A FUTURE MOBILE COMMUNICATION ENERGY EFFICIENT MODEL USING HYBRID TECHNIQUE IN 5G NETWORKS

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Abstract

The growth of the 5G technique has a vast range of high bandwidth uses on android mobiles like streaming of video and well-developed internet browsing. Even though it has many uses in smartphones is slightly attractive, many the data transmission rate also has a large power demand. The current fastest method can be useful for removing the unnecessary nodes but, with no care, can reduce the experience of the user. This implemented heuristic technique is useful to measure the energy consumption in smart mobiles. Here for each D2D transmitters conjecture to other D2D transmitters' allocation of the power happens only when the local information is obtained with the straight interactions within the environment and to utilize the experience. The entire system is simulated using NS3 and the performance is measured based on Efficiency, Energy consumption, Throughput, Packet Delivery Ratio and End to End Delay.

***Keywords*: Data Transmission, Energy Consumption, Data Rate, Computation Time, Heuristic Technique.**

1. Introduction

As an outcome of wireless telecommunication is one of the well improved and demandable usages. Improvement of the wireless access methodologies is about to attain the fourth generation and at last fifth generation is taken into account. The initial generation has fulfilled with the voice of mobile, but the second generation has initiated the ability and converges of mobile. This has been followed by the next generation, that the aim of it was the high speed in the data for opening the mobile broadband. Followed by the next fourth generation the mobile communication service offers broadband, large capability, large speed data transmission, offering the user the large quality interactive multimedia services, as well as teleconferencing, color video pictures, 3D animation games, and services of audio.
Following fig. 1 demonstrates the common model of the 5G network (Muhammad Khalil Shahidet al., 2020)..

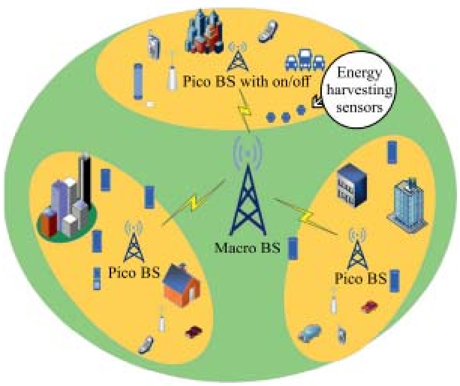

Figure. 1 Common 5G Network Model [5]

Following formula 1 is representing the base station's energy efficiency in a mathematical manner.

$$EE = \frac{R}{\eta\, P_t + P_c} \text{ [Bits /Joule]} \qquad (1)$$

From the above formula R denotes the entire data rate value in BPS(Bits Per Second), η indicates the reciprocal value transmit power, P_t denotes the power of transmission and P_c describes the entire power value of the transmitter.

Here a methodology called Hybrid Heuristic algorithms is implemented for D2D(Device to Device) transmitters. To accomplish the power of optimal allocation shortage of the information exchange within D2D should be considered. By indicating SINR (Signal to Interference and Noise Ratio) the implemented method maintains the superiority for all the tools in the network.

2. II LITERATURE SURVEY

MIMO is generally referred as Massive multi-Input and Multi-Output and it is very important parameter that has to be measured during all communications in a network. It has a antenna in both sender and receiver side. Predicting of signals in these models is really a tough work. Here the author had provided a QRM-MLD model which helps in finding out the latency decrease in an MIMO model. Arun Kumar, 2020 proposed model accomplished a decreased difficulty and latency when compared to the existing methods [1].

The increase of exponential in the network area and the count of the tools that are made in contact both produce the efficiency of energy an increasingly main concern for the smartphone network for the next generation. Particularly 5th generation network has been organized at the time when the efficiency of the energy emerge as a useful thing for the availability of the network for considering and for various societal and environmental problems that can play a vital place in supporting the industry for attaining sustainability goals. Within the range, Ioannis P. et al., 2021 convey the efficiency of the energy has attained its place performance and design constraint for the 5th generation network and this has recognized innovative risks for the next generation [2].

Amna Mughees et al., 2020 describe applications of ML (Machine Learning) methods in the 5th generation network is reviewed. Based on the review taxonomy of the ML applications in the 5th generation network is offered for developing the efficiency of the energy. The various problems are argued and can be solved based on the efficiency of the energy in the 5th generation network. The outcome offers a broad range of ideas that are related to ML in the 5th generation which addresses the problem of the efficiency of the energy in virtualization [3].

The development in secured WSN has to improve the parameters of energy consumption in each and every communication then only we can prove that the system works well in all aspects with respect to current communication in a 5g network. Here Joshua Onyeka Ogbebor et al., 2020 have proposed paradigm shifts in energy-efficient which gives a good result compared to other existing systems [4].

Due to the growth of wireless communication techniques VR (Virtual Reality), AR (Augmented Reality), and MR(Mixed Reality) applications are increased. 5G networks are used to manage high data exchange with less latency value. Energy management is the major goal of 5G communication networks. Energy consumption is measured using the Joule metric. Muhammad Khalil Shahid et al., 2020 review the various techniques to ensure better energy management in 5th generation networks. The outcome describes that ML-based setups may replace the traditional approaches [5].

From early first-generation mobile communication networks to contemporary fifth-generation mobile communication networks, Ibrahim Salah et al., 2021 did a comparative analysis. The writers have researched the advancements in recent study that have been made to transition to the following generation of mobile communication. The results also give an overview of several technologies, including millimetre waves, full duplex, tiny cells, massive MIMO, and beamforming, that help to meet the requirements of 5G. Finally, the researcher's survey analysis of Energy-Efficiency (EE) and Spectral Efficiency (SE) based Massive MIMO approaches represents a significant addition. The comparison research highlights the favourable trade-off situations between EE and SE technologies, which rely on various algorithms. [12]

The energy harvesting heterogeneous networks (EHHetNet) solution, which equips all base stations (BS) to gather output from wireless and renewable sources, is demonstrated by Anwer Al-Dulaimi et al. in 2018. In order to lower the network's energy usage during the B time slots, the research analyses the EHHetNets model and formulates the problem relating to the knowledge rank of the RE generation. Due to the use of binary variables, the prepared binary linear programming optimization problems were assessed as NP-hard problems. As a result, the researcher suggests a binary particle swarm optimization metaheuristic model (BPSO). The proposed BPSO method's performance was compared to that of the well-known genetic algorithm. The study estimates the success of the EHHetNets technique using the selected numerical results. [13]

Rural locations have a poorer distribution of digital networks due to problems including tough terrain, low income range, absence of power grid, low population density, and less established infrastructure. Due to these factors, rural places are less desirable for investment and less functional in terms of connectivity networks, making it impossible to provide everyone with access to the internet. Thembelihle Dlamin et al., 2021 have suggested a novel BS deployment and a strategy for resource management, both for rural and remote locations, to address this issue. Two MN (Mobile Network) operators spend their resources in this annexure for the purchase and tagging of green energy-powered BSs outfitted with complete computer capabilities. The network infrastructure is then divided between the mobile providers. [14]

Resources are being overspent, which is causing environmental and health problems to get worse on their own. Through the various 5G network communication specifications, Mohammad Azharuddin Inamdar et al., 2020 address the issues and challenges encountered when developing a low-energy consumption communication technology with an effective network performance based on the philosophy of green communication. The main findings of the study were based on implicit energy use, statistics based on carbon dioxide emissions, and methods utilised to address the problems, including Massive MIMO, D2D communication, green IOT, HetNets, energy harvesting, and spectrum sharing [15].

3. Proposed Methodology

The major issue of the 5G network is to allocate the power efficiently for cell consumers. This proposed study allocates better power distribution in a 5G network, which contains relays, small cells deployment, and system to system transmission. This research work focuses on the power allocation problem in 5th generation networks using a Hybrid Heuristic algorithm. This algorithm combines the features of ACO (Ant Colony Optimization) and PSO (Particle Swarm Optimization) techniques. The proposed algorithm is implemented with the help of the NS3 simulator and calculates the results and compared them with the existing approaches outcomes. Finally, they proved the efficiency of the proposed Hybrid Heuristic algorithm.

3.1. *ACO (Ant Colony Optimization)*

In the computer domain, ACO is one of the probabilistic approaches to solve the computing issues which may be finding the better paths using a graphical representation. Shengbin Liang et al., 2021 say that the ACO approach is projected by Dorigo. It has many merits like heuristic, distributed, and issues optimistic feedback. ACO has mainly been used to provide the solution for TSP((Traveling Salesman Problem)[11]. Combining simulated ants and local investigational algorithms is the better option for internet path and vehicle path selection. Simulated agents are identifying the possible path by operating via restricted space. These agents restore their locations and the quality of the solutions. Due to this reason, later iteration provides the best result. The following Fig 2 represents the working of ACO.

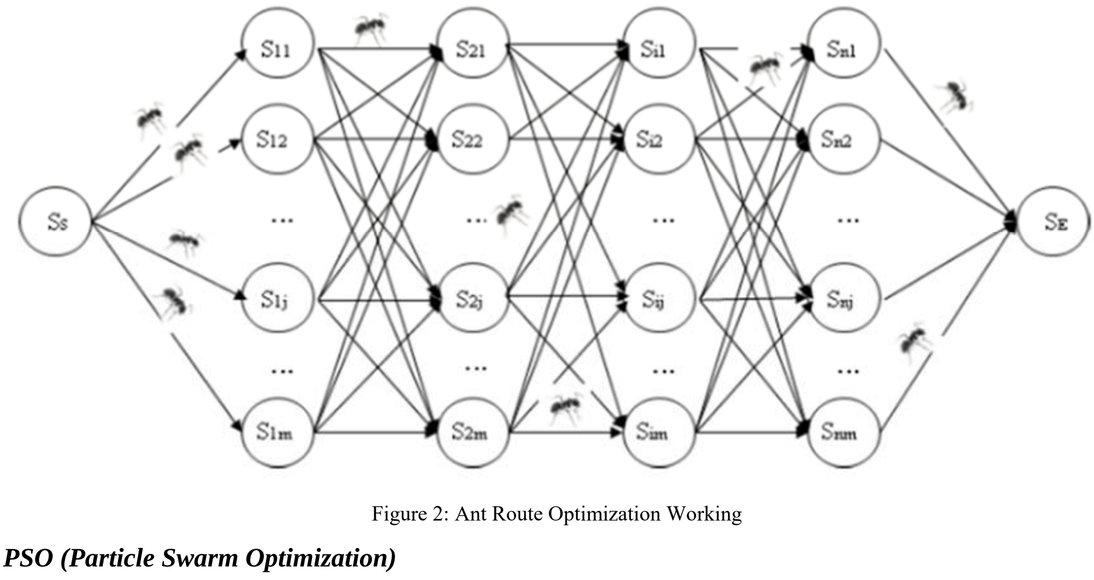

Figure 2: Ant Route Optimization Working

3.2. *PSO (Particle Swarm Optimization)*

In the computing domain, PSO is the method to identify the better result by repetitively trying to increase the result based on the measured quality. . Gourhari Jana et al., 2019 says PSO is the major population-based approach for stochastic type searching in a multidimensional kind space, and it also successfully providing the solution for a different type of optimization issues like various multifaceted issues[7]. It provides the solution using search space based on mathematical equations over the position and velocity of the particles. The movement of the particles is determined by the best-identified location Other particles are guided by existing the best locations, the PSO approach is not using the problem gradient.

Metaheuristics techniques like PSO do not provide a better outcome but they move towards a better result. Here hybrid heuristic algorithm is developed which integrates the enhanced discrete PSO with an improved ACO algorithm. In this research work, a hybrid heuristic algorithm is proposed for a power allocation plan in 5G multi-tier architecture. The following Fig 3 represents the working of PSO

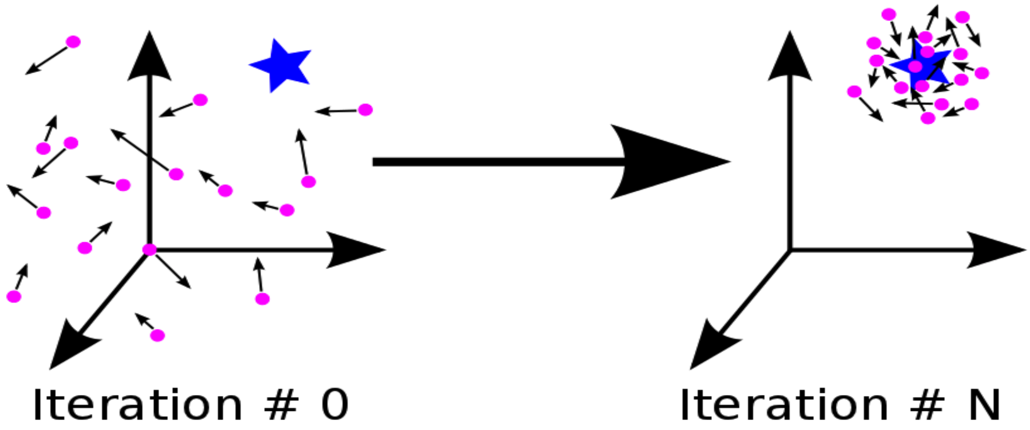

Figure 3: Particle Route Optimization Working

4. Result and Discussion

The efficiency of the energy is deduced by the proportion of the outcome performance, energy or products, for the input of energy. "Savings of energy" indicate a measure for saving energy that is controlled by the estimation and addition of assessing the usage when the execution of an energy efficiency development steps, where guaranteeing normalization for the heterogeneous conditions which has influence energy utilization. In addition, efficient energy development indicated an improvement inefficient energy because of the mechanical, social, or potentially financial difference [2]. In this article, Hybrid Heuristic Approach is introduced in 5G network for reducing energy consumption and increasing network efficiency. The output screen shots given below demonstrate the communication happening between the nodes using the algorithms such as Cyclostationary Feature Detection Technique and Matched Filter Multitaper Technique. The following Fig 4 represents Nodes creation, Fig 5 represents communication between nodes and Fig 6 represents packet transmission.

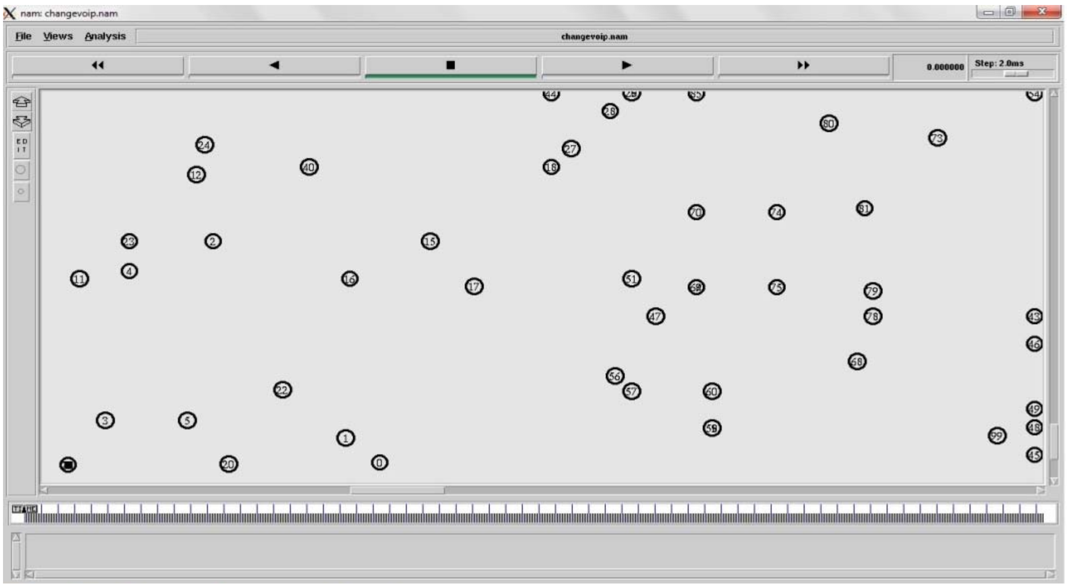

Figure 4: Creation of Nodes

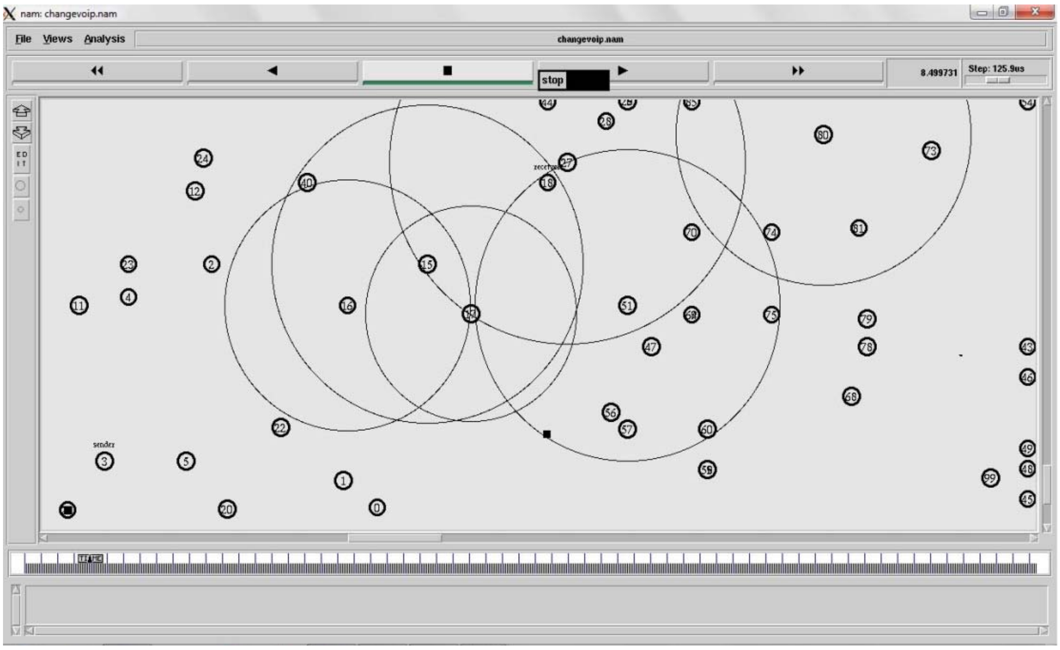

Figure 5: Communications between the Nodes

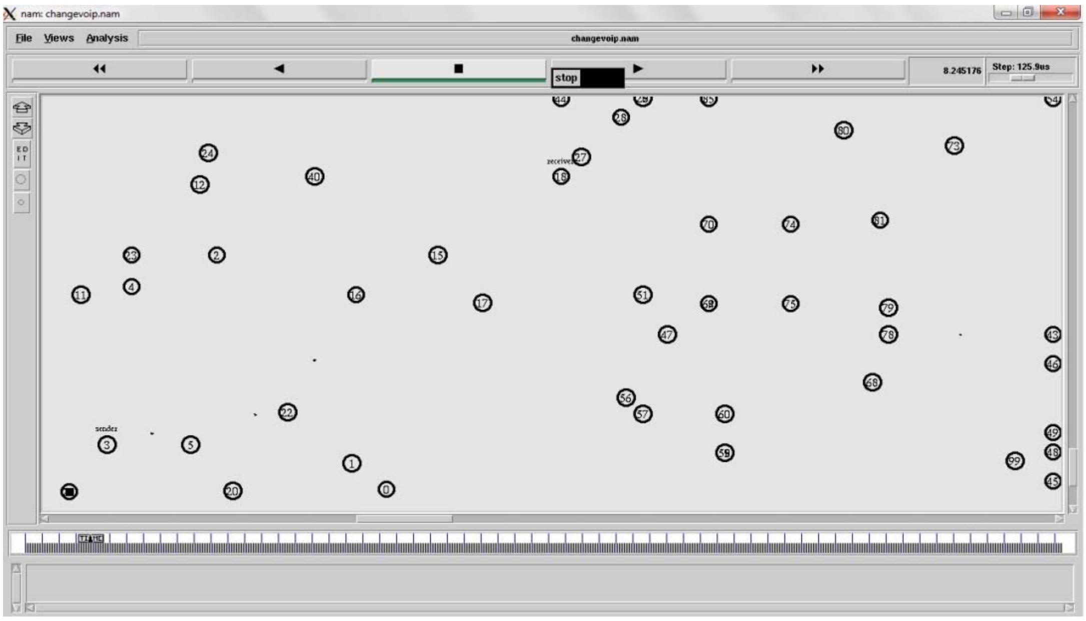

Figure 6: Packet Transmission

In this work we have used two types of scenario First scenario is communication using 100 nodes and second scenario is using 200 nodes.

Scenario 1 Analysis (100 Nodes):

4.1. ***Average Efficiency Comparison:***

The upcoming Table 1 compares the average efficiency of the proposed method with the existing techniques such as Cyclostationary Feature Detection Technique and Matched Filter Multitaper Technique.

No of Nodes	Cyclostationary Feature Detection Technique (kbps)	Matched Filter Multitaper Technique (kbps)	Hybrid Heuristic Approach (kbps)
10	10454	12476	28874
20	10546	12947	29241
30	11659	13258	30741
40	14487	17475	31876
50	14847	17987	32874
60	16587	20475	34894
70	16697	25632	36745
80	18854	26541	37564
90	18866	26650	37652
100	18910	26700	37855

Table 1 Average Efficiency Comparison

The upcoming Figure 7 shows the average efficiency of the proposed technique compared with the existing techniques such as Cyclostationary Feature Detection Technique and Matched Filter Multitaper Technique.

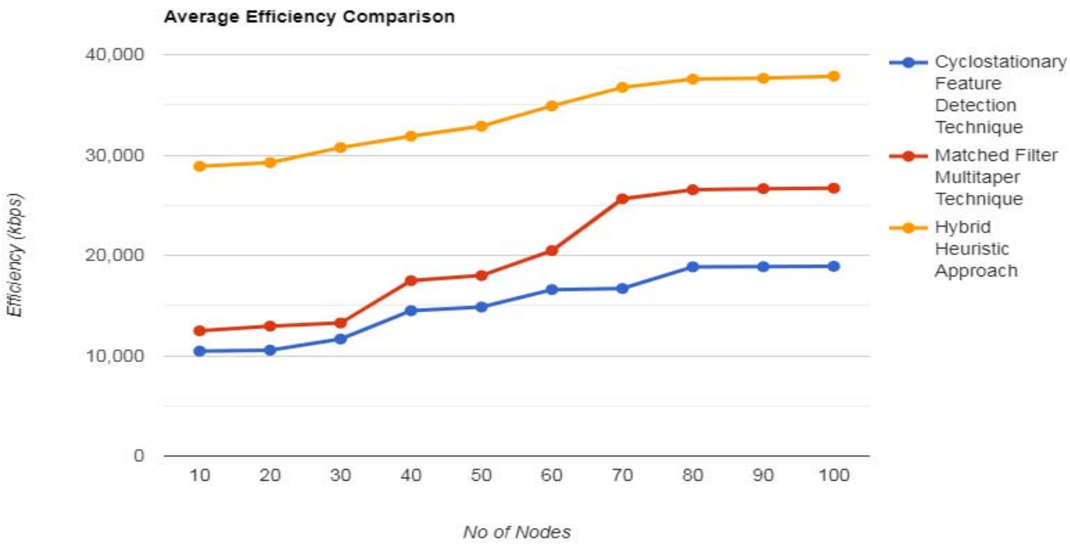

Fig 7 Average Efficiency Comparison

4.2. *Energy Consumption Comparison:*

The following Table 2 indicates the compare the proposed technique energy consumption with the existing techniques such as Cyclostationary Feature Detection Technique and Matched Filter Multitaper Technique.

No of Nodes	Cyclostationary Feature Detection Technique (J)	Matched Filter Multitaper Technique (J)	Hybrid Heuristic Approach (J)
10	20587	16007	10117
20	20241	14987	9974
30	18009	14475	9542
40	18874	12119	9241
50	18369	11974	7978
60	18147	11424	7536
70	17987	11114	7258
80	17541	10936	6974
90	17244	10540	6788
100	17114	10265	6585

Table 2 Energy Consumption Comparison

The following Figure 8 indicates the comparison chart of the proposed technique energy consumption with the existing techniques such as Cyclostationary Feature Detection Technique and Matched Filter Multitaper Technique.

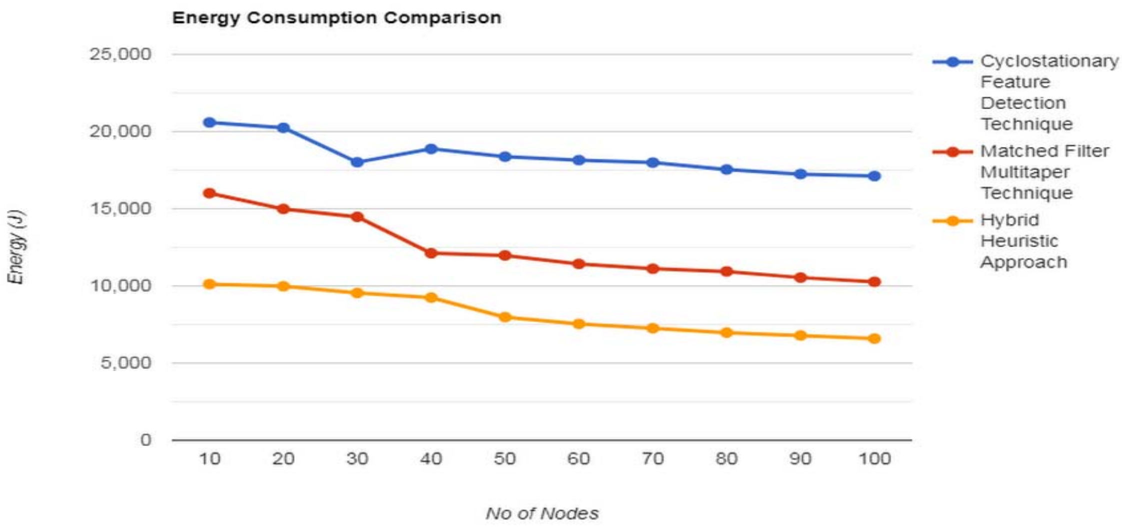

Fig 8 Energy Consumption Comparisons

4.3. *Average Throughput Comparison:*

The following Table 3 below indicates the comparison of the proposed technique average Throughput with the existing techniques such as Cyclostationary Feature Detection Technique and Matched Filter Multitaper Technique.

No of Nodes	Cyclostationary Feature Detection Technique (kbps)	Matched Filter Multitaper Technique (kbps)	Hybrid Heuristic Approach (kbps)
10	14541	17656	35003
20	14700	17998	35541
30	16850	18375	37941
40	21656	23575	37976
50	21997	23991	39972
60	23700	25785	39987
70	24997	29987	45974
80	25874	30102	49564
90	25987	30522	49980
100	26112	30899	50125

Table 3 Average Throughput Comparison

The following Figure 9 indicates the comparison of the proposed technique average Throughput with the existing techniques such as Cyclostationary Feature Detection Technique and Matched Filter Multitaper Technique.

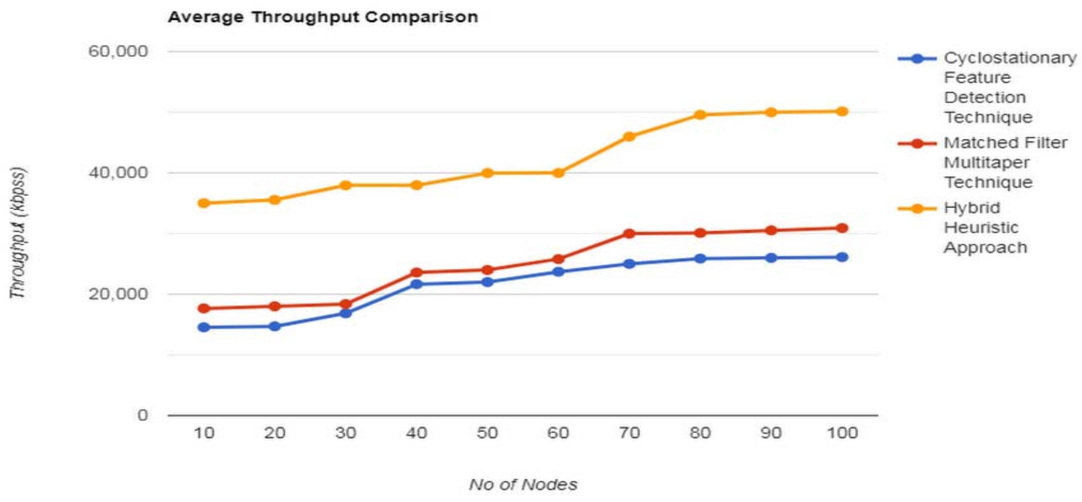

Fig 9 Average Throughput Comparison

4.4. *Average Packet Delivery Ratio Comparison:*

The following Table 4 below indicates the comparison of the proposed technique average Packet Delivery Ratio with the existing techniques such as Cyclostationary Feature Detection Technique and Matched Filter Multitaper Technique.

No of Nodes	Cyclostationary Feature Detection Technique (kbps)	Matched Filter Multitaper Technique (kbps)	Hybrid Heuristic Approach (kbps)
10	23	45	64
20	31	60	78
30	36	61	78
40	38	66	79
50	40	54	79
60	41	51	80
70	44	58	80
80	50	58	82
90	51	57	83
100	51	57	83

Table 4 Average Packet Delivery Ratio Comparison

The following Figure 10 indicates the comparison of the proposed technique average Packet Delivery Ratio with the existing techniques such as Cyclostationary Feature Detection Technique and Matched Filter Multitaper Technique.

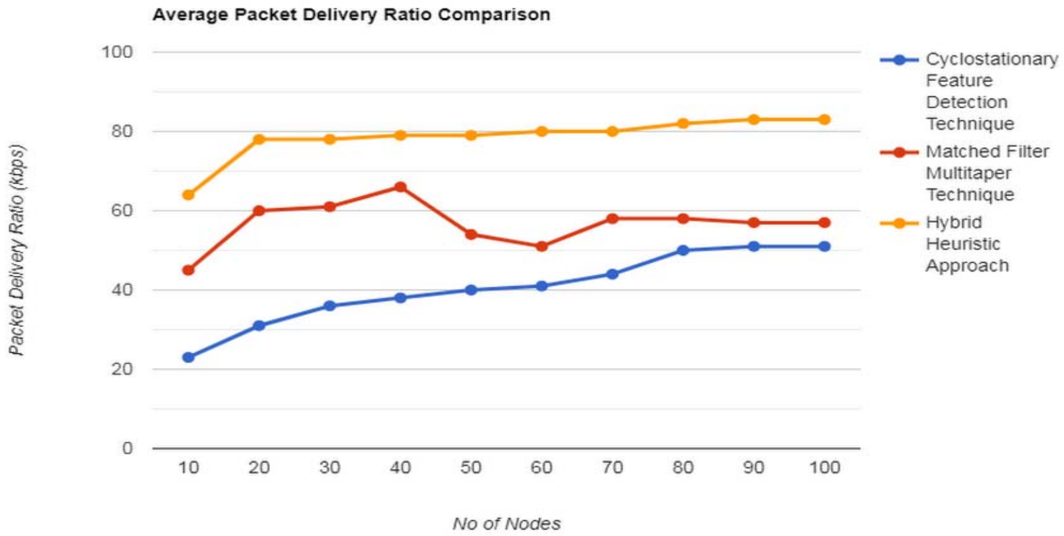

Fig 10 Average Packet Delivery Ratio Comparison

4.5. *Average End to End Delay Comparison:*

The following Table 5 below indicates the comparison of the proposed technique average End to End Delay with the existing techniques such as Cyclostationary Feature Detection Technique and Matched Filter Multitaper Technique.

No of Nodes	Cyclostationary Feature Detection Technique (kbps)	Matched Filter Multitaper Technique (kbps)	Hybrid Heuristic Approach (kbps)
10	91	71	41
20	92	75	41
30	99	81	44
40	107	85	44
50	113	90	46
60	123	91	48
70	128	94	50
80	131	96	51
90	133	99	53
100	135	101	57

Table 5 Average End to End Delay Comparison

The following Figure 11 indicates the comparison of the proposed technique average End to End Delay with the existing techniques such as Cyclostationary Feature Detection Technique and Matched Filter Multitaper Technique.

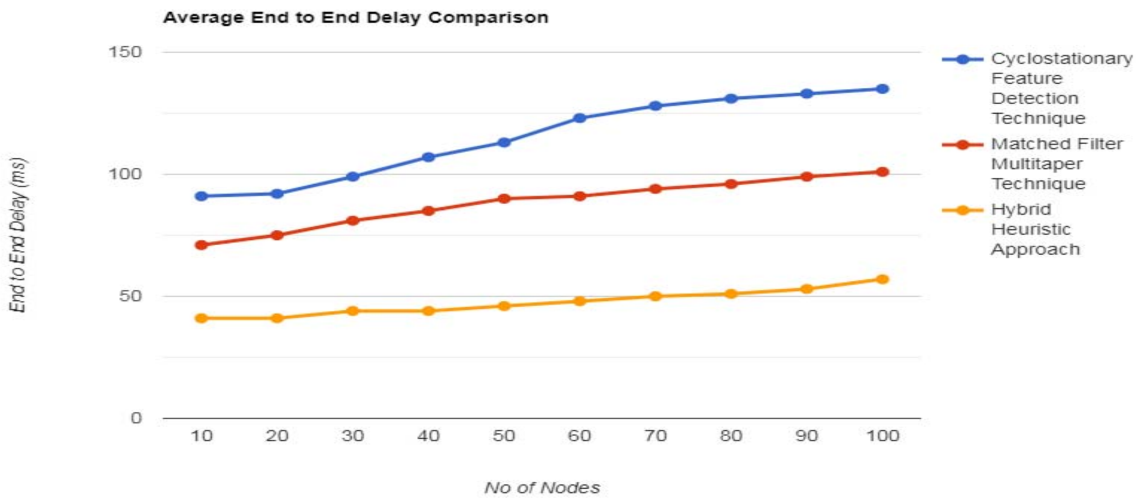

Fig 11 Average End to End Delay Comparison

Scenario 2 Analysis (200 Nodes):

4.6. ***Average Efficiency Comparison:***

The upcoming Table 6 compares the average efficiency of the proposed method with the existing techniques such as Cyclostationary Feature Detection Technique and Matched Filter Multitaper Technique.

No of Nodes	Cyclostationary Feature Detection Technique (kbps)	Matched Filter Multitaper Technique (kbps)	Hybrid Heuristic Approach (kbps)
110	11465	13490	29932
120	11580	13999	30540
130	12677	14325	31896
140	15499	18600	32910
150	15866	18998	33987
160	17599	21510	35965
170	17985	26687	37687
180	19869	27587	38584
190	19897	27700	38687
200	19927	27797	38890

Table 6 Average Efficiency Comparison

The upcoming Figure 12 shows the average efficiency of the proposed technique compared with the existing techniques such as Cyclostationary Feature Detection Technique and Matched Filter Multitaper Technique.

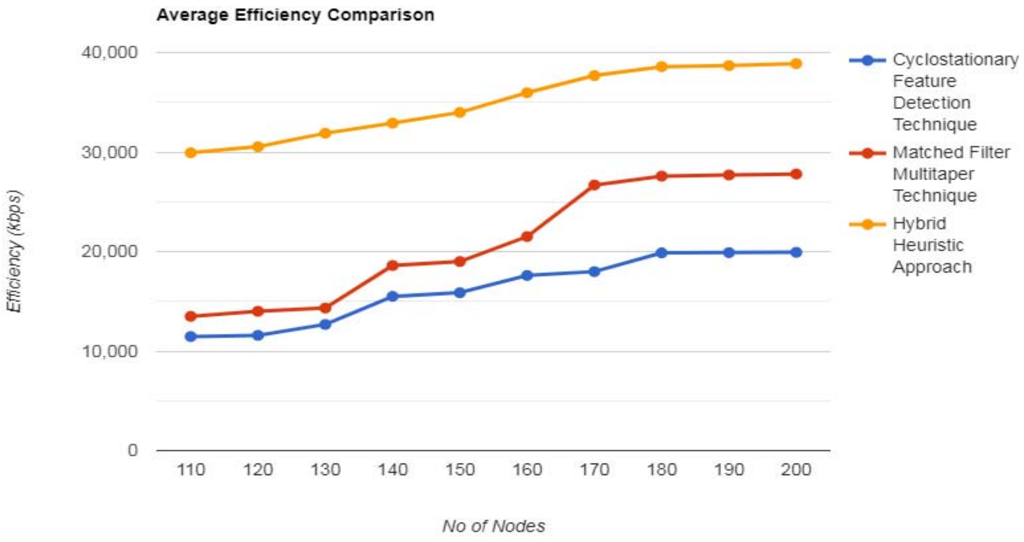

Fig 12 Average Efficiency Comparison

4.7. *Energy Consumption Comparison:*

The following Table 7 indicates the compare the proposed technique energy consumption with the existing techniques such as Cyclostationary Feature Detection Technique and Matched Filter Multitaper Technique.

No of Nodes	Cyclostationary Feature Detection Technique (J)	Matched Filter Multitaper Technique (J)	Hybrid Heuristic Approach (J)
110	21420	16980	9115
120	21110	13750	8620
130	19544	13210	8410
140	19620	11004	8108
150	19210	10574	6732
160	19050	10320	6420
170	18514	10009	6118
180	18339	9874	5800
190	18144	9420	5623
200	18022	9110	548

Table 7 Energy Consumption Comparison

The following Figure 13 indicates the comparison chart of the proposed technique energy consumption with the existing techniques such as Cyclostationary Feature Detection Technique and Matched Filter Multitaper Technique.

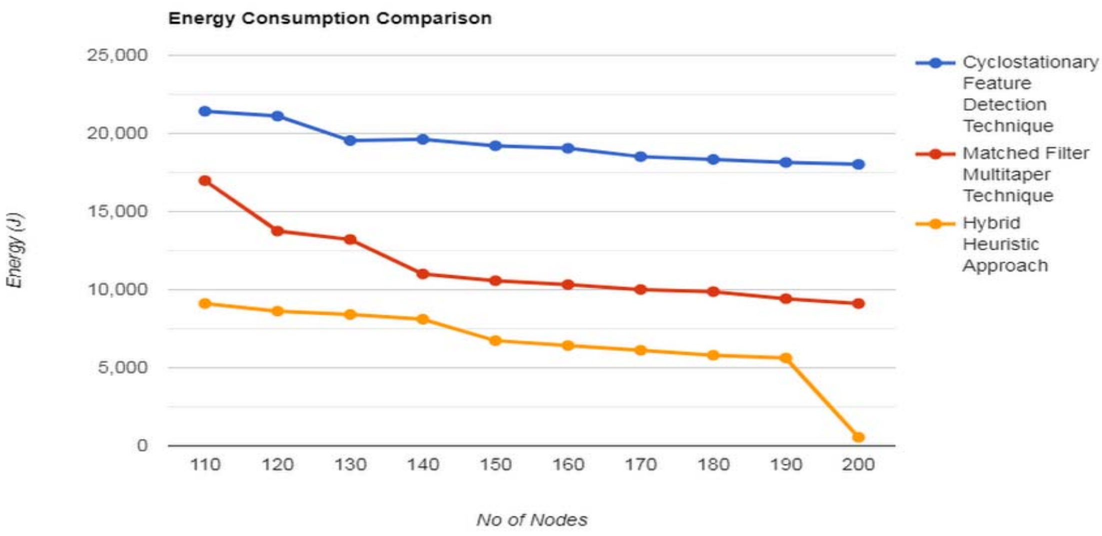

Fig 13 Energy Consumption Comparisons

4.8. *Average Throughput Comparison:*

The following Table 8 below indicates the comparison of the proposed technique average Throughput with the existing techniques such as Cyclostationary Feature Detection Technique and Matched Filter Multitaper Technique.

No of Nodes	Cyclostationary Feature Detection Technique (kbps)	Matched Filter Multitaper Technique (kbps)	Hybrid Heuristic Approach (kbps)
110	15650	18720	36566
120	15779	18810	36710
130	18250	19997	38654
140	22710	24620	38999
150	22999	25110	40950
160	24912	26921	40990
170	25897	30650	46788
180	26910	31221	50720
190	26995	31741	50996
200	27540	31998	51102

Table 8 Average Throughput Comparison

The following Figure 14 indicates the comparison of the proposed technique average Throughput with the existing techniques such as Cyclostationary Feature Detection Technique and Matched Filter Multitaper Technique.

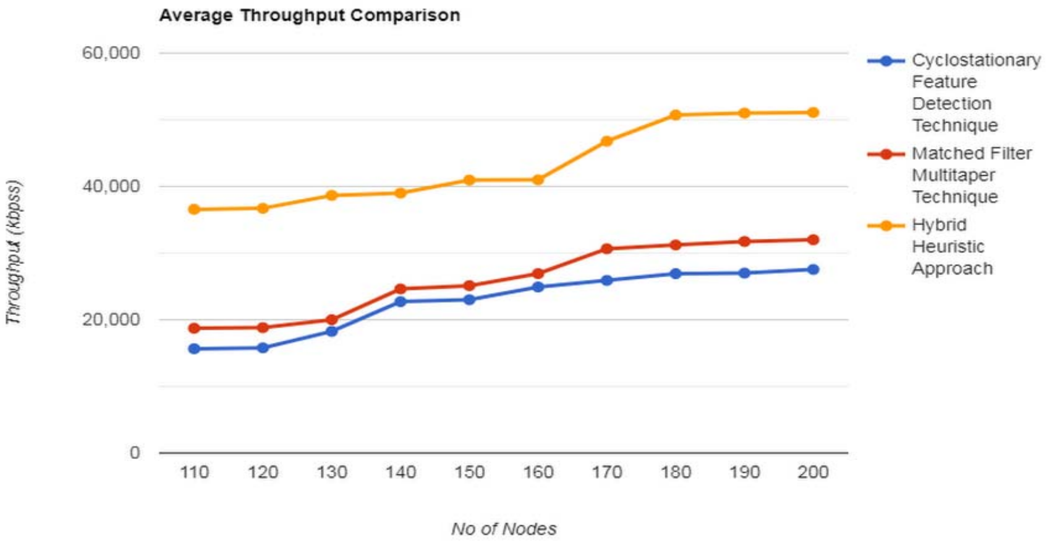

Fig 14 Average Throughput Comparison

4.9. *Average Packet Delivery Ratio Comparison*

The following Table 9 below indicates the comparison of the proposed technique average Packet Delivery Ratio with the existing techniques such as Cyclostationary Feature Detection Technique and Matched Filter Multitaper Technique.

No of Nodes	Cyclostationary Feature Detection Technique (kbps)	Matched Filter Multitaper Technique (kbps)	Hybrid Heuristic Approach (kbps)
110	25	49	87
120	35	70	87
130	39	71	96
140	45	69	96
150	48	70	96
160	50	75	112
170	52	79	112
180	60	80	123
190	65	82	125
200	69	82	125

Table 9 Average Packet Delivery Ratio Comparison

The following Figure 15 indicates the comparison of the proposed technique average Packet Delivery Ratio with the existing techniques such as Cyclostationary Feature Detection Technique and Matched Filter Multitaper Technique.

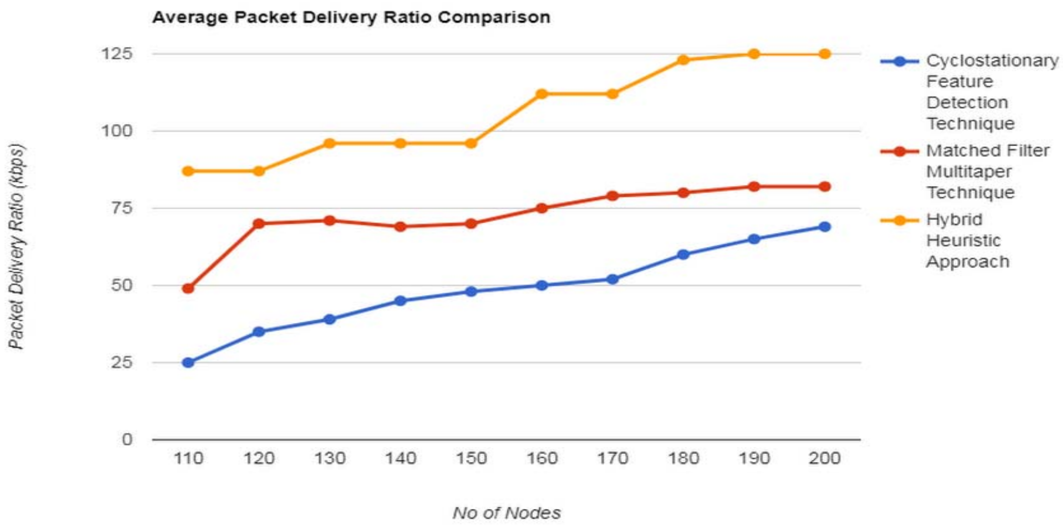

Fig 15 Average Packet Delivery Ratio Comparison

4.10. *Average End to End Delay Comparison*

The following Table 10 below indicates the comparison of the proposed technique average End to End Delay with the existing techniques such as Cyclostationary Feature Detection Technique and Matched Filter Multitaper Technique.

No of Nodes	Cyclostationary Feature Detection Technique (kbps)	Matched Filter Multitaper Technique (kbps)	Hybrid Heuristic Approach (kbps)
110	96	74	45
120	99	80	45
130	102	81	47
140	109	85	47
150	117	96	50
160	132	96	50
170	135	99	52
180	140	99	52
190	143	112	61
200	145	116	62

Table 10 Average End to End Delay Comparison

The following Figure 16 indicates the comparison of the proposed technique average End to End Delay with the existing techniques such as Cyclostationary Feature Detection Technique and Matched Filter Multitaper Technique.

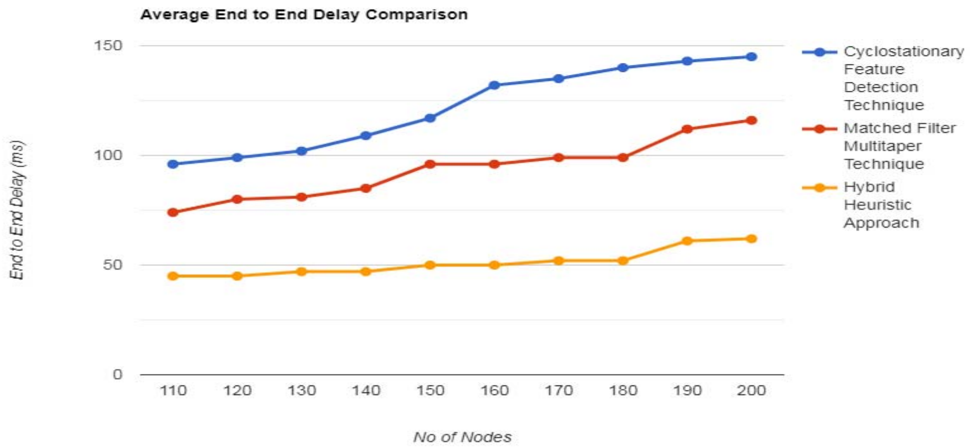

Fig 16 Average End to End Delay Comparison

The outcome of the proposed hybrid heuristic algorithm is compared with existing techniques such as Cyclostationary Feature Detection Technique and Matched Filter Multitaper Technique. The proposed method produces better outcomes based on their Efficiency, Energy consumption, Throughput, Packet Delivery Ratio and End to End Delay.

5. Conclusion

The major advantage of this hybrid heuristic algorithm is, it will provide huge broadcasting data (in Gigabit), which maintains more than 60,000 links. Compare with the previous generations current 5G generations are easily manageable. It provides better technological sound to support heterogeneous types of services including private networks also. A hybrid heuristic algorithm creates uniform, uninterrupted, and reliable connectivity throughout the world. The proposed work is simulated and tested using an NS3 simulator. Proposed work produces better output than the excising techniques like Cyclostationary Feature Detection Technique and Matched Filter Multitaper Technique.

Conflict of Interest

The authors have no conflicts of interest to declare. The article interpretation and analysis were contributed to by all authors, who also drafted the substantial scientific content.

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