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Dynamic Channel Allocation with Artificial Bee Colony (ABC) Based Scheduling and Fuzzy Covariance Possibilistic C-means (FCPCM) Clustering Based Mobile AD HOC Networks

K. Jegadeeswaran* and R. Radhakrishnan

ABSTRACT

Mobile ad hoc networks (MANETs) are getting remarkably popular, and the usual network loads regarded for MANETs are becoming enormous with the evolution of applications. As a result, this helps in the considerable importance given for bandwidth efficiency when keeping up stringent requirements over the energy consumption, delay and jitter. Coordinated channel access protocols have proved themselves to be desirable for hugely loaded MANETs under regular load distributions. Nonetheless, these protocols, generally do not suit well for irregular load distributions, preferred cluster head selection, optimal scheduling , satisfying the Quality of Parameters (QoS) because of the absence of on-demand dynamic channel allocation techniques existing in the infrastructure based coordinated protocols. For resolving the above mentioned issues, the important contributions of this paper are briefed as below: i) Introducing a Centralized Dynamic Channel Allocation (CDCA) for Fuzzy Covariance Possibilistic C-Means (FCPCM) clustering based MANETs; ii) Suggested a cooperative load balancing algorithm; iii) Scheduling is conducted by making use of the Artificial Bee Colony (ABC) which aids in the optimization of the resource utilization parameters such as power consumption, throughput and energy. iv) Combine two algorithms like DCA-Time Reservation making use of Adaptive Control (TRACE) (DCA-TRACE) and Cluster Heads Multi hop time (CMH)-TRACE in order to provide assistance for irregular load distributions and introduce CDCA-TRACE. In the work proposed, major contribution is carried out in CMH-TRACE module, wherein the selection of the cluster head is done employing FCPCM. It has been demonstrated to yield a greater throughput and to have more energy efficiency in comparison with the CSMA type protocols. Simulation studies, depends on the simplifications of practical phenomena. The Primary results speculated that the algorithm attains a synchronization accurateness of about 48 μs in this environment.

Index Terms: Mobile Adhoc Networks (MANET), Bandwidth Efficiency, Distributed Dynamic Channel Allocation, Time Reservation making use of Adaptive Control (TRACE), Fuzzy Covariance Possibilistic C-Means (FCPCM), Artificial Bee Colony (ABC), Centralized Dynamic Channel Allocation (CDCA).

1. INTRODUCTION

A Mobile Ad Hoc Network (MANET) is basically a self-configuring system consisting of wireless nodes which does not require any predefined communications architecture [1]. In the case when any two of the nodes are not able to communicate without any intrusion, each node must then continue to forward the packets, and act as a relay, on the behalf of nodes added. Due to the transmission characteristic of a radio conduit, overlie broadcast (collisions) can occur which can lead to amplified delay and packet loss because of retransmissions. This way, a critical concern is expressed when the nodes are allowed to be in contact with the channel (i.e., send/receive a packet), as a verdict announced by the Media Access Control (MAC)

* Department of Computer Science and Engineering, Vidhya Mandhir Institute of Technology, Ingur, Erode–638052, Tamilnadu, India, *Email: jegadeeswar@gmail.com*

protocol. Generally, MAC protocols might be hugely divided into two groups supported by their approach towards rendering access rights. In the case of disputation protocols, such as Aloha, Carrier Sense Multiple Access(CSMA), Multiple Access with Collision Avoidance (MACA), Multiple Access with Collision Avoidance Wireless (MACAW), Floor Acquisition Multiple Access(FAMA), and 802.11 [2], nodes contend in an asynchronous manner for the admittance to the shared channel. Several collision prevention techniques are provided [3] and they all have random retransmissions eventually. The most significant advantage of this categorizing is that they have transparency, i.e., the procedure does not do any modification to its process with the topology changes.

When contention based protocols cannot offer deterministic delay bounds, they are efficient in the presence of low load with only few collisions present to be resolved. Their primary drawback comes up during high load, when these protocols have to expend much of their time in the resolution of collisions. As a consequence, the throughput nears to zero thereby leading to an unstable network. For the purpose of avoiding this instability, deterministic allocation protocols were proposed. These protocols, that include TDMA, variations over spatial reuse TDMA 161 [4], and TSMA [5], allocate every node with a transmission schedule specifying the synchronized slots in which the node may do their transmission. As it is assured that at the least one slot in the schedule will have success, these protocols have limited delay.

Simple TDMA allocates a permanent, distinct transmission slot to every node present in the network. When TDMA has mobility transparency, its throughput is very less as there exists no spatial reuse, i.e., simultaneous multiple transmissions are not permitted even in the condition when the transmitting nodes are adequately distant enough so that collision would not occur. Different variants of TDMA try to raise the spatial reuse factor by the dynamic computation of the transmission schedules. Nonetheless, such kinds of protocols have mobility transparency no longer since the transmission schedules have to be recalculated with the network topology variations. Moreover, in case the network is largely mobile, these protocols practically tend to become unstable with the nodes spending nearly all of their time in their transmission schedules maintenance. TDMA factors that determine the interference and amount of spatial reuse, share the bandwidth obtainable within groups in order to reduce the disturbance all the way through the set of connections. Defeating the intrusion is a desirable objective since huge intrusion leads to greater fault rates, thereby reducing the throughput as given in [6]. On the other side, minimizing the bandwidth obtainable for each group or cluster also limits the capability of the cluster. Node mobility and irregular node distribution might magnify the local load much higher compared to the cluster capacity, resulting in the packets drop and reducing the throughput in the traffic in real-time. The selection of how these factors are to be fixed needs to be on the basis of this replacement and then will be of huge important by different conditions like the physical layer and node density parameters.

An evaluation which defines the relationship between the protocol parameters and also the performance metrics necessitates to guarantee the effective usage of less amount of resources in MANETs, and such a model is developed in this thesis. The circumstances where a MANET carries out its operation might vary over time. Irregular traffic loads are usual in MANETs because of the inherent characteristics like the dynamically varying environment scenarios and the node mobility. The design of the network must have strategies of dynamic channel allocation for supporting discontinuous traffic. The aim of these techniques is the distribution of the channel resources for the nodes requiring channel access when considering the interference levels and spatial reuse. Though different dynamic channel allocation techniques have been introduced for other types of network like cellular networks, because of the particular characteristics of MANETs, there is no direct applicability of these strategies. The novel approach dynamic channel allocation has to be employed in MANET that is already operating in a cellular network as it renders more flexibility in the allocation of channels. Hence, the dynamic channel allocation strategy is aimed at defeating the disadvantage of fixed channel allocation scheme.

In this research work is proposed a Fuzzy Covariance Possibilistic C-Means strategy for the clustering of the nodes for the purpose of channel access in the CH's of network data transmission along with effective utilization of bandwidth. The CH's are obtained from the newly introduced Distributed Dynamic Channel Allocation strategy, which places operating circumstances on the rise for a resource consumption that is well organized for MANETs and thereafter introduced a Load Balancing technique for the smoothing of the irregularity in the load sharing and combine it with the strategy of Distributed Dynamic Channel Allocation. The scheduling scheme along with Artificial Bee Colony (ABC) technique then does the optimization of the resource utilization parameters like power consumption and energy. It was indicated that particular energy consumption pointed to the relationship of mapping between the energy consumption and the power consumption parameters that again guided towards the energy resourcefulness of the machine tools from the view of efficient input and output. The new Centralized Dynamic Channel Allocation (CDCA) is integrated in ABC scheduling; therefore it is called as CDCABC-TRACE.

2. LITERATURE REVIEW

Bora Karaoglu et al [7] has suggested the cooperative load balancing along with dynamic channel allocation for the purpose of cluster based mobile adhoc network. The dynamic channel allocation algorithm and cooperative loads balancing technique is exploited in the MANET in addition to cluster formation, and the bandwidth efficiency gets boosted. But the delay incurred in the packet transmission may not be much reduced. Coordinated channel access procedures are highly suitable for load distributions that are uniform. This protocol does not suit load distribution that is non-uniform due to channel access being uncoordinated. It is because of the absence of on-demand dynamic channel allocation. For the purpose of addressing this issue, lightweight dynamic channel allocation mechanism and also cooperative load balancing strategy are proposed in the case of cluster based MANET. Hence in the existing system, the Guaranteed Time Slot (GTS) strategies are employed for nodes present in the cluster formation. GTS is desirable for transmitting information that is time-sensitive, i.e. it allocates time slots to a particular node. With those available slots, the nodes can transmit the packets in a scheduled way. For efficiency, routing algorithms is used to sense the transmission path and send the packets quickly. This will minimize the delay since the packets get transmitted in a particular order. GTS technique desires robust communication having no loss and duplication of information though the delay is observed till a specific degree. But it takes more energy for transmitting the packets.

In [8] proposed Multihop Time Reservation employing Adaptive Control for Energy efficiency (MH-TRACE). The MH-TRACE is a Medium Access Control (MAC) protocol for enhancing energy competence it will unite the entirely centralized and distributed connections. This MH-TRACE cluster is utilized for coordinating the clusters and avoiding interference. Here, they introduced cyclic super frames which consist of frames each frames is assigned to particular time in order to support reservation-based periodic channel access for real-time traffic. This transmission schedule within each cluster are accomplished by the cluster heads CH), intra group information collisions are completely eradicated and inter group collisions are abridged. There exist two methods castoff to save energy. The primary method is used to reduce energy dissipation at the MAC layer. The second mechanism is with respect to the reduction of energy dissipation by preventing the packet receptions which will, in turn, be also avoided at the higher layers. When related to the obtainable CSMA-type broadcast protocols such as 802.11. MH-TRACE provides the contribution of extra energy efficiency using the Time Division Multiple Access (TDMA). It also offers sophisticated throughput owing to coordinated channel admittance.

In [9] introduced a two new Medium Access Control (MAC) protocols for wireless ad hoc networks, the Progressive Backoff Algorithm (PBOA) and the Progressive Ramp Up Algorithm (PRUA). Both protocols divide time in frames in which a contention slot is followed by a data slot. PBOA is integrated with a well known power control algorithm. PRUA performs no power control, and so is not as energy efficient, but can achieve a tight packing of transmissions by allowing nodes to make educated decisions during the contention period. Under both protocols, contenting nodes try to select their potential destinations so that spatial reuse is as high as possible, even if that means transmitting a packet that is not on the head of their routing buffer. In this proposed work compared both protocols with Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA), and also with the Power Control MAC (PCM) protocol. This proposed work also compared them with a hypothetical MAC protocol that would be able to make optimal decisions and so achieve the network capacity. The results show that both protocols perform better than CSMA/CA and PCM in terms of throughput and robustness with respect to the choice of the routing protocol. Also, PRUA is more energy efficient than CSMA/CA, and PBOA is more energy efficient than both CSMA/CA and PCM.

In [10] established the accurate affiliation among the two issues. Particularly, this effort initiates the crisis of tranquil mutual exclusion to replica one significant feature of the Distributed dynamic channel allocation (DDCA) issue. This suggested process magnifies a communal algorithm that capacities soothing mutual exclusion for a single source and offer substantiation for vital and adequate surroundings for the data structure. By taking into account distributed dynamic channel allocation as a unique case of tranquil mutual exclusion, practices and broaden the algorithm to concentrate on the issues that occur in distributed channel allocation such as dealing with multiple channels, deadlock resolution, and channel selection strategies, strategy of effectual data structures. Exploration and mockup outcomes are delivered and illustrates that the outcomes of this investigation can be utilized to design well-organized distributed channel allocation procedures.In [11] encompass anticipated improved uniformity of IEEE 802.11. A Transmission scheme MANET Multicasting has been instigated. Multi casting in the case of Mobile Adhoc Networks have been primarily based on MAC layers. Presently, the Round Robin Acknowledge and Retransmit (RRAR) method is castoff. If certain packets are inapt all through packet communication amongst source and endpoint, then it will do the retransmission of the packet another time. Hence, the consistency is improved and the interruption is also compressed. Every node consumes higher amount of energy for the transfer of the packet. This survey from the literature describes briefly the failures due to packet interruption during the packet transmission and its added challenge of energy expenditure. In the systems suggested, that packets interruption will be compressed, and also the energy ingestion of the nodes energy will be reduced.

3. PROPOSED METHODOLOGY

In this subdivision first describe the details of dynamic channel allocation mechanisms under Time Reservation making use of Adaptive Control (TRACE) for MANET and the cooperative load balancing algorithms. During cooperative load balancing task, cluster formation is carryout by using Fuzzy Covariance Possibilistic C-Means (FCPCM) Clustering. Cluster head assortment is anticipated using FCPCM with the aim of maximizing the network existence by energy effectiveness and power reduction. During cooperative load balancing algorithm task, optimal scheduling is also performed by using Artificial Bee Colony (ABC) is introduced. It was pointed out that specific energy consumption referred to the mapping relationship between energy consumption and the power consumption parameters, which reflected the energy efficiency of machine tools. The proposed Centralized Dynamic Channel Allocation (CDCA) is incorporated in ABC scheduling; hence it is named as CDCABC-TRACE.

3.1. System Model

3.1.1. Single Transceiver

The nodes present in the network are fixed with a transceiver in which its functioning happens in two directions: either transmission or reception. Nodes could not broadcast and receive simultaneously.

3.1.2. Channel Sensing

The receiver node is very much proficient in identifying the occurrence of a carrier signal and for measuring its power for those communications/messages which cannot be deciphered into a packet that is lawful.

3.1.3. Collisions

For instance, simultaneous transmission over the system cannot be performed until the transmission grasps the receiver to promote the packets. The receiver can be seized only in case of the power level of any one of the transmissions being considerably greater in comparison to the power level of all the other same time transmissions. Such a capturing strategy acts the driving factor of the benefits that are gained by means of channel reuse.

3.1.4. Channel Coordinators

The distribution of the resources is formulated through channel coordinators. These coordinators may be either ordinary node which is chosen for performing the responsibility, or else they may be nodes that are specialized. The channel allocated to the nodes in the network for transmission requirements supplied by the channel coordinators. Furthermore, the system is considered to be a closed system in which all of the nodes are in compliance with the channel access rules.

3.1.5. Mobility Model

In this work a discrete-time system is considered for simulation work. The mobility of every pair over the square region is decided by its present location, and is not dependent on the other history information, and the next location is along a grid. Represent by $S_1[t]$ the location of the sender 1 at any time slot t, the location of receiver at time slot, and P the set containing all positions on the square-lattice.Multi Hop- Time Reservation making use of Adaptive Control (MH-TRACE) entire protocol is described detail in [12]. In MH-TRACE, a small number of nodes take the responsibility of channel coordinators, thus recognized as cluster-heads. The channel coordinators are also known as the cluster heads, thereby certain responsibilities can be performed by the CHs in MH-TRACE. While in MH-TRACE, time slots are divided into superframes of equal length, superframes are further divided into frames repeated exactly with time. Every CH operates making use of one of the available frames in the superframe structure and gives the nodes the channel access within its range of communication.

3.2. Dynamic Channel Allocation for TRACE

The dynamic channel allocation mechanism for the TRACE is carried out in the same way as discussed in [13]. DCA-TRACE permits CHs to function in more than one frame per superframe, in case they become overloaded. DCA-TRACE integrates two additional approaches on upper MH-TRACE: i) a system also maintains the record of entry level of interference that is noticed from the rest of the CHs in each frame; and ii) a technique for detecting the degree of interference from the nodes that are transmitting in each data slot of every frame. These mechanisms utilize available messages and do not add up any complexity except to the slightly raising memory requirements to store the levels of interference. Cluster heads in MH-TRACE, makes use of this mechanism to first-rate the minimal interference structure intended for them. At the culmination of every frame, the interruption level of the CA and the Beacon slots get reorganized in accordance with the measured values in that specific frame making use of ,

$$I_{k,t} = \begin{cases} M_{k,t} \ \textit{if} \ I_{k,t-1} < M_{k,t}; \\ (1-\alpha) I_{k,t-1} + \alpha \ M_{k,t} \ \textit{otherwise} \end{cases} \quad (1)$$

where $I_{k,t}$ and $I_{k,t-1}$ denote the levels of interference of the k[th] slot in the present also in earlier superframe, congruently. $M_{k,t}$□→ interference level calculated of the k[th] slot in the existing superframe, and signifies a smoothing aspect prefixed to 0.2. In the provided equation (1) the levels of interference of the k[th] slot is measures the maximal levels, but in dynamic manner it is changes simultaneously. So in order to solve this problem here fuzzy membership function is introduced which $M_{k,t}$ depends on three scale parameters a, b, c. The new parameter values is represented as $M_{k,t} \in \{M_{ka,t}, M_{kb,t}, M_{kc,t}\}$. The triangular curve is a function of a vector in [14], $I_{k,t-1}$, and depends on three scalar parameters $M_{k,t} \in \{M_{ka,t}, M_{kb,t}, M_{kc,t}\}$, as given by

$$I_{k,t} = f\left(I_{k,t-1,} M_{ka,t}, M_{kb,t}, M_{kc,t}\right) = \begin{cases} M_{k,t} if I_{k,t-1} < M_{ka,t} \\ \dfrac{I_{k,t-1} - M_{ka,t}}{M_{kb,t} - M_{ka,t}}, M_{ka,t} \le I_{k,t-1} \le M_{kb,t} \\ \dfrac{M_{kc,t} - I_{k,t-1}}{M_{kc,t} - M_{kb,t}}, M_{kb,t} \le I_{k,t-1} \le M_{kc,t} \\ I_{k,t-1} + M_{kc,t}, M_{kc,t} \le I_{k,t-1} \end{cases} \tag{2}$$

In DCA-TRACE, CHs tag a frame to be not available in case of another cluster using the frame and residing much closer than a specific threshold, Tr_{intf}, which is measured by means of the high interference value of that particular frame. Based on the earlier reservations of the frames Cluster Head (CH) decides number of frames required to access, m, when the super frame conclude its work. Least noisy m numbers of frames are selected by measuring level of interference of each frame having an interference value which is also lying below a common threshold, Tr_{intf}. In case of the number of frames that are available being lesser than m, the CHs work solely in the frames that are available. Tr_{intf}, avoids excessive interference present in between the co-frame clusters which can the make the clustering structure destabilized in a potential manner. For the purpose of the mobility of the node, the random way-point mobility model [15] is utilized, in which the speed of the nodes are selected from a uniform stochastic distribution in between 0.0 and 5.0 m/s along with zero pause time.

3.3. Fuzzy Covariance Possibilistic C-Means (FCPCM) for Cluster Formation

The majority of clustering methods for mobile ad hoc networks choose a subset of nodes so as to outline a connection that sustains control functions. A set of the chosen/selected nodes are identified as Cluster Heads (CHs) and every node in the connection is connected with one. CHs are associated among one another openly or via gateway nodes. The amalgamation of gateway nodes and CHs outline an associated backbone. This associated backbone assists simplify purposes such as bandwidth allocation, channel access, routing power control and virtual circuit support [16]. Since CHs must perform extra work with respect to ordinary nodes they can easily become a single point of failure within a cluster. For this reason, the CH election process should consider for the CHs role, those nodes with a higher degree of relative stability [17].

The main task of a CH is to calculate the routes for long-distance messages and to forward inter-cluster packets. A packet from any source node is first directed to its CHs. If the destination is located in the same cluster, the CHs just forward the packet to the destination node. If the destination node is located in a different cluster, the CH of the sending node routes the packet within the substructure of the network, to the CH of the destination node. Then, these CHs forward the packet to its final destiny [18].

In precise, selecting a finest number of CHs which will acquiesce higher throughput but attains low latency is still a significant problem. So in this research work fully distributed system is proposed where all the nodes contribute the similar liability and performs as cluster heads. Nonetheless, additional CHs result additional amount of hops for a packet as it gets directed from the source to the endpoint, as the packet has to go away through better number of CHs. Thus this result directs to higher latency, higher power utilization and higher information processing per node. Conversely, to exploit the resource consumption decides to have the minimal number of CHs to wrap the complete geographical region in which the nodes are dispersed. The complete area can be divided into zones, the amount of which can be resolute by the broadcast range of the nodes. This can set a lower bound on the amount of CHs requisite. Consequently the energy consumption and number of messages that are communicated to transceiver are minimized during clustering process.

Fuzzy Covariance Possibilistic C-Means (FCPCM): In this section Fuzzy Covariance Possibilistic C-Means (FCPCM) is a clustering method developed based on the energy of the nodes for extending the lifetime of MANET. The operation of a sensor network begins with the cluster set up phase, where clusters of the sensor nodes are developed, which is followed by the data transmission phase, in which the cluster nodes will send the gathered data to cluster head. Each CH then aggregates the received data from cluster nodes and then relays it to the transceiver. Thus the complete region is splits into various clusters; the subsequent phase is to select the CH amongst the contributing nodes to stabilize energy utilization and power management. Various CHs election methods are anticipated over several decades in which many suggestions errand consistently distributed clusters with constant average cluster sizes [19]. Thus, a new FCPCM aware clustering algorithm for cluster formation and CH selection is required. The set of CH nodes can be selected based on the distance metric as objective function. The main objective in FCPCM clustering is to find the internal structure of cluster nodes to partition this network region into c different clusters. The members of these clusters are among each other more similar than in comparison with the elements from the other clusters. The FCPCM clustering aims at minimizing the criterion function.

$$F_{PCM} = \sum_{j=1}^{c}\sum_{k=1}^{n}\mu_{jk}^{\eta}d_{jk}^{2} + \sum_{j=1}^{c}v_j^2\sum_{k=1}^{n}\left(1-\mu_{jk}\right)^{\eta} \tag{3}$$

where c stands for the number of clusters, n is the numbers of nodes in the network model, d_{jk}^2 is the distance between the j^{th} cluster prototype to the k node, μ_{jk} is the typicality of the k^{th} sample regarding the j^{th} cluster prototype and v_j stands for the fuzzy variance of the j^{th} cluster. Euclidean distance measure is used here to measure the distance between nodes the cluster prototype, with the dimension $1 \times m$, is defined as follows

$$V_j = \frac{\sum_{k=1}^{n}\mu_{jk}^{\eta}z_k}{\sum_{k=1}^{n}\mu_{jk}^{\eta}} \tag{4}$$

where z_k stands for selected cluster nodes sample and μ_{jk} stands for the fuzzy membership matrix which is calculated as follows

$$\mu_{jk} = \left(1+\left(\frac{d_{jk}^2}{v_j^2}\right)^{\frac{1}{n-1}}\right)^{-1} \tag{5}$$

$$v_{jk}^{2}=\frac{\sum_{k=1}^{n}\mu_{jk}^{\eta}d_{jk}^{2}}{\sum_{k=1}^{n}\mu_{jk}^{\eta}} \tag{6}$$

where η denotes the fuzziness parameter. The Mahalanobis distance is further used in the calculation of the typicality is defined as

$$d_{jk}^{2}=\left(z_{k}-v_{j}\right)A_{j}\left(z_{k}-v_{j}\right)^{T},A_{j}=\left(\rho_{j}\left|F_{j}\right|\right)^{\frac{1}{m}}F_{j}^{-1} \tag{7}$$

where the variable $\rho_j = |A_i|$ and F_j is the fuzzy covariance matrix of dimension $m \times m$ defined as follows

$$F_{j}=\frac{\sum_{k=1}^{n}\mu_{jk}^{\eta}\left(z_{k}-v_{j}\right)^{T}\left(z_{k}-v_{j}\right)}{\sum_{k=1}^{n}\mu_{jk}^{\eta}} \tag{8}$$

In this case the typicality variable v_{jk} (Eq. 6) was fixed to value δ. The δ is in a tuning parameter which depends on the expected form of clusters, i.e., if expect the clusters along the line, or with very big ratio between the maximal and the minimal eigen value of the cluster covariance matrix, this factor should be small. Each cluster head handles the maximum possible number of nodes in its cluster. By this mode of clustering the nodes in network model is grouped into k number of clusters and the cluster heads in each cluster are selected. During the end of this phase, information about all of the cluster nodes is provided to cluster head. The CH can minimize the rate of energy consumption and every frame, the interference level of the Beacon and the CA slots in the clusters are measured correspondingly and taken as objective function for CH selection.

Collaborative Load Balancing for TRACE Collaborative load balancing mechanism for TRACE protocol is explained detailed in [12] and suggest CMH-TRACE and CDCA-TRACE, which supplement reassuring CH reselection and inspecting on DCA-TRACE and MH-TRACE, disparately. Whilst in CDCATRACE and CMH-TRACE, nodes persistently detect the attainable data slots at the CHs and broadcast the Beacon messages. When all the accessible data slots for a cluster head are selected, with a possibility p, the vibrant node attempts to stimulate the supportive load balancing algorithm. When the supportive load balancing is stimulated, present node, utilizing a data slot from the severely loaded cluster head contend for data slots from proximate Cluster Heads while sustaining and exploiting its allocated data slot till it guards a newfangled data slot from existing Cluster Head. The additional overhead acquaint with neighboring Cluster Heads by the cooperative load balancing is restricted or limited. It is imperative to remember that the active nodes only have admittance to a new CH with permitted resources that trigger cooperative load balancing algorithm. Triggering the algorithm also reduces the load furthermore. In view of the fact that TRACE previously has a low dispute overhead [20] recognition to its automatic channel reservation algorithm for active nodes, the slight increase in the contention overhead does not have a significant effect on protocol performance. When the load balancing and clustering is done completely, subsequently scheduling is carried out in accordance with the Artificial Bee Colony (ABC).

Proposed Optimal Scheduling using Artificial Bee Colony (ABC): The design of scheduling process in the network is that carefully turning on a subset of data slot framework in accordance with the known network state information with the aim of avoiding excessive interference in addition to maximize network throughput, power consumption and energy with ABC. During this process transmission rates of the transceiver at time t are decided with the following three constraints: (i) channel condition $C[t]$, (ii) network topology, which is described by the mobiles' locations ($S[t]$, $R[t]$), and (iii) the scheduling decision $A[t]$. Now consider that $C[t] = c$, $(S[t], R[t]) = (s, r)$, and $A[t] = a$ where s, r, a indicates the realizations of random variables. A maximum link rate c_1 can be accomplished over link 1 when there is no other active pairs interfering pair 1; otherwise, the link rate is zero. A link-rate vector $L_{\{c,(s,r),a\}}$ are defined as given below,

$$L_{\{c,(s,r),a\},1} = \begin{cases} c_1 \text{ if } a_h = 0 \text{ for any pair } h \text{ such that} |s_h - r_1| \le (1+\Delta)|s_1 - r_1|; \\ L_{\{c,(s,d),a\},1} = 0, \text{ otherwise} \end{cases} \tag{9}$$

In addition during scheduling process overall network load ($Load_1$) and excessive bandwidth allocated to overloaded links ($Load_2$). The overall objective function of the scheduling is defined as follows,

$$f(L, Load_1, Load\ ) = \frac{\alpha}{(\beta \times Load_1 + \gamma \times Load_2 + \lambda \times L)} \tag{10}$$

Where α, β, γ & λ are manually configured coefficients. $Load_1$ and $Load_2$ are expressed as shown

$$Load_1 = \sum_{c-1}^{C} D_c \tag{11}$$

$$Load_2 = \sum_{ij \in N} W_{ij} x \left(\sum_{c-1}^{C} D_c - CB_{ij} \right) \tag{12}$$

$$W_{ij} = \begin{cases} 0 \text{ if} \sum_{c-1}^{C} D_c \le CB_{ij} \\ 1 \text{ otherwise} \end{cases} \tag{13}$$

D_c-Bandwidth demand for cluster c on each link, CB_{ij}-Bandwidth capacity of link (i, j) and C-Total number of active clusters . The foraging behavior of honey bees are been adopted by ABC for the simulation. There happens a special dancing behavior of the bees [21] during the search for channel conditions. The ease in developing [22] has made ABC as successful approach used for several optimizations and thus many optimization problems are solved with only a few controls of parameters [23]. Here, in order to choose most significant parameter channel condition $C[t]$, analysis and optimization of scheduling. The procedure of ABC is performed with a population consisting of random number of cluster nodes with m number of $C[t]$, for every data slots in frame work and the scheduling scheme subsequently looks for best optimal channel condition for optimal results by means of updating the generations continuously. Every cluster channel conditions utilize its individual resources that are having from at the same time data transmission among transceivers. This scheduling operation is performed based on the colony of three bees. The employed bees that are nodes in the clusters used to visit the food source position to find optimal channel conditions. Each one of the employee bee in ABC gathers information about channel conditions of cluster nodes. Employed bees also perform the local investigation to find parameter channel condition $C[t]$ and try to exploit the nearest optimal channel conditions neighboring locations results for nodes in the cluster. Those bees that are waiting in the nest area to parameter channel condition $C[t]$ are termed as onlooker bees. Onlooker bees perform the global investigation to parameter channel conditionand update global resulting in update phase. The random discovery of new parameter channel condition $C[t]$ value of the cluster nodes which is not usually focused by the employed bees is performed by scout bees. These three steps are continued until a maximum number of the iterations termination criterion is satisfied. The fitness value to optimize the parameter channel condition is determined based on the objective function (10). An artificial onlooker bee selects optimal channel based on the calculation of the probability value using the following expression,

$$p_{vw} = \frac{f(L,\ Load_1,\ Load_2)}{\sum_{w=1}^{SN} f(L,\ Load_1,\ Load_2)} \tag{14}$$

where $f(L, Load_1, Load_2)$ represents the fitness value to each node i employee bee location, SN refers to the size of the population . The new channel position is updated using a following equation (15)

$$cp_i = ch_j + \theta_{ij} (ch_{ij} - \chi_{\kappa 1}) \tag{15}$$

Where k and l are randomly selected channels in cluster $k \in \{1, 2, ... SN\}$ & $j \in \{1, 2, ... D\}$. $\theta_{ij} \in [-1.1]$, In ABC, if a bee current node position does not improve the result within a pre - specified number of iterations, then the current node to be assumed as neglected and it is updates as,

$$cp_i^j = cp_{\min}^j + rand(0,1)\left(cp_{\max}^j - cp_{\min}^j\right) \tag{16}$$

All the above mentioned steps majorly depend on following parameters which restricts the operation *SN*, Maximum Number of the Cycles (MNC). Every cluster channel conditions utilize its individual resources that are having from at the same time data transmission among transceivers. Further we optimized for a given scenario and a desired optimal performance metric.

4. RESULTS AND DISCUSSION

The context of the area where the nodes have their position, and the number of nodes which are available in the connections, along the prototype that generates the information are considerable in the augmentation of the design parameters. On the contrary, owed to the dynamic background of MANETs, the information might not be available previously, and certain elements may alter over the way of the set-up lifespan. As a result, it is indispensable for the processes to robustly alter to changing environments. While in clumsy MAC protocols similar to IEEE 802.11 [24], the common channel resource is communal amongst the nodes of network with respect to carrier sensing. This effortless performance is well suitable for treating any kind of non-uniformity in the load allocation. All the same, these processes do not smooth as the load in the connection upsurges owing to the cumulative sum of collisions. On the contrary, coordinated MAC protocols similar to TRACE protocols and IEEE 802.15.4 (GTS mode) curtail or eradicate crashes by assigning devoted channel resources to transmitters. Contrasting MH-TRACE, the channel allotment for CDCA-TRACE and DCA-TRACE can be agreed, by constructing malleable protocols when related with the predecessor. By fluctuating the channel access mode, they are competent to acclimatize i) plummeting network dimensions, and ii) non-uniformities in allocating load. Here, the performances with respect to the CDCA-TRACE, DCA-TRACE, and CMH-TRACE protocols are compared in addition to their own predecessor, MH-TRACE and two IEEE standard protocols, such as IEEE 802.15.4 and IEEE 802.11. IEEE 802.15.4 module along with GTS assignment is extension for NS2 simulator [25].

Owing to the agility of the nodes in the set-up, the diameter of the set-up may diminish in dimension all over the way/route of network practice. At one intense, when the foremost aloofness amongst any two nodes in the set-up is underneath the communiqué radius, nodes usage a single hop associated set-up. The bandwidth proficiency of MH-TRACE sharply diminishes for similar process, as MH-TRACE cannot standardize the sum of frames in every superframe robustly, and all Cluster Head can practices a single frame/super frame. Even so, the dynamic channel allocation mode of DCA-TRACE accelerates adaptation of the rules to these ambiances by permitting the single Cluster Head entry all the data slots and all the frames.

This research work concentrates on the performance of the MAC layer only. Hence, utilize simple network and transport layer protocols that provide local broadcasting. A connection-less transport layer model is assumed in which the transport layer directly connects the upper and lower layers. All data packets are assumed to be destined to the local neighborhood (i.e., local broadcasting). All received data packets are passed to the application layer and are not relayed further. Matching the network layer algorithm, link layer broadcasting is assumed. All the nodes in the vicinity of the transmitter receive the packet as long as the power levels permit successful decoding. Ad hoc DCF mode for link layer broadcasting traffic is used for IEEE 802.11. Note that in this mode, the RTS/CTS and ACK mechanisms are disabled. Similarly, no ACK mechanism is used in the TRACE protocols either, and there are no packet retransmissions. For IEEE 802.15.4, beacon enabled mode of operation is used with Guaranteed Time Slot (GTS) mechanism. The ACK mechanism is disabled for the data packets but is active for the control messages.

Similar to the network layer algorithm, link layer broadcasting is presumed. All the nodes in the neighborhood of the transmitter take delivery of the packet as the power intensities authorize effective decoding. Ad hoc DCF approach for link layer distribution traffic is utilized for IEEE 802.11. The mode, in RTS/CTS and ACK methods are incapacitated. In the same way, no ACK approach is utilized in the TRACE protocols, and there are no further packet retransmissions. Intended for IEEE 802.15.4, beacon enabled operation mode, is castoff with Guaranteed Time Slot (GTS) method. The ACK mechanism is incapacitated for the data packets but is dynamic for control messages. The TRACE rules necessitate time coordination's at the MAC layer. In our replications, nodes are presumed to be effortlessly coordinated. TRACE does not employ a node coordination algorithm. In real time employments, organization should be as long as using dedicated systems such as GPS or external coordination/synchronization algorithms employed along TRACE. It is likely to acquire higher synchronization accurateness on the direction of nanoseconds by using GPS systems [49]. The synchronization algorithms that are based on packet exchanges are less accurate and introduce synchronization errors to the system, especially for larger networks. These synchronization errors may reduce the performance of implementations that use inaccurate synchronization algorithms.

The default propagation model (two-ray ground model) that is available in ns-2 is used. For all simulations, used a constant transmit power that results in a maximum receiving range of 250 m under zero interference. In the case of interference, all packets received during the interference period are dropped unless one of the packets captures the receiver with a power value at least 10 times larger than the power of any interfering packets. The source application produces real-time traffic in Constant Bit-Rate (CBR) means that generates packets every 25 ms. Due to real-time communication constraints, packets become obsolete and are discarded at the source if they are not sent within 25 ms. The channel rate is set to 2 Mbps for TRACE and 802.11 while the default channel rate of 250 Kbps is used for 802.15.4 in order to ensure consistency with various internal timer values such as association timeouts and ACK timeouts. In order to account for the data rate difference, a source coding rate of 4 Kbps is used for 802.15.4 while 32 Kbps is used for the other protocols.

Here in this section, the performances corresponding to CDCABC-TRACE ,CDCAP-TRACE, CDCA-TRACE, DCA-TRACE, and CMH-TRACE are compared for the case of a network where 40 source nodes are immobile and are disseminated over a 100 m × 100 m square i.e., fixed in the middle of the 1,000 m × 1,000 m area with the realization of a constant grid. The lingering 200 nodes are moving and instigated in

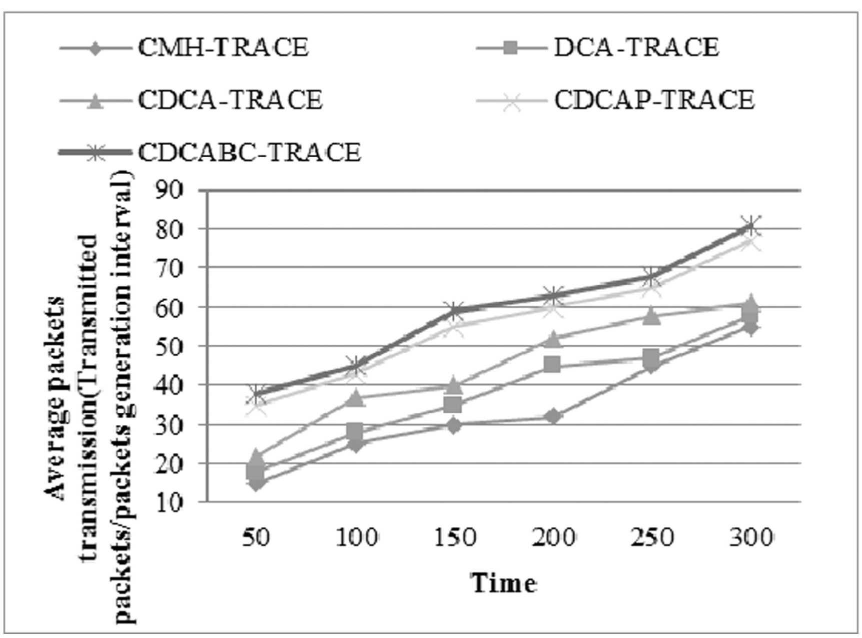

Figure 1: The comparison result of the average no.of data packets transmission per packets generation interval at load distribution at multi-hop network

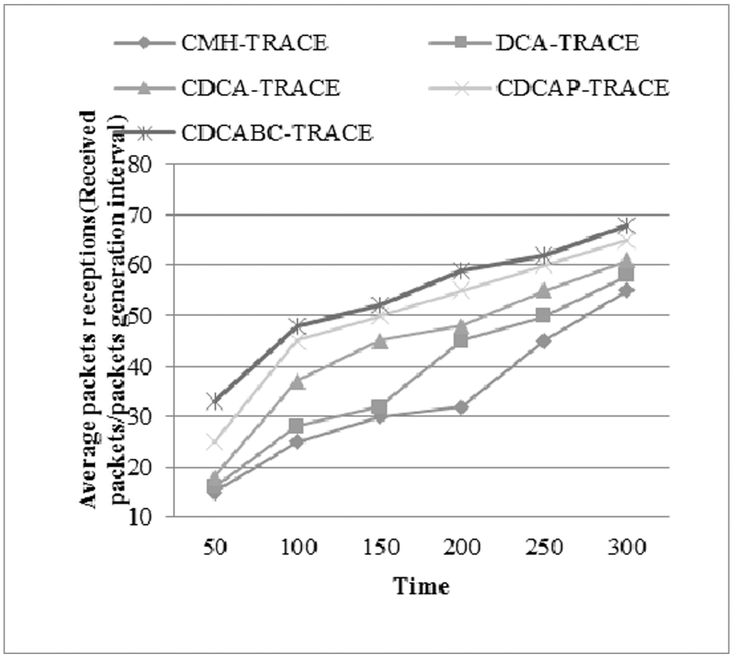

Figure 2: The comparison result of the average no.of data packets received per packets generation interval at load distribution at multi-hop network

a random manner. In IEEE 802:15:4 do retain an extra 25 controller in a construction of a grid encircling the whole network.

Figures 1 demonstrates the average amount of packets transferred per packet generation interval, TX. Similar to the previous Centralized Dynamic Channel Allocation (CDCA) is incorporated into Particle Swarm Optimization (PSO) scheduling CDCAP-TRACE set up, as the set-up load enlarges, with a shrinking space, all techniques suggests channel access to number of nodes, consequential in a upstretched TX up to a saturation point. Furthermore this point, TX oversupply as the amount of sources raises. From the figure it is concluded that the average number of packets transmitted result is high for proposed CDCABC-TRACE that is 81 at simulation time 300 , since the proposed work optimal scheduling is done by considering the load traffic and load balancing is also performed with optimal cluster head selected results .

Figures 2 illustrates the average number of packets received per packet generation interval, RX. In addition to total rate of data transmissions and also receptions on an average over 80 iterations all through the simulation course duration of about 20 seconds. Similar to the previous CDCABC-TRACE set-up, as the network load amplifies, with a diminishing speed; all procedure offers channel admittance to additional nodes, consequential in an increase in RX up to a saturation point. From the figure 2 it is concluded that the average number of packets transmitted result is high for proposed CDCABC-TRACE that is 68 at simulation time 300 , since the proposed work optimal scheduling is done by using ABC with heavy load traffic and load balancing is also performed with optimal cluster head selected results.

Throughput: The larger the transmission time, the smaller becomes the throughput and it is evident from the expression utilized for throughput.

$$\text{Throughput} = (\text{Size of the data packet})/\text{Transmission time} \quad (17)$$

Figure 3 depicts the comparison results of the throughput values of the CDCABC-TRACE, CDCAP-TRACE, CDCA-TRACE, DCA-TRACE, and CMH-TRACE. By using priority based scheduling, waiting time of each packet will be reduced based on their priority. Hence, the throughput will always be high for

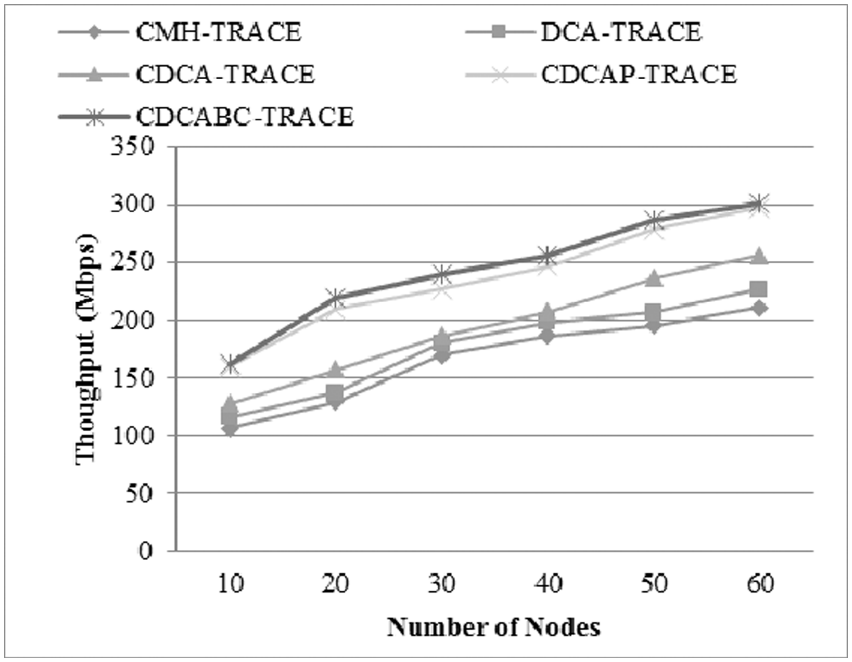

Figure 3: The throughput comparison result

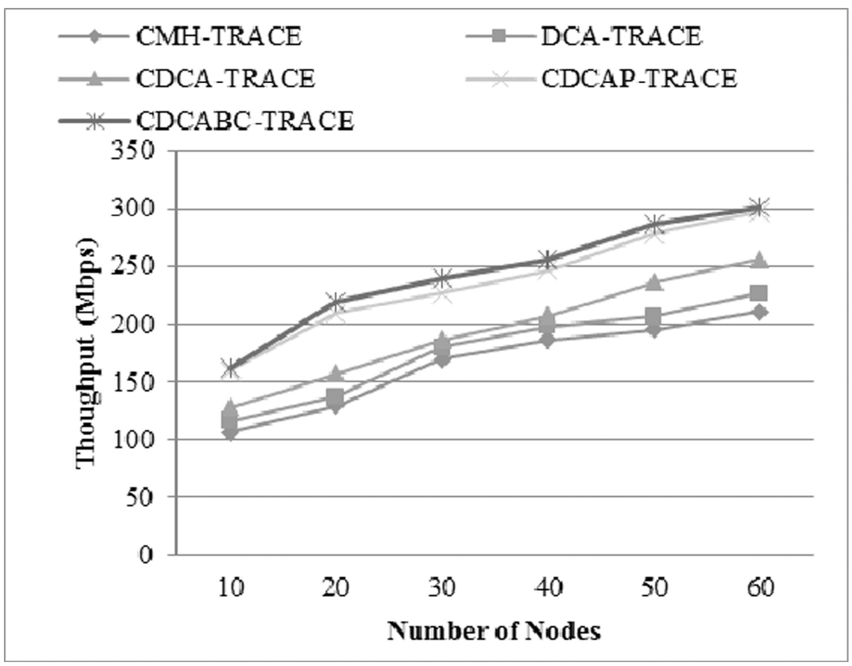

Figure 4: The delay propogation comparison result

this proposed system. The results are illustrated in Figure 3.

Delay: It is the delay necessary for transmitting the data packet from source node to destination node in MANET. Delay is the ratio of total distance from source to Destination (DT to Transmission Speed (TS) and it is given as below,

$$Delay = \frac{DT}{TS} \tag{18}$$

Figure 4 shows the graphical representation results of packet delay comparison of the proposed and existing protocols used in this work. The packet delay of the proposed CDCABC-TRACE is

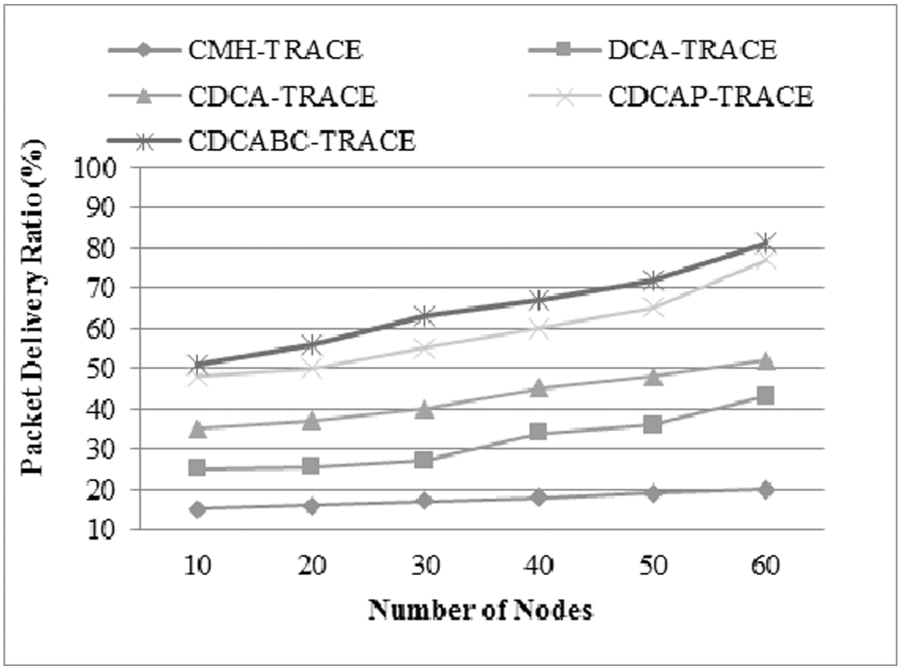

Figure 5: Packet delivery ratio Comparison results

lesser when compared with existing CDCAP-TRACE, CDCA-TRACE, DCA-TRACE, and CMH-TRACE methods.

*Packet Delivery Ratio***:** Packet Delivery Ratio (PDR) is well-defined as the proportion of data packets received by the endpoints/destinations to those generated by the sources. Mathematically, it can be defined as:

$$Packet\ Delivery\ Ratio\ \left(PDR\right)=\frac{S_1}{S_2} \tag{19}$$

Where, S_1 is the sum of data packets received by the each destination and S_2 is the sum of data packets generated by the each source

Number of packets without loss of information (without packet corruption) received to destination node. Figure 5 indicates the graphical representation results of packet delivery ratio of the network. That shows how many number of non-corrupted data packets reached to the destination node. From the results it is observed that the new CDCABC-TRACE protocol is having high packet delivery ratio in comparison with the existing protocols such as CDCAP-TRACE, CMH-TRACE, DCA-TRACE and CDCA-TRACE.

5. CONCLUSION AND FUTURE WORK

This work shows a dynamic Centralized Dynamic Channel Allocation (CDCA) scheme, along with a strategy of a cooperative load balancing which applies to cluster based MANETs. In Cooperative load balancing algorithm, the nodes choose their channel access providers on the basis of the resources availability. While the load balancing algorithm is performed, Multi Hop -Time Reservation employs Adaptive Control (MH-TRACE), definite nodes deliberately raise the concern of the channel coordinators, and therefore they become known to be the cluster-heads (CH). All CHs issue Beacon packets at times for broadcasting their presence to every node present in their neighborhood. Here the selection of CH under energy, power consumption becomes a challenging task. In order to deal with this issue, FCPCM has been employed based on the energy of the nodes for extending the lifetime of MANET. When the load balancing and clustering is done completely, subsequently scheduling is carried out in accordance with the Artificial Bee Colony (ABC). The proposed CDCABC-TRACE allocation operates through the means of carrier sensing and hence the overhead is not increased. It has been proven to have great efficiency in maximizing the service levels in addition to the throughput in the system producing reduced impact over the energy consumption and packet delay variation. It was pointed out that specific energy consumption referred to the mapping relationship between energy consumption and the power consumption parameters, which reflected the energy efficiency of machine tools. The protocols which uses these strategies for improving the performance with respect to throughput, energy consumption and Inter-Packet Delay Variation (IPDV).This research work has not reconnoitered the possessions of upper/higher layers like routing layer, and acts as a substitute to distillate on the MAC layer probable and restricted distribution provision. Packet routing has a chief facet relating to load distribution. Local link layer transmitting facility is directly exploited by a number of routing algorithms like network flooding. In addition, it can be utilized along with simultaneous transmission techniques and network coding for supportive assortment. In common, routing layers and joint optimization of the MAC may facilitate still more well-organized answers. Examination of the possessions of routing is left as opportunistic work.

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