). Moreover, the table 8 cardinal all the publication channels where the chosen papers were published. All the chosen articles used in various publications as shown in the table 4.

D. Q3.WHAT ARE THE RESEARCH TYPE OF 5G WITH BC AND GC STRATEGIES?

In this study, six (6) types of studies were identified, as evaluation research and survey are (2 articles)(8%), Solution proposal (8 studies)(34%), Experimental study (9 articles)(39%), and only 1 article found as implementation study and investigation study (3 studies)(13%) as in figure 10. Most of the chosen studies (Solution proposal) are accordingly experimental to 5G with BC and GC issues, whereas some solutions and investigation research of 5G with BC and GC applications presented 9. In the pursuing paragraph, several models of research types are listed: In this 5G smart era, GC is a great gainsay for the property evolution of networks. For prolongs network life energy harvesting application is an auspicious approach [57]. But energy flack from cattish IoT inclination can affect momentous energy loss transmitters. Secured wireless power communication architecture is requisite by

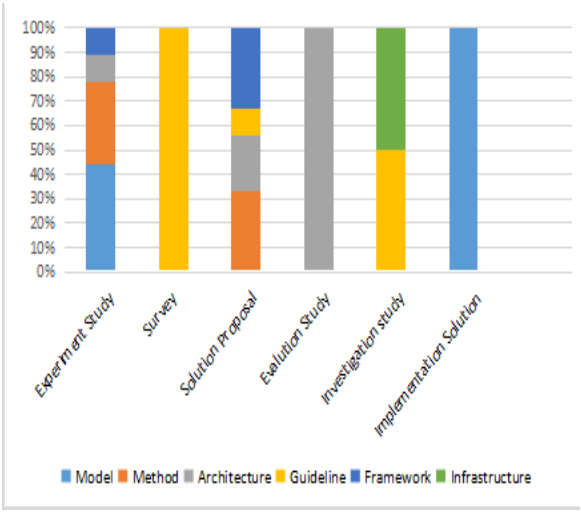


FIGURE 9. Research types.

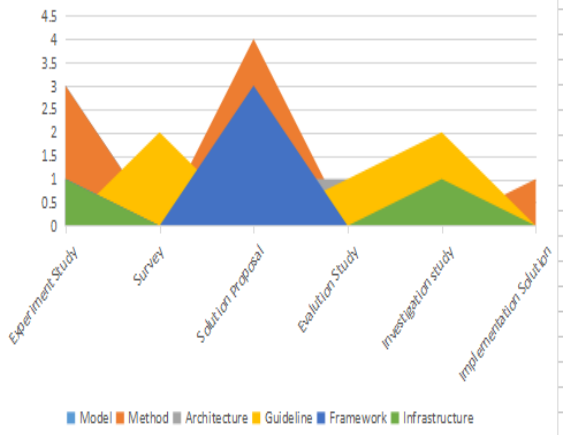


FIGURE 10. Approaches.

commuted BC with it [62]. To assist information in network expeditiously and firmly for the upcoming 5G smart era has got over trouble. A strategy supported a BC to cipher the privacy reussite in content-centric mobile networks for 5G is projected. The authors enforced the bilateral reliance between users and content providers. Likewise, the sociability and tamper-resistant BC ledger ascertain the admittance privacy and control of the end-user [63]. Moreover, a taxonomy figure 13 is presented to highlight the solutions to the defined issues.

E. Q4. WHICH STRATEGIES HAVE BEEN PROPOSED TO OVERCOME THE ENERGY EFFICIENCY ISSUES?

Table 6 cataloged all the content that is already addressed in chosen papers. The outcome pretense that mostly content settled by 5G with BC OR BC with GC OR 5G with GC systems, performance valuation, and evaluation of GC. Several instances are bestowed in the given paragraphs: In the given article [72], indite evaluated 5G is anticipated to acquire into green networks, which utter high Caliber of divine service and energy efficiency. To know the petition of upcoming

applications, momentous ameliorate required in 5G network bailiwick with the commencement of BC. BC sceptered complacent caching issues to exploit system substitute and acquire a new caching strategy by commute abyssal reinforcement learning in [73]. To acquire a spectrum-efficient and incentive-compatible framework supported by BC and 5G can be enforced into two phases: 1. H2H (human to human) users signed a written agreement for spectrum sharing along with the base station. 2.The distributed spectrum is awarded to M2M tendency [74]. The Green BC can also enterprise similar uses to help in the funding of efficient renewable energy. The secure and decentralized existence of green BC could modify a p2p network for energy efficiency [75]. It can assist renewable devices to grow over because they form renewables more conveniently. Moreover, the emergent thought of SDN can furnish an overall prospect of the networks for embedded the devices management [76]. Furthermore, the demand for WPT protocol is also trended to leave the unsuitability due to using power cables [77]. Optimal use of transmitter and receiver antenna increases the skillfulness in WPT devices.

F. Q5. WHAT ARE THE CONTEMPORARY CHALLENGES AND GAPS IN THE SMART ERA OF 5G TECHNOLOGY BY HAVING BC WITH GC?

Most applications known in this research settled on 5G and BC. 5G is a modish technology as reported to study by 2030 the endeavor of smart devices and 5G will be everywhere like smart cities, vehicles, banking, healthcare, agriculture, farming, TVs, smart homes, vacuum cleaners, furniture as in figure 1. Even so, some study gaps also have been indicated. The primary study gap is that current articles have not included working of 5G with BC and GC based methodology, which needs more study shortly.

Another search notch is mostly study is supported on security problems, low latency, privacy, transparency, and high speed but according to this study, there is no work found on smart energy. It can be ascertained to hold on to the energy consumption. Furthermore, according to this study, not a single study has been found on 5G with BC and GC. All the current literature is on 5G with BC OR 5G with GC OR BC with GC. Moreover, it will obviate more study shortly. There is another gap in the limited number of publications on conference-level publishing channels. Mostly study is found in known journals. SO, high-grade symposium and conferences are requisite which accent on 5G with BC and GC. Furthermore, for the implementation of such kinds of smart devices, staff training for maintenance and management is required. Training can be the largest loss of money and time. Lastly, the acceptance level for such kinds of devices is very low. Public or authorized organizations always took too much time to accept this kind of smart device, mostly the gap between the invention and implementation is more than 10 years. Which is the biggest loss of technology, time, and money as well.

TABLE 4. Publication channels of the selected research.

Publication source	References
Elsevier Journal of Network and Computer Applications	[58]
Elsevier Computers & Industrial Engineering	[30]
Conference IEEE Wireless Communications	[57]
Conference IEEE 86th Vehicular Technology Conference (VTC-Fall)	[59]
MDPI Signals	[39]
Elsevier Computer Communications	[51]
MDPI Information	[31]
IEEE Access	[60], [14], [40], [66], [55]
IEEE Transactions on Green Communications and Networking	[17]
International Conference on Information Science and Communication Technology (ICISCT) IEEE	[61]
IEEE Network	[62], [64], [65], [74]
IEEE communications magazine	[43]
Springer International Conference on Industrial Networks and Intelligent Systems	[18]
Springer Wireless Networks	[54]
Springer Mobile Networks and Applications	[44]

TABLE 5. Quality assessment score.

Ref	T.Score	No.
[74]	4.5	1
[58] [30] [62] [43] [60] [40] [65] [14] [55]	4	9
[57] [14] [17] [64] [54] [44]	3.5	6
[51] [66]	3	2
[61] [59]	2	2
[31] [39] [18]	1.5	3

G. Q6. WHAT APPROACHES HAVE BEEN REPORTED IN THE 5G AND BC STUDY TO ADDRESS POWER PROBLEMS?

In figure 12 conclusions pretense that nearly all of the approaches to the study nonce the method (8)(34%), model, and architecture (3)(13%). Leftover approaches depict

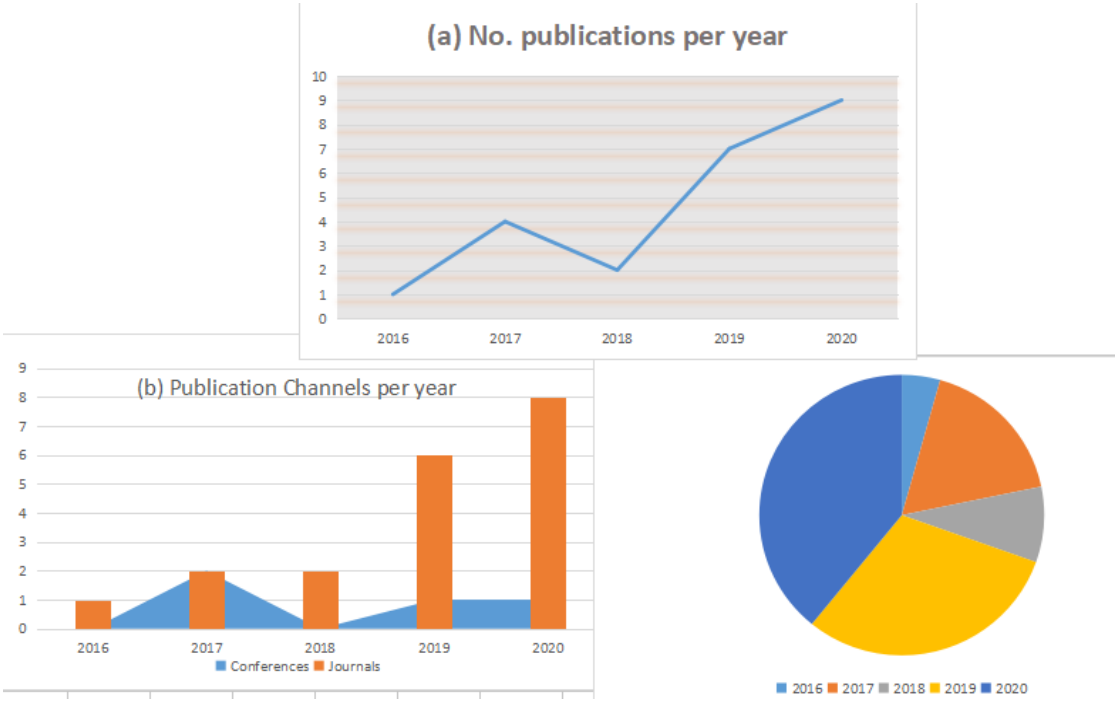
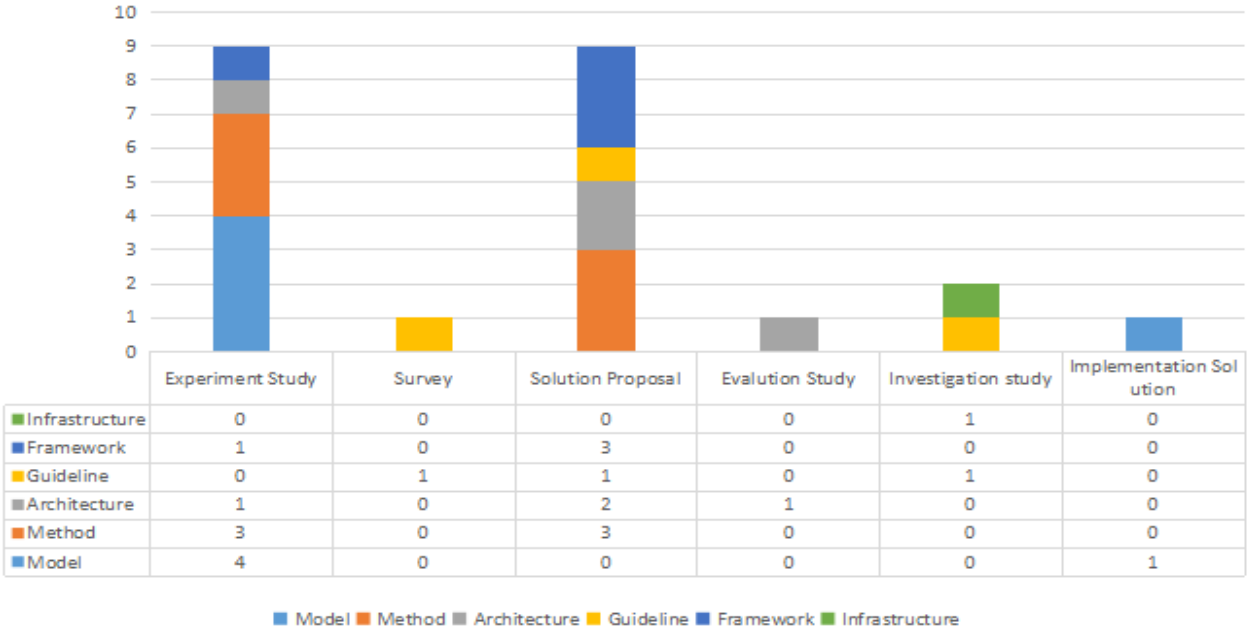


FIGURE 11. Trends in studies by year.



	Experiment Study	Survey	Solution Proposal	Evalution Study	Investigation study	Implementation Solution
Infrastructure	0	0	0	0	1	0
Framework	1	0	3	0	0	0
Guideline	0	1	1	0	1	0
Architecture	1	0	2	1	0	0
Method	3	0	3	0	0	0
Model	4	0	0	0	0	1

FIGURE 12. Approaches used in selected studies.

a framework (4)(17%), guideline (5)(21%), and infrastructure (2)(8%). The various framework has been proposed to solve the highlighted issues. 5G with BC will enactment as the grit of smart devices and setting the effectuation for the evolution of smart system but it could not assist to relieve the energy by devising auto recharging devices [56]. GC is a corking contest for the sustainable evolution of networks. For protract lifetime network Energy harvesting technology is an auspicious approach [57]. A taxonomy is given with different protocols and approaches used in this study figure 13.

H. QUALITY ASSESSMENT

The QA score for every chosen article is in the given table 5. Nearly 8% of the chosen articles having an average score,

TABLE 6. Classification of the selected studies.

Ref.	Classification						Quality Assessment				
	P.Year	P.channel	Research Type	Research Topics	Approach	Strategy	(1)	(2)	(3)	(4)	T.Score
[58]	2017	Journal	Survey	A survey on green communication and security challenges in 5G networks	Architecture	Green Communication	0.5	0.5	1	2	4
[30]	2020	Journal	Investigation Study	Looking at energy through the lens of Industry 4.0: A systematic literature review of concerns and challenges	Guideline	PICOC	0.5	0.5	1	2	4
[57]	2017	Conference	Solution Proposal	Software Defined Energy Harvesting Networking for 5G Green Communications	Architecture	SD-EHN for 5G green communication	0.5	0	1	2	3.5
[59]	2017	Conference	Experimental research	Wireless Information and Power Transfer: Issues, Advances, and Challenges	Method	SWIPT, RF WPT	0.5	0.5	1	0	2
[39]	2020	Journal	Solution Proposal	Mobility Management-Based Autonomous Energy-Aware Framework Using Machine Learning Approach in Dense Mobile Networks	Framework	ML algorithms	0.5	0.5	0.5	0	1.5
[51]	2018	Journal	Solution Proposal	Energy Sustainable Paradigms and Methods for Future Mobile Networks: a Survey	Guideline	SDN and CRN	0.5	0.5	1	2	3
[31]	2020	Journal	Experimental Research	A New Green Prospective of Non-orthogonal Multiple Access (NOMA) for 5G	Model	5G and NOMA	0.5	0.5	0.5	0	1.5
[60]	2016	Journal	Experimental Research	Power Optimization in 5G Networks: A Step Towards Green Communication	Method	EE techniques	0.5	0.5	1	2	4
[17]	2017	Journal	Experimental Research	A green communication model for 5G systems	Model	SCNs	0.5	0.5	0.5	2	3.5
[61]	2020	Conference	Implementation Solution	A Review of Techniques and Challenges in Green Communication	Model	D2D communication and mMIMO system	1	0.5	0.5	0	2

TABLE 6. *(Continued.)* **Classification of the selected studies.**

[74]	2020	Journal	Experimental research	Blockchain-Empowered Secure Spectrum Sharing for 5G Heterogeneous Networks	Framework	Large-scale Spectrum in 5G	1	0.5	1	2	4.5
[14]	2019	Journal	Survey	How to Meet Increased Capacities by Future Green 5G Networks: A Survey	Guideline	Green Radio	0.5	0.5	1	2	4
[18]	2019	Conference	Solution Proposal	User-Pairing Scheme in NOMA Systems: A PSO-Based Approach	Method	SDN	0.5	0.5	0.5	0	1.5
[54]	2019	Journal	Experimental research	Sustainable green networking: exploiting degrees of freedom towards energy-efficient 5G systems	Architecture	mMIMO	0.5	0.5	1	1.5	3.5
[55]	2020	Journal	Solution Proposal	Access Point Switch ON/OFF Strategies for Green Cell-Free Massive MIMO Networking	Framework	Green cell-free mMIMO	0.5	0.5	1	2	4
[44]	2019	Journal	Experimental research	Policy-Based Management for Green Mobile Networks Through Software-Defined Networking	Method	SDN	0.5	0.5	1	1.5	3.5
[73]	2019	Journal	Solution Proposal	Blockchain and deep reinforcement learning empowered intelligent 5G beyond	Method	Deep learning and Blockchain	0.5	0.5	0.5	2	3.5

39% hold standard numbers, and 9% grasp the nether scores. QA can assist the experts to choose apt articles sited on defined asserted in Subsection.

V. DISCUSSION

SMS is cited on 5G communication with BC. Researches are supposed to answer the RQ's tendered at the start of this research. The conclusions show that GC have been proposed to solve the power issues in Green based 5G communication.

A. PROPOSED TAXONOMY

In this 5G communication, a strategy has been used to overcome the power consumption among smart devices. For IoE energy storage is very essential to overcome energy consumption. Integrating green BC within the smart devices for security purposes is the first step to wireless smart devices. It can increase the trust level on devices due to this green renewable distributed ledger and secure technology. The study on 5G applications with green BC identifies multiple issues like power consumption and trust concerns. These strategies can be used to overcome energy issues in different contexts. The strategies have been therefore classified into some main subsections based on their method: 5G, Green radio signal, WPT, SDN, green BC, IoTs, and green computing. 5G always has a fast, decentralized, reliable, and transparent feeling upon the development of smart devices. The realization shows the continuous effort of the fifth generation which shows the best result in the

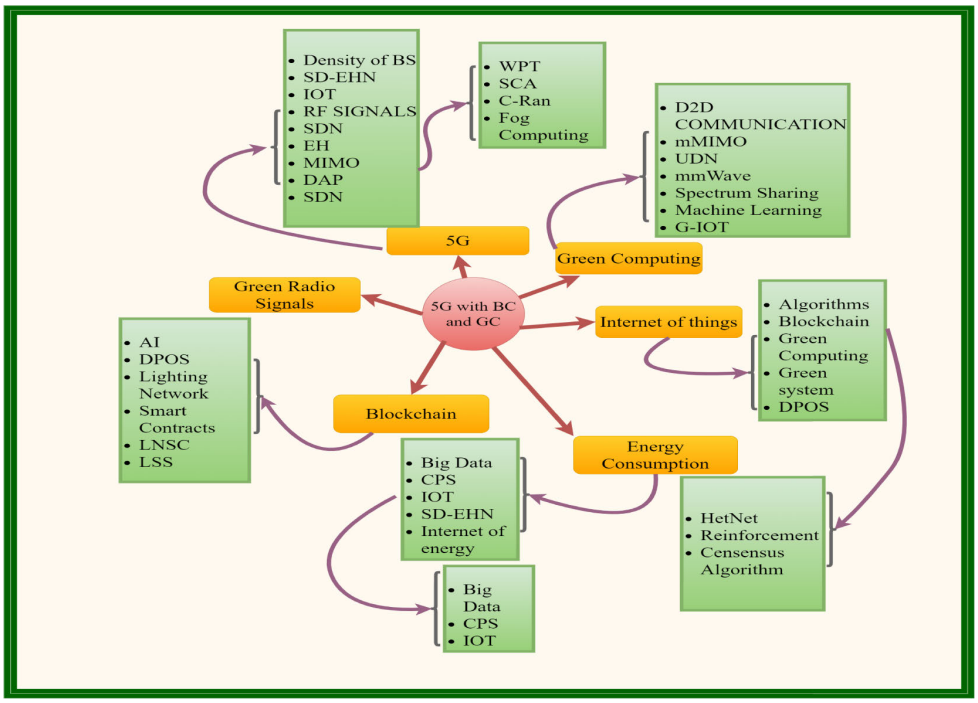


FIGURE 13. Taxonomy of 5G, Blockchain, and Green Computing.

connectivity of smart devices. Fast speed always attracts the users towards IoE. However, green radio signals also have a close relationship with this advanced technology because it is energy efficient and are having full radio flexibility at the spearhead of this smart system design. RF radio signals can cover all the requisite bands and bandwidths with meeting all specifications. BC with its unconventional conviction of decentralized power can anticipate security, immutability for storage, high level of data privacy, transparency, of 5G heterogeneous data. BC is contemplated to be a requisite tool to accomplish the execution expectation for 5G systems with the lowest costs and management aloft. Energy consumption encompassing both downlinks and uplinks for IOE with 5G communication. 5G are on the purview as IoE is getting the center space as smart devices are anticipated to form a significant part of this 5G network. IoT-based technologies such as m2m communication accompanied with smart data analytics are anticipated to sharply varying orientation of various industries. Similarly green methodology for 5G Communication network and gleaning energy for GC, with a blistering stipulation of wireless communication. Lastly, micro-integration also furnished the communal facet. It tied up multiple strategies together. Micro-integration of different strategies created a catchy environment for giving the idea to overcome energy consumption in 5G communication for smart and efficient devices. These tiers furnished the way to overcome the power consumption problem among 5G communication devices and green BC with integrating GC. This state of the art could assist us in resolving the power consumption issues by following different strategies. Taxonomy has been proposed in figure 13 to help the researcher in the following study.

B. MAIN FINDINGS

Total 318 articles are keenly analyzed by their names, keywords, and abstract, 295 papers were spurned and 23 articles were cautiously selected. The selection of 23 papers was observed to give the answers to given queries. The selected studies are bestowed with the interpretation in classification conclusions and their quires. Our main findings are listed below:

- Most of the studies taken from 2016 to 2020. The rise of technology is in 2020. 5G with BC found less in 2016-2018.
- Two different publish channels have been selected where 82% articles found in different journals and 18% articles found in conferences.
- Six (6) types of research were identified, such as evaluation research and survey are (2 articles)(8%), Solution proposal (8 studies)(34%), Experimental study (9 articles)(39%), and only 1 article found as implementation study, and investigation study (3 studies)(13%).
- Most of the studies are based on 5G with BC, 5G and GC, BC and GC. We are not able to find 5G with BC and GC for introducing the power efficient smart devices. So 5G is expected to evolve into green networks, which deliver a high quantity of services and energy efficiency.
- Current challenges are that according to this study latest literature is not having study 5G with Blockchain and Green computing-based methods.

- Most of the approaches of research type present method 34%, model 13% and architecture 13%. The remaining approaches describe a framework 17%, guideline 21%, and infrastructure 8%.
- Green blockchain along with SDN approach and WPT protocol can be helpful for IOE to resolve the energy consumption issue by generating renewable data packets.

C. OPEN CHALLENGES

Open challenges are being discussed in this fragment. After the integration of BC still, some issues are reported such as power consumption, renewable data packets, and trust issues. Energy storage and expansion of battery life is important phenomena in IOE. Another open issue is being observed that is the adoption of any new technology is very slow because of trust issues. No one is ready to accept any new technology immediately. According to the observation every technology needs almost 10 years to be a part of our lives. This trust gap is the big loss of money and time we need to overcome this loss. We need to take some key steps to remove this acceptance gap. Moreover for adopting these green blockchain-based 5G devices, it is necessary to train the staff for the maintenance and management of the latest technology, it will also take time and money to produce experts. So, Trust and education level need to be improved by defining some standards. 5G must be integrated with Green BC and GC to overcome some of these power issues. By integrating the SDN approach along with green BC and WPT protocol in GC-based 5G communication performance can be much better.

VI. CONCLUSION

This study reports an SMS of the fifth generation with green BC. This comprehensive review has been based on 23 studies. After having an in-depth study of the previous studies, it has been concluded that for power concerns green BC and GC can be merged with 5G.

Considering this motility condition, green computing will be merging with 5G for developing energy-efficient applications. The main intent of this study was to scrutinize the afoot existing subjects and concise them in 5G with BC. Between 2016 and 2020, 318 papers were chosen from an initial set of 80700 studies, 23 were chosen from that selection, and categorized them as intent criteria: research and contribution kind, 5G strategy, topics examined articles, and approaches.

It is assumed that 5G with BC has acquired valued attention since 2020. Most elected studies were founded in journals, but some mature articles were also from conferences. Three kinds of esquires are founded: experimental solution, solution proposal, and evaluation research. The designs and implementations of 5G with BC and GC were not the normally addressed articles in this mapping study.

But the searching techniques to gauge energy efficiency introducing green computing and green BC with 5G technology in the future. For improving energy efficiency in IOE, WPT protocol with SDN approach can be merged with green BC for producing renewable data packets to save energy. Moreover, a taxonomy is presented in this study which can help other experts to identify many methodologies which can enhance the performance of the study. However, further evaluation research must be regulated to appraise existing strategies.

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